

## **Appendix A4.7 Earthworks Summary Technical Note**

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**Project Name** **Kerdiffstown Landfill Remediation Project**  
**Subject** **Earthworks Summary Technical Note**  
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## **1. Introduction**

### **1.1 Background**

This Technical Note has been prepared to summarise the earthworks proposals which have been developed in sufficient detail to support a planning application for the remediation of Kerdiffstown Landfill site and to inform an associated Environmental Impact Assessment (EIA). The aim of this note is to provide confirmation and a summary of the following:

- The objectives and rationale for the earthworks proposals;
- Proposed site re-profiling and material movements;
- Capping proposals;
- Material importation requirements;
- Outline construction phasing; and
- A high level assessment of anticipated construction plant and required on and off-site plant / vehicle movements.

### **1.2 Objectives**

The project has a number of key objectives. For earthworks and remediation proposals these include:

- Remove risks to public health and safety;
- Reduce environmental risk profile to an acceptable level;
- Deliver a solution that is accepted by the community;
- Complete within 8 years; and
- Embedded sustainability in both remediation and post closure stages.

The earthworks proposals have therefore been developed taking cognisance of the project objectives and to satisfy the following remediation objectives:

- Site profiles which provide adequate slope stability for waste reprofiling and capping whilst being able to accommodate anticipated long term settlement of the waste mass;
- An earthworks balance for site reprofiling works;
- Minimise import requirements associated with capping of the site, as far as practicable;
- Accommodate proposed end use development; and
- Provide cost effective, valued engineered proposals.

### 1.3 Sources of information

The earthworks proposals have been developed from various sources of information including the following, based on reasonable assessment of the available data:

- Ground based topographical survey, Coastway, February 2012;
- Aerial topographical survey, Baseline Surveys, February 2016;
- Kerdiffstown Landfill Preliminary Ground Investigation, Priority, March 2012 (Ref: P11114);
- Kerdiffstown Landfill Phase 2 Ground Investigation, IGSL, November 2012 (Ref: 16412);
- Historical aerial photography; and
- Observations made during a site walkover by Jacobs' Geotechnical Engineers, January – July 2016.

### 1.4 Limitations

Landfill sites and in particular lining systems are complex engineering structures requiring detailed design and construction quality assurance (CQA). Risk assessment has shown that the remediation solution for Kerdiffstown requires a capping design, which is directly affected by the nature of wastes including composition, degradation rate and moisture content. Whilst the design proposals have been developed on the basis of available information, principally ground investigation data, there remain unknowns and/ or uncertainties due to the size and volume of the site. As a result some relevant aspects may not be finalised until later stages (during detailed design, pre-construction preparation/ contractual engagement or during the construction period).

The earthworks proposals have been sufficiently developed for the purposes of the planning application and have been informed site specific ground investigations, including a supplementary ground investigation completed in March 2017. Estimated quantities are however, approximate, based on the preliminary design and available information.

Some environmental impacts associated with the extraction and transport of primary raw materials and manufactured products would occur off-site. The source and processing/manufacture cannot be determined at this stage and the production of these materials is likely to have been the subject of separate consent procedures (such as applications for planning permission), which may have included environmental assessment. Therefore, it is currently outwith the scope of this assessment to consider the environmental impacts associated with the extraction of raw materials and the manufacture of products.

### 1.5 Supporting Information

This note should be read in conjunction with the following supporting information.

Document ref	Rev	Type	Title
32EW5604-DOC-0035	0	TN	Waste Settlement Potential Assessment
32EW5604-DOC-0036	0	TN	Capping and Waste Slope Stability Assessment
32EW5604-00-019	0	D	Re-profiled Site Contours
32EW5604-00-020	0	D	Isopachytes – EGL to Re-profiled Site Contours
32EW5604-00-021	0	D	Remediation Contours
32EW5604-00-022	0	D	Post Settlement Contours
32EW5604-00-023	0	D	Cross Sections (Sheet 1 of 2)
32EW5604-00-024	0	D	Cross Sections (Sheet 2 of 2)

Document ref	Rev	Type	Title
32EW5604-00-025	0	D	Typical Remediation Details
32EW5604-00-026	0	D	Outline Construction Phasing (Sheet 1 of 2)
32EW5604-00-027	0	D	Outline Construction Phasing (Sheet 2 of 2)
Earthworks Schedule	03	E	Earthwork balance summary table*
Earthworks Schedule	03	E	Earthworks phasing summary table*
Earthworks Schedule	03	E	Earthworks volume summary graph*
Earthworks Schedule	03	E	Earthworks vehicle movements summary graph*
Earthworks Schedule	03	E	Earthworks stockpiling summary graph*
Earthworks Schedule	03	E	Earthworks cut and fill by zone and phase tables*
Earthworks Schedule	03	E	Earthworks cut and fill by zone and phase graphs*

**Key:**

Document Type: D = Drawing; R = Report; TN = Technical Note; MP = Management Plan; E = Excel Spreadsheet / Table/ Graph; \* Included in Appendix A.

## 2. Site Zoning and Remediation Works Phasing

### 2.1 Site zoning

The original zoning of the site was established in the Remedial Options Report in July 2013 largely to reflect geographical coverage of the Site. The zoning has now been revisited as part of the hydrogeological/ groundwater assessment task based on a review of waste types and the groundwater monitoring undertaken over the past few years. New zonal references and boundaries are now proposed, although largely co-incident with the previously defined zones to then relate to the proposed remediation solutions.

The zones are summarised in the following table and indicated on relevant drawings.

Zone No.	Description
<b>1 (&amp; 1A)</b>	<p>Zone 1 represents the largest volumes of waste at the Site. This area is uncapped. Waste reported to largely comprise MSW, with although some C&amp;D waste also reported to be present. MSW is located over most of the zone, although more C&amp;D waste is apparent in the north-west corner of the zone (now designated as Zone 1A). Throughout the zone, where waste is encountered, it is considered that there is sufficient putrescible material present to class the wastes as non-hazardous biodegradable waste.</p>
<b>2A &amp; 2B</b>	<p>Both zones are relatively flat and broadly coincident with surrounding natural ground levels. The zones are underlain by waste materials largely concealed by large concrete hard standings / former building footprints.</p> <p>The wastes in Zone 2A comprise more MSW than that in the Zone 2B. Initial gas readings in Zone 2A show relatively high concentrations of methane and carbon dioxide. The majority of waste in Zone 2B is reported to comprise unprocessed non-hazardous mixed C&amp;D waste but mixed with MSW also present at varying depths. Methane results from boreholes in Zone 2B show lower concentrations than Zone 2A.</p> <p>Borehole logs indicate that hazardous wastes are not present within the waste mass.</p>

Zone No.	Description
3	Zone 3 comprises a partially filled lined cell. Full details of the waste contained in the cell are uncertain. However, the wastes in this area are likely to be similar to the wastes elsewhere on site and thought to comprise processed non-hazardous C&D materials with domestic waste mixed through.
4	This zone comprises large stockpiles, steep sided slopes to the site perimeter and large concrete hard standings/ former building/ structure footprints, overlying waste materials.  The majority of waste is reported to comprise C&D waste with a high proportion of inert material (dominantly reported as gravelly clay) with varying amounts of plastic, timber, textiles, steel, concrete, brick, PVC pipes. It is not considered that MSW (by definition) is present within this zone. Available gas readings show an absence or limited presence of methane and carbon dioxide concentrations.

Previous zoning of the Site included Zone 5. A large part of this zone currently has houses present and it is considered that no waste is present in this zone and is therefore not assessed as requiring remedial works. Construction works are proposed in this area as outlined in the sections below.

## 2.2 Works Phasing

The proposed phasing of works on site is shown on Drawing Numbers 32EW5604-026 and 027 Outline Remediation Phasing (Sheets 1 and 2) and summarised in tabular format as listed in Section 1.5 Supporting Information and contained in Appendix A.

### **Remediation Works**

Completion of the remediation works is predicted to take place over a 3.5 year period, during seven phases each lasting approximately six months in duration. These phases are dependent on a number of factors, including the period at which a planning decision is granted, legal agreements for land purchase, availability of suitable materials for importation, procurement approach for the works, hours of operation and ecological constraints. The durations are also likely to be subject to conditions, to restrict works where impacts and nuisance may be prevalent including inclement weather giving rise to surface water run-off, and dust and odour generation through waste excavation works. The construction contract(s) would be structured to include management and mitigation of such impacts in line with the findings and recommendations of the EIS.

The phasing of the remediation works has been developed considering the following constraints and requirements:

- The need for initial enabling works (e.g. construction of a new site entrance to facilitate the safe import of materials);
- Re-profiling of the site, achieving a cut / fill balance and associated bulk handling / movement of materials;
- Material import needs and space restrictions for temporary stockpiling of materials required to complete the restoration works;
- Surface water management during, prior to and following final remediation of the site;
- Landfill gas and leachate management; and
- Sequential restoration of the site to achieve a progressive reduction in associated health, safety and environmental risks during completion of the remediation works.

Separate management plans have been developed for landfill gas, leachate and surface water with other aspects to be addressed through a Construction Environmental Management Plan, to embrace mitigation techniques determined through the preparation of chapters in the EIS.

The phasing proposals are also intended to provide contingency for:

- Possible variations in earthworks volumes;
- Broad allowance for seasonal earthworks restrictions (e.g. suspension of works during adverse weather); and
- Unforeseen occurrences such as encountering materials that require removal from the site.

### ***End-Use Construction***

Following completion of the remediation works it is assumed that end-use construction works will commence. However, there is an opportunity for end-use works to be undertaken in parallel or as part of the remediation works, such as drainage installation and landscaping as a minimum.

## **2.3 Opportunities**

Whilst review of available data such as borehole logs indicate 'waste' the nature of this waste and its classification in terms of risk to the environment presents a potential opportunity in the development of the site. For example, a large stockpile is present in Zone 4, adjacent to the lined cell, and had been determined to be waste. However, excavations undertaken on this stockpile to utilise the material in the Demolition and Waste Removal Works contract in 2016 has shown a significant proportion of this material to be clayey or sandy. Processing of this stockpile and other apparent sources of waste to remove the waste fraction and assess suitability of the remaining material, from geotechnical and geo-environmental perspectives, would offer a reduction in the volume of material to be emplaced below the cap, whilst potentially producing material suitable for re-use in the landscaping of the site.

The approach to the earthworks proposals is seen to be conservative by assuming a 'worst case' for material importation to facilitate remediation of the site. Review of landscaping proposals may identify a need for additional soils to facilitate landscaping; however, it is considered that this requirement may be off-set by the re-processing of site won materials, subject to appropriate testing and CQA.

## **3. Enabling Works**

To facilitate the overall remediation of the site a number of initial enabling works are proposed as summarised in the following sections.

### **3.1 Site Entrance**

Remediation of the site and most notably capping of the waste materials will require a substantial import of earthworks materials as there is insufficient material available on site to facilitate such. The existing site entrance has restricted visibility splays and would require crossing of a secondary road by heavy goods vehicles. Consequently, to facilitate the safe import earthworks materials and to link with proposed end use proposals, it proposed to construct a new site entrance comprising a roundabout arrangement.

Construction of this new entrance has been identified as a first stage in the enabling works, requiring land purchase agreements and temporary use of adjacent lands to facilitate tie-in of the road network.

### **3.2 Landfill Infrastructure Compound**

Long term management of landfill gas and leachate through the life-cycle of the site requires the relocation of current management facilities. With the remediation proposals and taking cognisance of the proposed end-use it is proposed that a new, secure landfill infrastructure compound will be constructed in a single location. Due to the nature of the site and risks to the environment should any such facilities fail, the new compound has been positioned off-waste such that ground conditions are not liable to settlement due to waste degradation or loading. The new compound will be located immediately adjacent to the new site entrance.

Similarly the new (buried) pipeline required to discharge treated leachate to the local sewer network can be positioned predominately off-waste, along the boundary of the site, extending south-east to Johnstown Pumping Station. This pipeline is proposed to be commissioned at an early stage in the remediation works to reduce current leachate tankering costs and risks to the environment through road usage.

### **3.3 Baseline / Residual Demolition Works**

Following removal of unsafe buildings and structures in 2016 located in Zones 2B and 4 only concrete walls and surface intrusions remain. Walls of previously demolished buildings in Zone 2A also remain presently.

To facilitate the site re-profiling works and provide an area for temporary stockpiling of materials, these residual concrete structures located within Zones 2A, 2B and 4 will require demolition. Additionally, facilitation and construction of the new site entrance and landfill infrastructure compound will require the demolition of two existing residential dwellings located off Kerdiffstown Road to the east of the existing site entrance.

On-site concrete structures are envisaged to be demolished by pneumatic breakers fitted to excavators. It is proposed that the broken out material will be processed using mobile crushing and screening plant to be located in Zone 2B, due to its reduced exposure to surrounding environs compared to Zone 2A.

It is envisaged that fines produced from the crushing and screening operations will be disposed to the site (below cap), reinforcing steel extracted for recycling (off-site) and aggregate produced for re-use in drainage (subject to appropriate geotechnical and geo-environmental testing).

## **4. Waste Re-profiling**

### **4.1 Existing and proposed heights**

Excluding areas of existing hard standing in Zones 2A, 2B and 4, existing surface profiles are typically undulating with a number of large voids and surface stockpiles present. In addition, the majority of the existing boundary slopes have been formed at relatively steep gradients of up to 1v:1.5h.

Re-profiling of the site will be required to provide acceptable remediation profiles and stable slopes with respect to capping placement/ construction, long term stability and post construction settlement. This will also be required to accommodate end use proposals and drainage run-off.

The following maximum re-profiled levels are proposed in Zone 1 (as the most significant profile at the site):

- Existing top of site: 113.5mOD (Malin Head)
- Re-profiled top of waste: 114.5mOD (Malin Head)
- Top of Remediation profile: 115.15mOD (Malin Head)
- Post-settlement profile: 110.5mOD (Malin Head)

It should be noted that the positioning of the top levels are not directly correlated, i.e. the proposed top of cap is not directly above the existing top of site.

Re-profiling works in Zones 2A and 2B are limited given the proposed end-use and the location of multi-use sports pitches in these locations. Earthworks will be required to enable placement of low permeable soils and in the end-use construction to facilitate drainage run-off.

**4.2 Waste slope stability**

A preliminary waste stability assessment (refer to document number 32EW5604-DOC-0036) has been completed adopting typical geotechnical parameters for waste materials from published sources. The assessment demonstrates that the permanent slopes to be formed in waste materials will need a maximum slope gradient of 1 in 2.5 to provide acceptable long term stability. The minimum slope gradient (post-settlement) has been assessed to be 1 in 30, sufficient to maintain drainage run-off.

**4.3 Waste screening**

Waste materials present at the site typically contain a high proportion of C&D wastes, including large blocks of demolition rubble. Re-profiling of the site is expected to require the selected removal of oversize materials at the point of excavation and where encountered at proposed formation levels in areas of proposed capping construction. It is proposed that the oversize material will be crushed and screened to an acceptable grading to facilitate its re-use as bulk fill, or used to fill large voids. Crushing and screening and temporary stockpiling prior to re-use is proposed to be undertaken in the Zone 2B site won materials processing and stockpiling area.

The site was previously licensed to only accept non-hazardous and inert wastes. Based on historical knowledge of the site and current ground investigation information, including chemical testing, the risk of encountering hazardous waste is therefore considered low, though the possibility of encountering isolated occurrences of hazardous waste during the re-profiling works cannot be discounted.

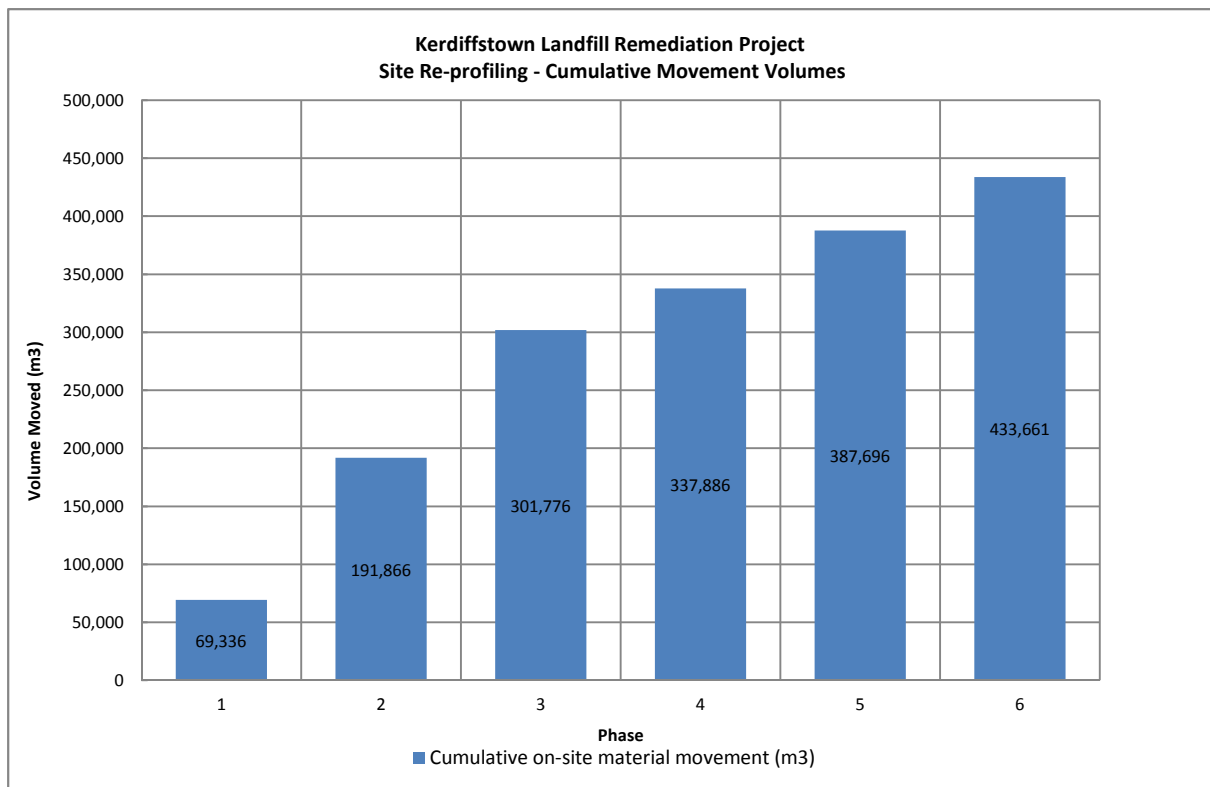
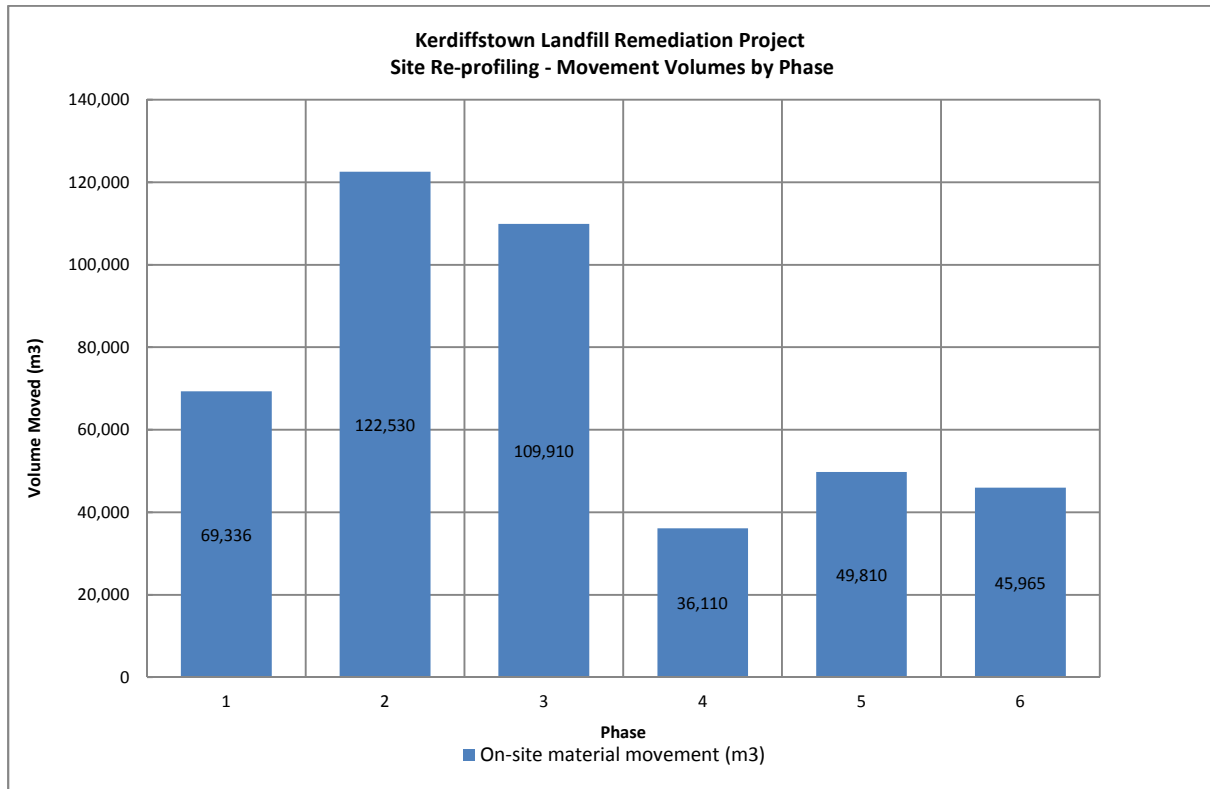
To manage the risk of hazardous materials all excavated and exposed waste materials will be subject to visual screening. Any materials suspected to be potentially hazardous shall be subject to temporary stockpiling and chemical testing to confirm their waste classification prior to placement as fill in the regrading works. Any material confirmed as hazardous will be disposed off-site to a suitably licensed facility.

**4.4 Waste re-profiling volumes**

It is likely that volumes calculated for re-profiling works may adjust during detailed design and / or construction works due to the nature of the material exposed. It is considered from borehole logs that a large proportion of the waste mass comprises construction and demolition wastes, where rubble and concrete blocks may be anticipated. Encountering such materials to then remove may generate a greater volume of material to be disposed to the site and materials required for backfill. Similarly, there is an opportunity to re-use site won soils in the remediation works, subject to appropriate testing and classification.

Currently anticipated total and cumulative earthwork volumes to be moved during each phase of the re-profiling works are summarised in the following charts.





A detailed breakdown of cut / fill volumes associated with the waste re-profiling works, including the movement of waste materials between different zones of the site is included in Appendix A.

The phasing of works may be adjusted based on the procurement approach adopted, availability of suitable capping materials and findings on site during construction works, such as highly odorous wastes (reduction in open areas slowing progress).

## 5. Remediation Proposals

### 5.1 Capping options

The remediation proposals include capping of exposed waste following the waste re-profiling works to reduce risks to human health and the environment by reducing the potential for future surface water infiltration and associated leachate generation and controlling gas migration.

The components of a landfill capping system may include:

- topsoil;
- subsoil;
- drainage layer;
- barrier (infiltration) layer; and
- gas drainage layer.

The capping system assessment is further discussed below.

Various options are available for the construction of a barrier layer, such as use of a flexible membrane liner (FML), geosynthetic clay liner (GCL) or clay (including bentonite enriched soils (BES)). Each has benefits and constraints when assessing stability, settlement and integration with requisite landfill infrastructure as well as effects on the proposed end-use proposals. These elements have been assessed to determine the proposed capping solutions which vary between the different zones of the site as shown below.

Zone	Proposed Capping Solution
1 & 1A	New multilayer capping (FML)
2A & 2B	Retained concrete hardstanding & low permeability cap (clay)
3	New multilayer capping (FML)
4	Low permeability soil cover

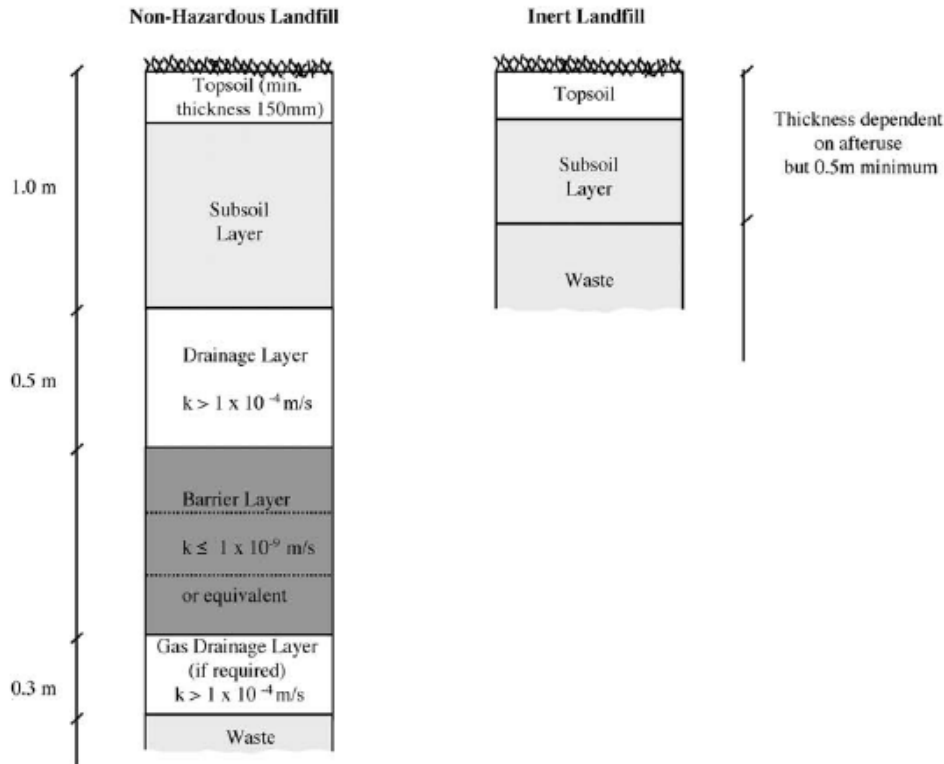
The variation in capping solutions reflects the assessed risk to groundwater from surface water infiltration following re-profiling works in different areas of the site. This considers the nature and thickness of waste materials present and the proposed maintenance of cover to waste materials by the retention of existing areas of concrete hardstanding in Zones 2A and 2B.

### 5.2 Retained concrete hard standings (Zones 2A & 2B)

The utilisation of existing hard standing areas in Zones 2A and 2B to provide a capping function assumes that minor remedial sealing works will be undertaken to restrict possible future infiltration. This includes inspection for and remediation of surface cracks, sealing of construction joints, filling and capping over voids and grouting up of redundant drainage.

### 5.3 Multilayer capping system (Zones 1 & 3)

The EPA Landfill Manual guidance series on Site Design provides a recommended capping system for landfill sites in receipt of non-hazardous and inert waste, as shown below.



Application of the recommended non-hazardous waste capping system would give an approximate depth of soils of about 2.4m. A source of suitable capping materials to construct the above capping system is not available at the site therefore the solution would require substantial material import.

Assessment of capping options has therefore been undertaken taking cognisance of the EPA guidance. The guidance states that the components of the capping system and the materials to be used should be evaluated on a case by case basis, and that not all components will be necessary for every site. Given the proposed works comprise the remediation of a former site, i.e. not a new development, derogation to the guidance is proposed as outlined below, whilst meeting risk mitigation objectives. The following alternative capping system is proposed for Zones 1 and 3.

Layer	Thickness
Top soil / soil forming material cover	150mm
Subsoil	350mm
Geosynthetic drainage layer	Negligible combined thickness (<15mm)
Geosynthetic barrier layer	
Geosynthetic gas drainage layer	
Regulation layer	150mm
<b>Total thickness</b>	<b>~ 650mm</b>

The proposed alternative capping solution will provide a 1.75m reduction in the total thickness of the capping system and a 75% reduction in required imported soil volumes and associated vehicle movements.

### 5.4 Low permeability capping (Zones 2A and 2B)

A low permeability capping solution is proposed for Zones 2A and 2B where separation to waste materials will not be provided by retention of concrete hardstanding areas. The proposed capping solution for Zones 2A and 2B is summarised in the following table.

Layer	Thickness
Top soil / soil forming material cover	150mm
Low permeability clay cap	350mm
<b>Total thickness</b>	<b>500mm</b>

The proposed solution reflects an assessed lower risk to groundwater from surface water infiltration in Zones 2A and 2B resulting from a combination of reduced waste thicknesses and predominant C&D waste composition with a reduced proportion of MSW compared to Zones 1 and 3.

### 5.5 Low permeability soils (Zone 4)

A low permeability soil cover solution is proposed for Zone 4 as summarised in the following table.

Layer	Thickness
Top soil / soil forming material cover	150mm
Low permeability subsoil	350mm
<b>Total thickness</b>	<b>500mm</b>

The proposed solution reflects an assessed lower risk to groundwater from surface water infiltration in Zone 4 resulting from a combination of reduced waste thicknesses, predominant C&D waste composition with minimal MSW, proposed removal of wastes encountered in the remediation of slopes, slope gradients and the use geosynthetic liner in the new surface water management pond covering a large area of the zone.

### 5.6 Capping profiles

Proposed top of capping levels at the end of the remediation works (pre-settlement) are shown on Drawing Number 32EW5604-021 Remediation Contours.

## 6. Capping and Waste Stability

A preliminary stability assessment has been undertaken for the site to support the proposed remediation waste and capping profiles, based on available data (refer to document number 32EW5604-DOC-0036). The use of the term waste is representative of the materials present in Zones 1, 2A, 2B and 3 and not to be inferred as each occurrence of waste, such as isolated pockets of wood, re-bar etc.

### 6.1 Waste stability

The preliminary assessment of slopes formed in waste has been undertaken by adopting typical geotechnical parameters for waste materials from published sources. The assessment, demonstrates that the required permanent slopes to be formed in waste materials will need a slope gradient of 1 in 2.5 or shallower to provide acceptable long term stability.

### 6.2 Multi-layer capping stability

A numerical assessment multi-layer capping stability has been undertaken for the following variables:

- Required slope gradient (1 in 2, 1 in 2.5 & 1 in 3)
- Material parameters ('typical' and 'best case' based on typically published values)
- Thickness of cover soils (0.5m & 1.0m)
- Geosynthetic barrier layer (FML & GCL)\*
- With or without the provision of a drainage layer.

Permissible multi-layer capping options determined from the preliminary stability assessment are summarised in the following table.

Slope Gradient	Permissible Multilayer Capping Solution	
	'Typical' Material Parameters	'Best Case' Material Parameters
>1 in 2.5	<ul style="list-style-type: none"> <li>• No solution feasible.</li> </ul>	<ul style="list-style-type: none"> <li>• No solution feasible.</li> </ul>
1 in 2.5 to 1 in 3	<ul style="list-style-type: none"> <li>• HDPE option with 0.5m max. cover soils, geo-grid reinforcement and a drainage layer.</li> <li>• GCL option not feasible.</li> </ul>	<ul style="list-style-type: none"> <li>• HDPE option with 0.5m max. cover soils and a geo-grid reinforcement but possible omission of drainage layer.</li> <li>• GCL option with 0.5m max. cover soils and geo-grid reinforcement with or without drainage layer.</li> </ul>
<1 in 3	<ul style="list-style-type: none"> <li>• HDPE option with 1.0m max. cover soils and no requirement for drainage or geo-grid reinforcement layers.</li> <li>• GCL option with 1.0m max. cover soils and geo-grid reinforcement but no requirement for a drainage layer.</li> </ul>	<ul style="list-style-type: none"> <li>• HDPE option with 1.0m max. cover soils and no requirement geo-grid reinforcement or drainage layer.</li> <li>• GCL option with 1.0m max cover soils and geo-grid reinforcement but no requirement for a drainage layer.</li> <li>• GCL option with 0.5m max cover soils and no requirement for geo-grid reinforcement or drainage layer.</li> </ul>

Due to the unknown source of capping materials there is a risk that 'best case' material parameters may not be achievable. Consequently, a HDPE multi-layer capping solution based on the use of 'typical' material parameters is currently proposed.

### 6.3 Low permeability capping (clay)

Stability calculations have not been undertaken for the low permeability soil capping options as this option will be restricted to gradients of 1 in 3 or shallower, hence, subject to the appropriate specification and placement of the soil materials is expected to provide adequate stability.

## **7. Post remediation settlement**

### **7.1 Requirement**

Settlement of the remediated waste mass will occur as a result of the decomposition of biodegradable waste within the landfill. Settlement values of between 10 and 25% are typically expected for municipal waste landfills. Settlement continues, gradually reducing with time, until the waste is stabilised, although the degree and rate of waste settlement are difficult to estimate especially where waste composition and infilling records are not available.

Consideration of potential settlement is required to ensure that the proposed remediation profiles remain acceptable over the long term. This includes:

- The maintenance of acceptable surface gradients and avoidance of low spots to prevent possible surface water ponding; and
- Excessive deformation of the capping which could result in a loss of capping integrity.

Settlement of the site may be induced by:

- Loading of waste materials by proposed re-profiling works;
- Long term waste degradation and associated loss of mass;
- Loading of waste materials by capping works; and
- Any loads applied to the ground surface.

### **7.2 Assessment**

To confirm acceptable post-settlement profiles will be maintained, a preliminary settlement assessment has been undertaken for the site (refer to document number 32EW5604-DOC-0035). This assessment is based on the following assumptions:

- Due to the generally high permeability and relatively free draining characteristics of the types of waste indicted to be present at the site, settlement induced by the site re-profiling works will occur during the re-profiling works and will not substantially contribute to post remediation settlement;
- The limited thickness of the proposed capping solution will result in limited loading of any underlying wastes and any minor settlement induced will be 'built out' during capping construction; and
- Substantial loading above the capping system will not occur.

Reflecting the above assumptions the preliminary settlement assessment has focussed on settlement due to long term waste degradation. Post remediation settlement predictions have been made by the application of Jacob's in house numerical predictive waste settlement model which is related to the anticipated composition and age of the waste materials present at the site.

### **7.3 Settlement predictions (Zones 1 and 3)**

Post remediation settlement due to waste degradation in Zones 1 and 3 is predicted to be in the order of 14% with settlement expected to be substantially complete by 2150.

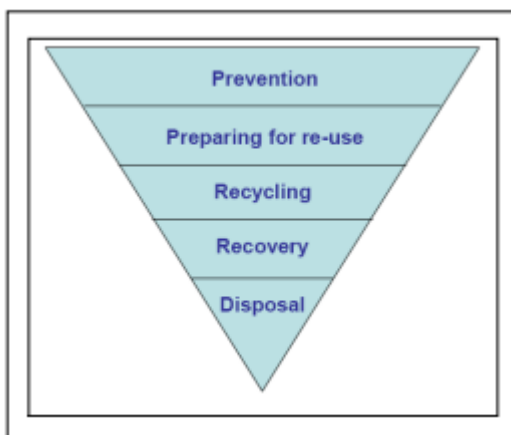
The predicted settlement percentage has been applied to post re-profiling waste thicknesses to predict actual settlement across the site. Through an iterative process, the proposed remediation profiles were adjusted until no post-settlement low spots occurred and a minimum gradient of 1 in 30 was achieved for all areas of proposed capping, providing suitably profiles for surface water management and complying with EPA guidance. This excluded the retained hardstanding areas which have are assumed to be drained separately as part of end use proposals.

The required remediation profile is shown on Drawing Number 32EW5604-00-021 Remediation Contours and the predicted post settlement profile shown on Drawing Number 32EW5604-00-022 Post Settlement Contours.

Emplacement of wastes should be specified in any future contractual agreement to meet performance specifications and density targets, or by method specification as agreed through trials. Should substantial loading of the capping system be required, supplementary settlement calculations will be required to confirm resulting deformation of the capping system remains within acceptable tolerances.

### 8. Material import & export

The application of key material and waste management principles, such as the waste management hierarchy (shown below), will reduce the effects on natural resources. In particular, this will be achieved by re-using existing soils, with appropriate processing and assessment.



In considering material resources use and waste management, it is important to define when, under current legislation and understanding, a material is considered to be a waste. The Waste Framework Directive (European Directive 2006/12/EC, as amended by Directive 2008/98/EC) defines waste as any substance or object that the holder discards or is required to discharge. The Waste Framework Directive is implemented by European Communities (Waste Directive) Regulation (S.I. No. 126/2011). Once a material has become waste, it remains waste until it has been fully recovered and no longer poses a potential threat to the environment or to human health, at which point it is no longer subject to the controls and other measures required by the Directive. These principles are applied by the EPA to waste used as aggregate/construction material in civil engineering applications, which ceases to be waste once it is incorporated in the construction.

Proposals for material management are to be set out in a Construction Environmental Management Plan (CEMP), required as part of the EIS and planning process.

#### 8.1 Export volumes

The significant export of materials from the site is not expected to be required during the site remediation works. It is proposed that waste materials would be inspected at the point of excavation and where deemed to be suspected as non-compliant, would be subject to the relevant waste acceptance criteria process in accordance with Article 16 and Annex II of the Landfill Directive. The Landfill Directive is implemented by Article 50 of Waste Management (Licensing) Regulations 2004 (S.I. No. 395/2004). Waste would be classified as being hazardous when it displays one or more of the hazardous properties listed in the Second Schedule of the Waste Management Act as amended (European Communities (Waste Directive) Regulations 2011 (S.I. 126 of 2011)). On completion of the classification, the correct European Waste Catalogue (EWC) code referenced from the List of Waste (LoW) 37 would be assigned. LoWs are listed in the EPA document "Waste Classification List of Waste & Determining if Waste is Hazardous or Non-hazardous", valid from 1<sup>st</sup> June 2015.

Materials that may require removal from site are therefore expected to be restricted to:

- materials with a re-sale value generated from the residual demolition works (e.g. reinforcing steel; tyres); and
- non-compliant or hazardous wastes, if encountered during the site re-profiling works, which require disposal to a suitably licensed, off-site facility as determined through the above process.

### 8.2 Import volumes

The site will not be operated as a landfill site. No waste materials will be imported to the site as part of the remediation works, except where that material is defined as waste as outlined above.

With the exception of a limited stockpile of sub-soil material located adjacent to the existing site entrance, no other materials suitable for capping construction are available on site. Capping of the site will therefore require a substantial import of soil materials with an associated high number of vehicle movements, albeit this has been significantly reduced through assessment of capping options.

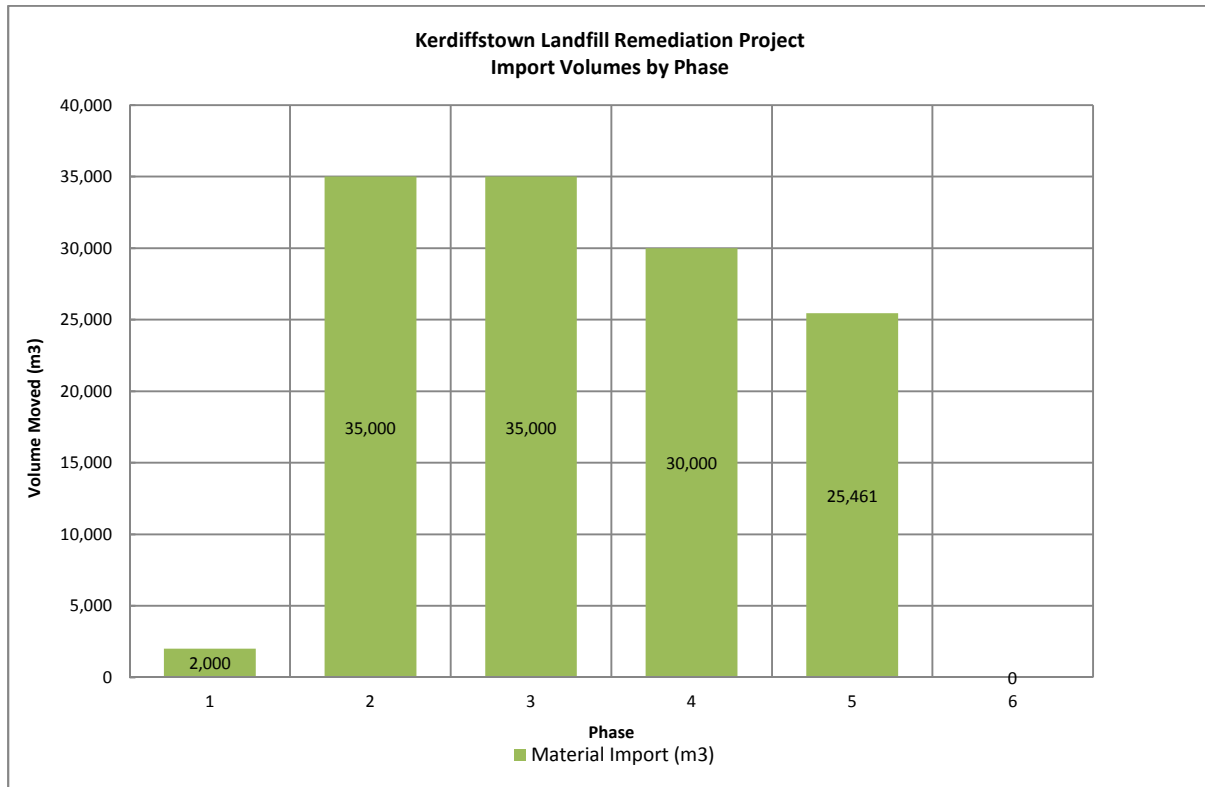
The total volume of soil materials required to construct the capping has been calculated by applying the proposed construction thicknesses to the required capping areas. Additional import of engineering fill is proposed for the construction of bunds to Zone 3 and the Zone 4 ponds.

The approximate material import volumes are summarised in the following table.

Material		Import volumes (m <sup>3</sup> )
Capping	Topsoil	29,300
	Sub-soil	68,300
	Regulation layer (sand)	16,500
Engineered bunds		13,300
<b>Total volume</b>		<b>127,400</b>

Currently anticipated import volumes during each phase of the re-profiling works are summarised in the following chart.





It is envisaged that further material import may be necessary to offer mitigation to landscape and visual impacts as well as in the construction of the end-use proposals. However, the volumes are unlikely to be significantly above that indicated as required to facilitate the remediation works, where these figures are considered to be conservative with opportunities to reduce import volumes through re-processing of on-site materials.

A review of mitigations proposed in EIS chapters will be required to be undertaken to assess impacts.

## 9. Temporary Stockpiling

Completion of the remediation works will require the temporary stockpiling of site won and imported materials at various phases during the works. Proposals for stockpile management are to be set out in a Construction Environmental Management Plan (CEMP), required as part of the EIS and planning process.

### 9.1 Stockpiling approach

To prevent possible contamination of clean materials by site wastes is proposed to establish separate stockpiling areas for imported materials and site won materials.

Proposed stockpiling arrangements are summarised in the following table with stockpile locations shown indicatively on Drawing Numbers 32EW5604-023 and 024 – Outline Remediation Phasing (Sheets 1 and 2).

Stockpile locations are retained on existing concrete hardstanding areas as far as practicable, to offer a separation to and protection of the underlying materials.

Stockpile	Proposed Location	Proposed uses
Existing sub-soil	Retained adjacent to existing site entrance.	Zones 1 and 4 capping
Imported 'clean' soils	Zone 2A	Zone 3 toe bund Zone 4 pond bunds Zones 1 to 4 capping.
Crushed / screened concrete (aggregate)	Zone 2B	Gas wells, access tracks.
Site wastes (including fines from crushing of concrete)	Zone 2B	Infill to Zones 1 and 3 Export from site if classified as hazardous during waste classification

Other areas will require to be designated on site, such as holding areas, quarantine areas and storage of unprocessed waste. Storage of processed waste is unlikely to be necessary as it would be transported to the infill area (typically Zones 1 and 3) immediately to reduce the need for double handling.

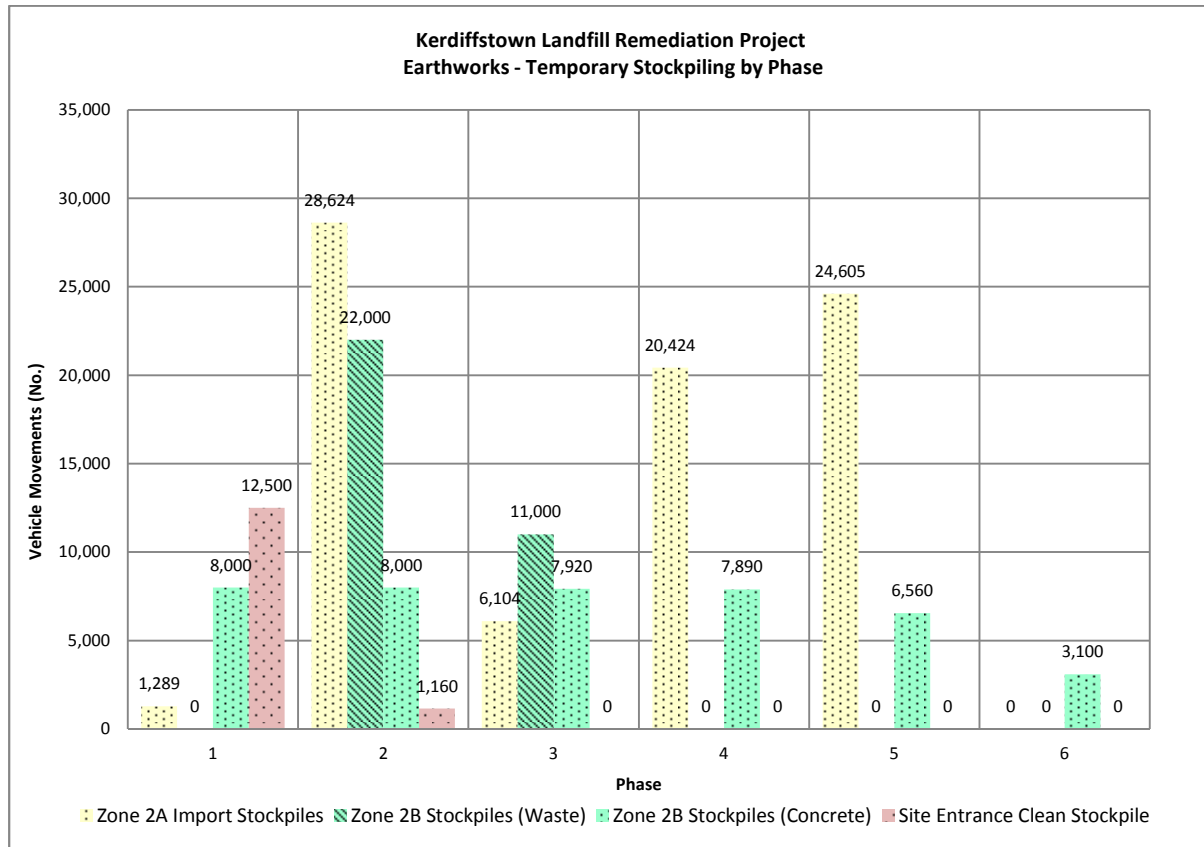
The general segregation imported clean materials and site material stockpiles between Zones 2A and 2B respectively will also limit the risk of cross contamination of clean materials by avoiding the need for road going vehicles to directly traffic on or through areas containing exposed waste materials.

Surface water management proposals indicate that there will be no discharge from the site permitted during the remediation works. The Zone 4 ponds will be adopted as retention ponds during the construction works, and it is anticipated that the contractor would be required to utilise silt-buster traps as is typical on earthworks/ construction projects.

To further mitigate the risk of off-site contamination, it is proposed that all road going vehicles which access stockpile areas will be required to pass through a wheel washing facility prior to exiting the site. Further, site access roads including Kerdiffstown Road would be subject to regular road sweeping as and when required.

### 9.2 Stockpile volumes

Sizing of stockpiles cannot be determined at this stage as it is dependent on the availability of suitable material for import, the programming of the works, subject to planning approval being granted, and the procurement approach adopted. However, a high level assessment of anticipated volumes of materials stored in each stockpile during the different phases of the remediation works are summarised on the following graph.



A detailed breakdown of the source and proposed end location by zone of stockpiled materials is also included in Appendix A.

### 9.3 Stockpile management

It is envisaged that stockpiling of materials will be undertaken in accordance with 'Construction Code of Practice for the Sustainable Use of Soils on Construction Sites' published by the UK Department for Environment Food and Rural Affairs or equivalent Irish guidelines.

As a minimum stockpile management shall include:

- Visual screening for potential contaminated materials;
- Segregation of material suspected to be contaminated from clean materials ;
- Stockpiling of materials at appropriate heights / batters to prevent potential instability;
- Protection of stockpiled materials from scour / erosion;
- The provision of adequate drainage to limit and control potential contaminated surface water run-off, including silt mitigation;
- The avoidance of un-necessary trafficking / handling of stockpiled materials;

The following additional measures shall be applied to topsoil stockpiles:

- A limitation on stockpile height to prevent degradation of the topsoil structure; and
- Adequate control of weed growth.

### 9.4 Stockpile heights

With the exception of top soil (or soil forming materials), stockpile heights are proposed to be restricted to a maximum of 4m to facilitate adequate management during the works.

A reduced stockpile height of 2m will apply to any top soil / soil forming materials to prevent possible degradation of soil structure.

### 10. Construction plant and vehicle movements

#### 10.1 Site plant requirements

Anticipated site plant requirements to complete the remediation works are summarised in the following table.

Site Plant	Use / requirement	No. of Plant Required					
		Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6
Tracked excavator (21t)	Bulk excavation & loading	4	4	4	4	3	3
Tracked long reach excavator (21t)	Re-profiling of side slopes	1	1	1	1	0	0
Tracked excavator with pneumatic breaker (21t)	Demolition works	2	0	0	0	0	0
Mobile crushing and screening plant	Crushing and screening of material generated from demolition works and oversized materials encountered during the site re-profiling works	1	1	1	1	0	0
Articulated dump trucks (Moxy)	Mass haul of bulk earthworks materials including site wastes and capping soils.	4	8	8	4	5	4
Bulldozer and towed compactor	Bulk re-profiling, spreading and compaction of waste and capping materials	3	3	3	2	2	2
Dumper (6t)	Movement of low volume materials (e.g. drainage stone)	1	1	1	1	1	1
Road sweeper	Cleaning of site access tracks / highway at site entrance.	1	1	1	1	1	1
Tractor and water bowser	Damping down of site access tracks.	1	1	1	1	1	1

#### 10.2 Anticipated import & on-site vehicle movements

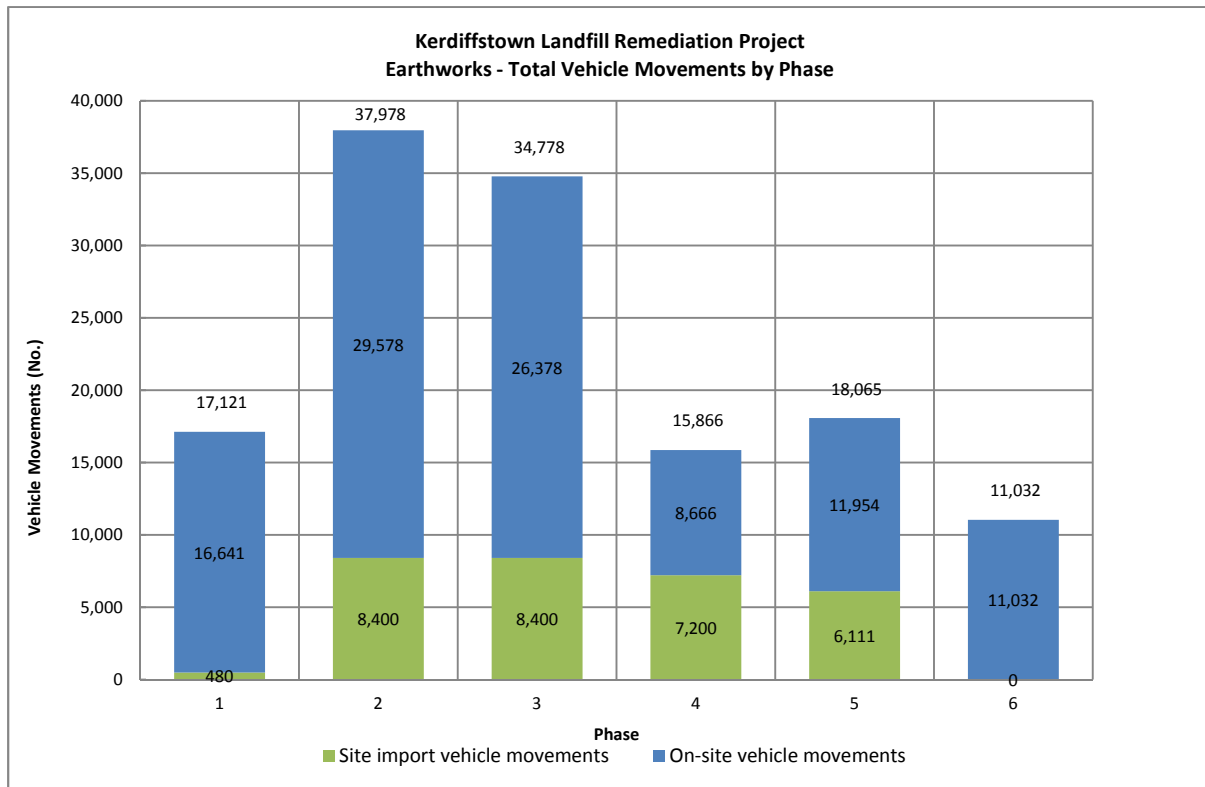
The source of the proposed capping materials is currently unknown but is likely to be from a combination of other construction projects with a net surplus of soil materials and / or material from virgin mineral extraction.

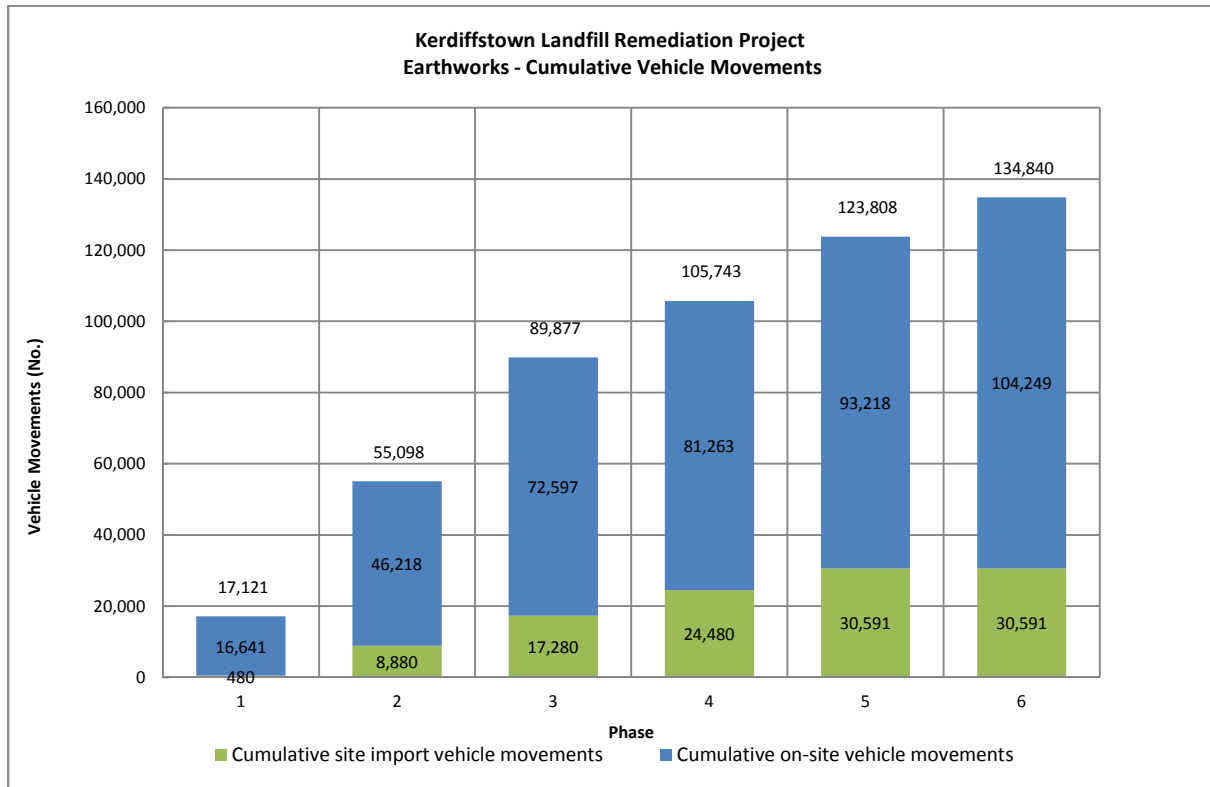
The haulage of materials to the site is expected to be from the M7 and Johnstown Road via the new site entrance to be constructed as part of the initial enabling works.

On-site vehicle movements will principally include those associated with:

- Movement of material generated by demolition works for crushing and screening;
- Re-profiling and the bulk movement of materials between different zones of the site;
- Temporary stockpiling and screening of waste materials;
- The use of stockpiled capping materials; and
- The movement of selected / specialist fills (e.g. materials used for drainage and access track construction).

Anticipated total and cumulative on-site and import vehicle movements by each restoration phase are summarised in the following charts.

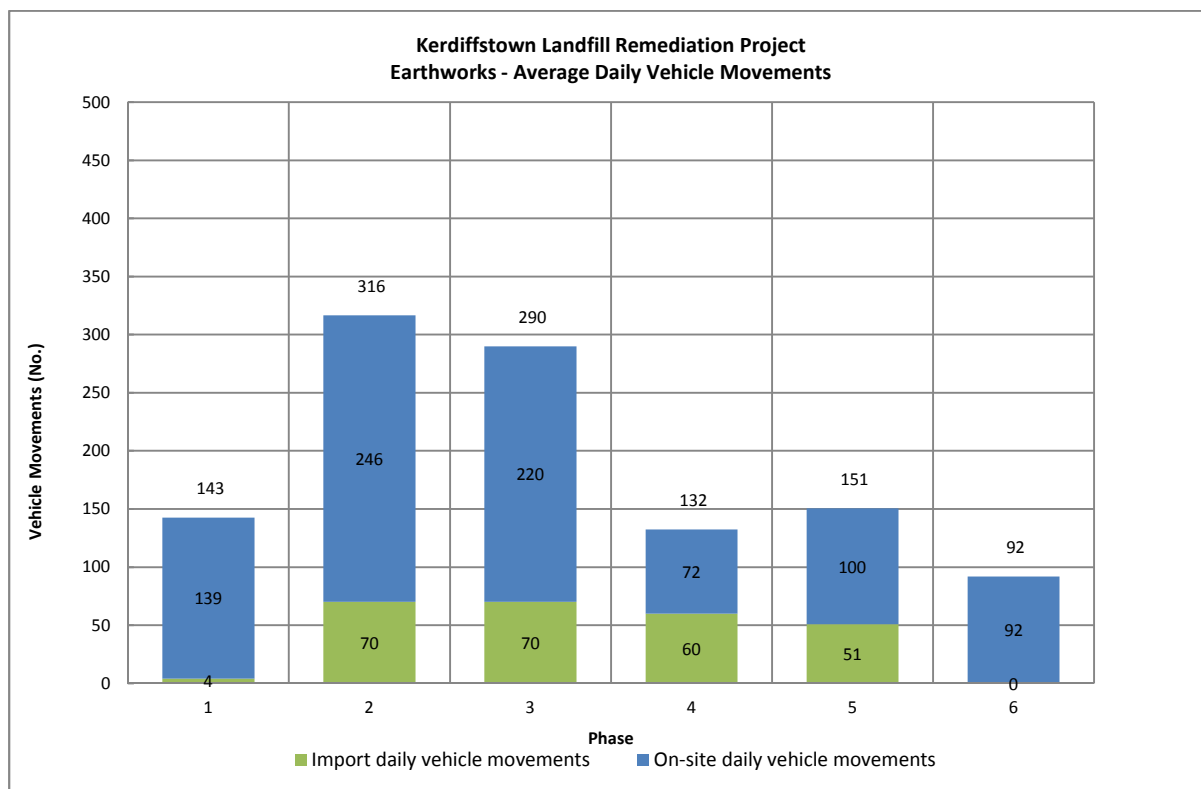




The number of vehicle movements required has been determined applying the following assumptions:

- Import of soil materials will be undertaken by 20t road going tipper lorries with a 12m<sup>3</sup> capacity;
- The bulk movement of materials on site will be undertaken by articulated dump trucks with a 12m<sup>3</sup> capacity;
- 20% bulking of materials during transportation (imported and on-site material movements);
- Vehicle movements are for single journeys (i.e. either loaded to site or empty away from site)

Anticipated daily vehicle movements are summarised in the following chart and are based on each phase having 120 working days (24 working weeks and 5 working days per week).



### 11. Construction Quality Assurance (CQA)

Construction Quality Assurance (CQA) is defined as a planned system of activities that provide assurance that the facility was constructed in accordance with the contract and technical specifications.

To enable overall quality management it is proposed that the remediation works will be governed by a comprehensive Construction Quality Assurance (CQA) Plan, prepared for submission to and review by the EPA. The CQA Plan should set out construction quality control (CQC) procedures to ensure materials and workmanship meet design specifications. Where geosynthetic materials are used manufacturing quality assurance (MQA) and manufacturing quality control (MQC) documentation should be supplied by the manufacturers for each product, and assessed for compliance with the design requirements. This is important with respect capping system stability assessments for Zones 1 and 3.

The CQA Plan should also set out procedures for implementing quality control, such as through inspection activities that include visual observations, field testing and measurements, laboratory testing, and evaluation of the test data.

The CQA programme relies on the technical specification and the conditions of contract drawn up by the designer. These should include minimum (or maximum) requirements for materials and tests to be undertaken to verify the materials and/or the construction are meeting the specified standards. Where assessing suitability of soils for import to the site geotechnical and geo-environmental testing will require to be specified, such that compliance with typical earthworks specifications (e.g. NRA Specification for Roadworks) and waste acceptance criteria can be clearly identified.

The CQA Plan should also set out roles and responsibilities for the remediation works. This is not a contractual document but should be used to inform contractual arrangements and obligations. The Construction Environmental Management Plan may also inform and be informed by the CQA Plan.

On completion of the remediation works a Validation Report should be prepared, to demonstrate that the liner system(s) and associated components comply with the specification as set out in the CQA Plan.

## **12. Summary and Recommendations**

Assessment of earthworks proposals associated with the remediation of Kerdiffstown has indicated that:

- Risk assessments undertaken offer a reduced capping thickness whilst achieving a reduction in risk to the environment and human health;
- A high level assessment of construction phasing indicates that remediation works would be required to be completed over a 3-4 year period;
- Opportunities exist to reduce material import through the processing of on-site materials and adoption of waste classification processes;
- A significant volume of material is required to be imported to the site to facilitate the remediation works, having an impact on the environment in the short term;
- A high level assessment of on-site vehicle movements has been undertaken based on a series of assumptions to determine indicative plant that may be required to facilitate the remediation works and the approximate movements, requiring mitigation of nuisance on site (dust, odour, litter etc.);
- Remediation works shall be subject to CQA processes, typical for landfill construction projects.

It is recommended that further review of appropriate procurement approaches is undertaken in advance of the remediation works, focusing on the need for and specification of particular materials for designated purposes (subgrade preparation, drainage, capping, growing medium). The findings of this assessment including outline construction phasing may require to be revisited on the basis of that review.



**Appendix A – Earthworks Summary Information**

Earthwork balance summary table
Earthworks phasing summary table
Earthworks volume summary graph
Earthworks volumes & vehicle movements by phase
Earthworks vehicle movements summary graphs
Earthworks stockpiling summary graph
Earthworks cut and fill by zone and phase – tables & graphs

<b>Project:</b>	Kerdiffstown Landfill Remediation Project	<b>By:</b>	JPB
<b>Project No:</b>	32EW5604	<b>Date:</b>	24/11/2016
<b>Task:</b>	B - Earthworks Design	<b>Check:</b>	RT
<b>Description:</b>	Ewks Balance	<b>Date:</b>	14/03/2017

#### Final Restoration

Column Ref.	B=E+F+G+L+W	C=H+Q+V	D=B-C	E	F	G	H	I=E+F-H	J	K	L=J+K	M	N	O	P	Q=N+O+P	R	S	T	U	V=R+S+T+U	W=Q+V-L	X=G	
	Totals			Site Waste Materials					Site Won Clean Materials			Capping Materials				Misc. Selected Materials					Total Material Import	Total Material Export		
	Bulk Cut / Import	Bulk Fill	Bulk Balance	Surface Wastes	Cut Inert / Non-Hazardous	Cut - Hazardous	Fill	Balance	Concrete	Subsoils	Sub-total	Area	Topsoil	Subsoil	Reg. Layer	Sub-total	Engineered Bunds	Access Tracks	Drainage Stone	Gas Wells / Trench Backfill	Sub-total			
Units	m3	m3	m3	m3	m3	m3	m3	m3	m3	m3	m3	m2	0.15	0.35	0.15	m3	m3	m3	m3	m3	m3	m3	m3	m3
Zone 1	108,925	173,425	-64,500	0	47,000	0	111,500	-64,500	0	0	0	93,500	14,025	32,725	14,025	60,775	0	1,000	0	150	1,150	61,925	0	
Zone 2A	22,350	20,150	2,200	0	8,500	0	6,300	2,200	2,500	0	2,500	24,900	3,735	8,715	0	12,450	0	0	0	1,400	1,400	11,350	0	
Zone 2B	28,225	24,025	4,200	0	17,800	0	13,600	4,200	3,600	0	3,600	18,250	2,738	6,388	0	9,125	0	0	0	1,300	1,300	6,825	0	
Zone 3	11,811	97,311	-85,500	0	0	0	85,500	-85,500	0	0	0	17,000	2,550	5,950	2,550	11,050	711	0	0	50	761	11,811	0	
Zone 4	197,700	28,700	169,000	0	183,000	0	14,000	169,000	1,900	0	1,900	27,400	4,110	9,590	0	13,700	0	1,000	0	0	1,000	12,800	0	
Zone 4 ponds (incl.backfill)	32,150	54,150	-22,000	0	0	0	22,000	-22,000	0	0	0	14,100	2,115	4,935	0	7,050	25,100	0	0	0	25,100	32,150	0	
Site Entrance Area	0	0	0	0	0	0	0	0	0	2,500	2,500	0	0	0	0	0	0	0	0	0	0	-2,500	0	
Clean stockpile	0	0	0	0	0	0	0	0	0	10,000	10,000	0	0	0	0	0	0	0	0	0	0	-10,000	0	
<b>Totals</b>	<b>401,161</b>	<b>397,761</b>	<b>3,400</b>	<b>0</b>	<b>256,300</b>	<b>0</b>	<b>252,900</b>	<b>3,400</b>	<b>8,000</b>	<b>12,500</b>	<b>20,500</b>	<b>195,150</b>	<b>29,273</b>	<b>68,303</b>	<b>16,575</b>	<b>114,150</b>	<b>25,811</b>	<b>2,000</b>	<b>0</b>	<b>2,900</b>	<b>30,711</b>	<b>127,461</b>	<b>0</b>	

#### Earthwork balance summary table

<b>Project:</b>	Kerdiffstown Landfill Remediation Project	<b>By:</b>	JPB
<b>Project No:</b>	32EW5604	<b>Date:</b>	23/11/2016
<b>Task:</b>	B - Earthworks Design	<b>Check:</b>	RT
<b>Description:</b>	Outline Restoration Phasing - First Issue	<b>Date:</b>	14/03/2017

Year	Remediation							End use
	1	2	3	4	4+			
Remediation Phase	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8

Site Entrance Area, Infrastructure & Offsite Works								
0.1	New site boundary fence							
0.2	New site entrance							
0.3	New site compound							
0.4	Permanent leachate infrastructure installation & commissioning							
0.5	Leachate discharge pipeline construction							
0.6	Permanent gas infrastructure installation & commissioning							
0.7	Construction of surface water discharge to the Morell River							
0.8	Temporary surface water management measures (progressive)							
0.9	Clean stockpile use							

Zone 1								
1.1	Waste filling (surplus 4 materials)							
1.2	Capping of NW zone							
1.3	Construction of surface water management pond							
1.4	NE slope boundary drainage							
1.5	Remediation of NE slopes incl. capping							
1.6	Removal of existing flare stack							
1.7	Remediation / capping of remaining outer slopes							
1.8	Removal of SW screening bund							
1.9	Final restoration / capping of central area							
1.10	Gas wells installed							
1.11	Construction of soakaway							
1.12	Cleaning of ponds & commissioning.							

Zone 2A (Import area)								
2A.1	Demolition of buildings							
2A.2	Fill import / stockpiling							
2A.3	Stockpiled material use (incl. existing clean stockpile)							
2A.4	Re-profiling & capping							
2A.5	Vent trenches / gas management measures							

Zone 2B (Processing area)								
2B.1	Demolition of buildings & structures							
2B.2	Crushing and screening of demolition arisings							
2B.3	Demolition material stockpiling							
2B.4	Temporary stockpiling of Zone 4 wastes							
2B.5	Re-profiling & capping							
2B.7	Vent trenches / gas management measures							

Zone 3								
3.1	Toe bund construction							
3.2	Waste filling							
3.3	Capping							
3.4	Gas wells installed							

Zone 4								
4.1	Demolition of buildings / retaining wall							
4.2	Slope remediation & waste screening							
4.3	Construction of surface water management ponds (for remediation phase)							
4.4	Final restoration / capping (backfilling of ponds)							
4.5	Cleaning of ponds; installation of ecological enhancements to ponds							

**Earthworks phasing summary table**

Project:	Kerdiffstown Landfill Remediation Project	By:	JPB
Project No:	32EW5604	Date:	10/11/2016
Task:	B - Earthworks Design	Check:	RT
Description:	Phase 1 Volumes & Vehicle Movements	Date:	14/03/2017

Material Movement														
Fill Move From	Fill Move To											Vol. moved from during phase	Cumulative vol. moved	
	Site Entrance & New Compound	Zone 1	Zone 2A	Zone 2B	Zone 3	Zone 4	Zone 4 (Pond Bunds)	Site Entrance Stockpile	Zone 2A Import Stockpiles	Zone 2B Stockpiles (Waste)	Zone 2B Stockpiles (Concrete)			
Site Entrance & New Compound	-	-	-	-	-	-	-	2,500	-	-	-	-	2,500	2,500
Zone 1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zone 2A	-	-	-	-	-	-	-	-	-	-	2,500	-	2,500	2,500
Zone 2B	-	-	-	-	-	-	-	-	-	-	3,600	-	3,600	3,600
Zone 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zone 4	-	15,375	-	-	42,750	-	-	-	-	-	-	1,900	60,025	60,025
Site Entrance Stockpile	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zone 2A Import Stockpiles	-	-	-	-	711	-	-	-	-	-	-	-	711	711
Zone 2B Stockpiles (Waste)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zone 2B Stockpiles (Concrete)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Site Import	-	-	-	-	-	-	-	-	2,000	-	-	-	2,000	2,000
Vol. carried over from previous phase	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vol. moved during phase	-	15,375	-	-	43,461	-	-	2,500	2,000	-	8,000	-	71,336	-
Cumulative vol. moved	-	15,375	-	-	43,461	-	-	2,500	2,000	-	8,000	-	-	71,336
Vol. stockpiled at start of phase	-	-	-	-	-	-	-	10,000	-	-	-	-	-	10,000
Vol. stockpiled at end of phase	-	-	-	-	-	-	-	12,500	1,289	-	8,000	-	-	21,789

Vehicle Movements														
Vehicle Move From	Vehicle Move To											Vehicle movements during phase	Cumulative vehicle movements	
	Site Entrance & New Compound	Zone 1	Zone 2A	Zone 2B	Zone 3	Zone 4	Zone 4 (Pond Bunds)	Site Entrance Stockpile	Zone 2A Import Stockpiles	Zone 2B Stockpiles (Waste)	Zone 2B Stockpiles (Concrete)			
Site Entrance & New Compound	-	-	-	-	-	-	-	600	-	-	-	-	600	600
Zone 1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zone 2A	-	-	-	-	-	-	-	-	-	-	-	600	600	600
Zone 2B	-	-	-	-	-	-	-	-	-	-	-	864	864	864
Zone 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zone 4	-	3,690	-	-	10,260	-	-	-	-	-	-	456	14,406	14,406
Site Entrance Stockpile	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zone 2A Import Stockpiles	-	-	-	-	171	-	-	-	-	-	-	-	171	171
Zone 2B Stockpiles (Waste)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zone 2B Stockpiles (Concrete)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Site Import	-	-	-	-	-	-	-	-	480	-	-	-	480	480
Vehicle movements during phase	-	3,690	-	-	10,431	-	-	600	480	-	1,920	-	17,121	-
Cumulative vehicle movements	-	3,690	-	-	10,431	-	-	600	480	-	1,920	-	-	17,121

### Earthworks volumes & vehicle movements (Phase 1)

Project:	Kerdiffstown Landfill Remediation Project	By:	JPB
Project No:	32EW5604	Date:	10/11/2016
Task:	B - Earthworks Design	Check:	RT
Description:	Phase 2 Volumes & Vehicle Movements	Date:	14/03/2017

Material Movement														
Fill Move From	Fill Move To											Vol. moved from during phase	Cumulative vol. moved	
	Site Entrance & New Compound	Zone 1	Zone 2A	Zone 2B	Zone 3	Zone 4	Zone 4 (Pond Bunds)	Site Entrance Stockpile	Zone 2A Import Stockpiles	Zone 2B Stockpiles (Waste)	Zone 2B Stockpiles (Concrete)			
Site Entrance & New Compound	-	-	-	-	-	-	-	-	-	-	-	-	-	2,500
Zone 1	-	9,400	-	-	-	-	-	-	-	-	-	-	-	9,400
Zone 2A	-	-	-	-	-	-	-	-	-	-	-	-	-	2,500
Zone 2B	-	-	-	-	-	-	-	-	-	-	-	-	-	3,600
Zone 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zone 4	-	15,375	-	-	42,750	14,000	-	-	-	22,000	-	-	-	94,125
Site Entrance Stockpile	-	6,545	-	-	-	4,795	-	-	-	-	-	-	-	11,340
Zone 2A Import Stockpiles	-	5,610	-	-	-	2,055	-	-	-	-	-	-	-	7,665
Zone 2B Stockpiles (Waste)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zone 2B Stockpiles (Concrete)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Site Import	-	-	-	-	-	-	-	-	35,000	-	-	-	-	35,000
Vol. carried over from previous phase	-	15,375	-	-	43,461	-	-	2,500	2,000	-	8,000	-	-	-
Vol. moved during phase	-	36,930	-	-	42,750	20,850	-	-	35,000	22,000	-	-	-	157,530
Cumulative vol. moved	-	52,305	-	-	86,211	20,850	-	2,500	37,000	22,000	8,000	-	-	228,866
Vol. stockpiled at start of phase	-	-	-	-	-	-	-	12,500	1,289	-	8,000	-	-	21,789
Vol. stockpiled at end of phase	-	-	-	-	-	-	-	1,160	28,624	22,000	8,000	-	-	59,784

Vehicle Movements														
Vehicle Move From	Vehicle Move To											Vehicle movements during phase	Cumulative vehicle movements	
	Site Entrance & New Compound	Zone 1	Zone 2A	Zone 2B	Zone 3	Zone 4	Zone 4 (Pond Bunds)	Site Entrance Stockpile	Zone 2A Import Stockpiles	Zone 2B Stockpiles (Waste)	Zone 2B Stockpiles (Concrete)			
Site Entrance & New Compound	-	-	-	-	-	-	-	-	-	-	-	-	-	600
Zone 1	-	2,256	-	-	-	-	-	-	-	-	-	-	-	2,256
Zone 2A	-	-	-	-	-	-	-	-	-	-	-	-	-	600
Zone 2B	-	-	-	-	-	-	-	-	-	-	-	-	-	864
Zone 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zone 4	-	3,690	-	-	10,260	3,360	-	-	-	5,280	-	-	-	22,590
Site Entrance Stockpile	-	1,571	-	-	-	1,151	-	-	-	-	-	-	-	2,722
Zone 2A Import Stockpiles	-	1,346	-	-	171	493	-	-	-	-	-	-	-	2,010
Zone 2B Stockpiles (Waste)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zone 2B Stockpiles (Concrete)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Site Import	-	-	-	-	-	-	-	-	8,400	-	-	-	-	8,400
Vehicle movements during phase	-	8,863	-	-	10,431	5,004	-	-	8,400	5,280	-	-	-	37,978
Cumulative vehicle movements	-	12,553	-	-	20,861	5,004	-	600	8,880	5,280	1,920	-	-	55,098

### Earthworks volumes & vehicle movements (Phase 2)

Project:	Kerdistown Landfill Remediation Project	By:	JPB
Project No:	32EW5604	Date:	10/11/2016
Task:	B - Earthworks Design	Check:	RT
Description:	Phase 3 Volumes & Vehicle Movements	Date:	14/03/2017

Material Movement															
Fill Move From	Fill Move To											Vol. moved from during phase	Cumulative vol. moved		
	Site Entrance & New Compound	Zone 1	Zone 2A	Zone 2B	Zone 3	Zone 4	Zone 4 (Pond Bunds)	Site Entrance Stockpile	Zone 2A Import Stockpiles	Zone 2B Stockpiles (Waste)	Zone 2B Stockpiles (Concrete)				
Site Entrance & New Compound	-	-	-	-	-	-	-	-	-	-	-	-	-	2,500	
Zone 1	-	9,400	-	-	-	-	-	-	-	-	-	-	-	9,400	18,800
Zone 2A	-	-	-	-	-	-	-	-	-	-	-	-	-	2,500	
Zone 2B	-	-	-	-	-	-	-	-	-	-	-	-	-	3,600	
Zone 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Zone 4	-	30,750	-	-	-	-	-	-	-	-	-	-	-	30,750	184,900
Site Entrance Stockpile	-	1,160	-	-	-	-	-	-	-	-	-	-	-	1,160	12,500
Zone 2A Import Stockpiles	-	10,995	-	-	11,050	6,850	28,625	-	-	-	-	-	-	57,520	65,896
Zone 2B Stockpiles (Waste)	-	-	-	-	-	-	11,000	-	-	-	-	-	-	11,000	11,000
Zone 2B Stockpiles (Concrete)	-	30	-	-	50	-	-	-	-	-	-	-	-	80	80
Site Import	-	-	-	-	-	-	-	-	35,000	-	-	-	-	35,000	72,000
Vol. carried over from previous phase	-	52,305	-	-	86,211	20,850	-	2,500	37,000	22,000	8,000	-	-	-	-
Vol. moved during phase	-	52,335	-	-	11,100	6,850	39,625	-	35,000	-	-	-	-	144,910	-
Cumulative vol. moved	-	104,640	-	-	97,311	27,700	39,625	2,500	72,000	22,000	8,000	-	-	373,776	-
Vol. stockpiled at start of phase	-	-	-	-	-	-	-	-	1,160	28,624	22,000	8,000	-	59,784	-
Vol. stockpiled at end of phase	-	-	-	-	-	-	-	-	-	6,104	11,000	7,920	-	25,024	-

Vehicle Movements															
Vehicle Move From	Vehicle Move To											Vehicle movements during phase	Cumulative vehicle movements		
	Site Entrance & New Compound	Zone 1	Zone 2A	Zone 2B	Zone 3	Zone 4	Zone 4 (Pond Bunds)	Site Entrance Stockpile	Zone 2A Import Stockpiles	Zone 2B Stockpiles (Waste)	Zone 2B Stockpiles (Concrete)				
Site Entrance & New Compound	-	-	-	-	-	-	-	-	-	-	-	-	-	600	
Zone 1	-	2,256	-	-	-	-	-	-	-	-	-	-	-	2,256	4,512
Zone 2A	-	-	-	-	-	-	-	-	-	-	-	-	-	600	
Zone 2B	-	-	-	-	-	-	-	-	-	-	-	-	-	864	
Zone 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Zone 4	-	7,380	-	-	-	-	-	-	-	-	-	-	-	7,380	44,376
Site Entrance Stockpile	-	278	-	-	-	-	-	-	-	-	-	-	-	278	3,000
Zone 2A Import Stockpiles	-	2,639	-	-	2,652	1,644	6,870	-	-	-	-	-	-	13,805	15,986
Zone 2B Stockpiles (Waste)	-	-	-	-	-	-	2,640	-	-	-	-	-	-	2,640	2,640
Zone 2B Stockpiles (Concrete)	-	7	-	-	12	-	-	-	-	-	-	-	-	19	19
Site Import	-	-	-	-	-	-	-	-	8,400	-	-	-	-	8,400	17,280
Vehicle movements during phase	-	12,560	-	-	2,664	1,644	9,510	-	8,400	-	-	-	-	34,778	-
Cumulative vehicle movements	-	25,114	-	-	23,525	6,648	9,510	600	17,280	5,280	1,920	-	-	89,877	-

### Earthworks volumes & vehicle movements (Phase 3)

Project:	Kerdiffstown Landfill Remediation Project	By:	JPB
Project No:	32EW5604	Date:	10/11/2016
Task:	B - Earthworks Design	Check:	RT
Description:	Phase 4 Volumes & Vehicle Movements	Date:	14/03/2017

Material Movement															
Fill Move From	Fill Move To											Vol. moved from during phase	Cumulative vol. moved		
	Site Entrance & New Compound	Zone 1	Zone 2A	Zone 2B	Zone 3	Zone 4	Zone 4 (Ponds)	Site Entrance Stockpile	Zone 2A Import Stockpiles	Zone 2B Stockpiles (Waste)	Zone 2B Stockpiles (Concrete)				
Site Entrance & New Compound	-	-	-	-	-	-	-	-	-	-	-	-	-	2,500	
Zone 1	-	9,400	-	-	-	-	-	-	-	-	-	-	-	9,400	28,200
Zone 2A	-	-	-	-	-	-	-	-	-	-	-	-	-	2,500	
Zone 2B	-	-	-	-	-	-	-	-	-	-	-	-	-	3,600	
Zone 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Zone 4	-	-	-	-	-	-	-	-	-	-	-	-	-	184,900	
Site Entrance Stockpile	-	-	-	-	-	-	-	-	-	-	-	-	-	12,500	
Zone 2A Import Stockpiles	-	12,155	-	-	-	-	3,525	-	-	-	-	-	-	15,680	81,576
Zone 2B Stockpiles (Waste)	-	-	-	-	-	-	11,000	-	-	-	-	-	-	11,000	22,000
Zone 2B Stockpiles (Concrete)	-	30	-	-	-	-	-	-	-	-	-	-	-	30	110
Site Import	-	-	-	-	-	-	-	-	30,000	-	-	-	-	30,000	102,000
Vol. carried over from previous phase	-	104,640	-	-	97,311	27,700	39,625	2,500	72,000	22,000	8,000	-	-	-	-
Vol. moved during phase	-	21,585	-	-	-	-	14,525	-	30,000	-	-	-	-	66,110	-
Cumulative vol. moved	-	126,225	-	-	97,311	27,700	54,150	2,500	102,000	22,000	8,000	-	-	-	439,886
Vol. stockpiled at start of phase	-	-	-	-	-	-	-	-	6,104	11,000	7,920	-	-	25,024	-
Vol. stockpiled at end of phase	-	-	-	-	-	-	-	-	20,424	-	7,890	-	-	28,314	-

Vehicle Movements															
Vehicle Move From	Vehicle Move To											Vehicle movements during phase	Cumulative vehicle movements		
	Site Entrance & New Compound	Zone 1	Zone 2A	Zone 2B	Zone 3	Zone 4	Zone 4 (Pond Bunds)	Site Entrance Stockpile	Zone 2A Import Stockpiles	Zone 2B Stockpiles (Waste)	Zone 2B Stockpiles (Concrete)				
Site Entrance & New Compound	-	-	-	-	-	-	-	-	-	-	-	-	-	600	
Zone 1	-	2,256	-	-	-	-	-	-	-	-	-	-	-	2,256	6,768
Zone 2A	-	-	-	-	-	-	-	-	-	-	-	-	-	600	
Zone 2B	-	-	-	-	-	-	-	-	-	-	-	-	-	864	
Zone 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Zone 4	-	-	-	-	-	-	-	-	-	-	-	-	-	44,376	
Site Entrance Stockpile	-	-	-	-	-	-	-	-	-	-	-	-	-	3,000	
Zone 2A Import Stockpiles	-	2,917	-	-	-	-	846	-	-	-	-	-	-	3,763	19,749
Zone 2B Stockpiles (Waste)	-	-	-	-	-	-	2,640	-	-	-	-	-	-	2,640	5,280
Zone 2B Stockpiles (Concrete)	-	7	-	-	-	-	-	-	-	-	-	-	-	7	26
Site Import	-	-	-	-	-	-	-	-	7,200	-	-	-	-	7,200	24,480
Vehicle movements during phase	-	5,180	-	-	-	-	3,486	-	7,200	-	-	-	-	15,866	-
Cumulative vehicle movements	-	30,294	-	-	23,525	6,648	12,996	600	24,480	5,280	1,920	-	-	105,743	

### Earthworks volumes & vehicle movements (Phase 4)

Project:	Kerdiffstown Landfill Remediation Project	By:	JPB
Project No:	32EW5604	Date:	10/11/2016
Task:	B - Earthworks Design	Check:	RT
Description:	Phase 5 Volumes & Vehicle Movements	Date:	14/03/2017

Material Movement															
Fill Move From	Fill Move To											Vol. moved from during phase	Cumulative vol. moved		
	Site Entrance & New Compound	Zone 1	Zone 2A	Zone 2B	Zone 3	Zone 4	Zone 4 (Pond Bunds)	Site Entrance Stockpile	Zone 2A Import Stockpiles	Zone 2B Stockpiles (Waste)	Zone 2B Stockpiles (Concrete)				
Site Entrance & New Compound	-	-	-	-	-	-	-	-	-	-	-	-	-	2,500	
Zone 1	-	9,400	-	-	-	-	-	-	-	-	-	-	-	9,400	37,600
Zone 2A	-	-	-	-	-	-	-	-	-	-	-	-	-	2,500	
Zone 2B	-	4,200	-	13,600	-	-	-	-	-	-	-	-	-	17,800	21,400
Zone 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Zone 4	-	-	-	-	-	-	-	-	-	-	-	-	-	184,900	
Site Entrance Stockpile	-	-	-	-	-	-	-	-	-	-	-	-	-	12,500	
Zone 2A Import Stockpiles	-	12,155	-	9,125	-	-	-	-	-	-	-	-	-	21,280	102,856
Zone 2B Stockpiles (Waste)	-	-	-	-	-	-	-	-	-	-	-	-	-	22,000	
Zone 2B Stockpiles (Concrete)	-	30	-	1,300	-	-	-	-	-	-	-	-	-	1,330	1,440
Site Import	-	-	-	-	-	-	-	-	25,461	-	-	-	-	25,461	127,461
Vol. carried over from previous phase	-	126,225	-	-	97,311	27,700	54,150	2,500	102,000	22,000	8,000	-	-	-	
Vol. moved during phase	-	25,785	-	24,025	-	-	-	-	25,461	-	-	-	-	75,271	
Cumulative vol. moved	-	152,010	-	24,025	97,311	27,700	54,150	2,500	127,461	22,000	8,000	-	-	515,157	
Vol. stockpiled at start of phase	-	-	-	-	-	-	-	-	20,424	-	7,890	-	-	28,314	
Vol. stockpiled at end of phase	-	-	-	-	-	-	-	-	24,605	-	6,560	-	-	31,165	

Vehicle Movements															
Vehicle Move From	Vehicle Move To											Vehicle movements during phase	Cumulative vehicle movements		
	Site Entrance & New Compound	Zone 1	Zone 2A	Zone 2B	Zone 3	Zone 4	Zone 4 (Pond Bunds)	Site Entrance Stockpile	Zone 2A Import Stockpiles	Zone 2B Stockpiles (Waste)	Zone 2B Stockpiles (Concrete)				
Site Entrance & New Compound	-	-	-	-	-	-	-	-	-	-	-	-	-	600	
Zone 1	-	2,256	-	-	-	-	-	-	-	-	-	-	-	2,256	9,024
Zone 2A	-	-	-	-	-	-	-	-	-	-	-	-	-	600	
Zone 2B	-	1,008	-	3,264	-	-	-	-	-	-	-	-	-	4,272	5,136
Zone 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Zone 4	-	-	-	-	-	-	-	-	-	-	-	-	-	44,376	
Site Entrance Stockpile	-	-	-	-	-	-	-	-	-	-	-	-	-	3,000	
Zone 2A Import Stockpiles	-	2,917	-	2,190	-	-	-	-	-	-	-	-	-	5,107	24,856
Zone 2B Stockpiles (Waste)	-	-	-	-	-	-	-	-	-	-	-	-	-	5,280	
Zone 2B Stockpiles (Concrete)	-	7	-	312	-	-	-	-	-	-	-	-	-	319	346
Site Import	-	-	-	-	-	-	-	-	6,111	-	-	-	-	6,111	30,591
Vehicle movements during phase	-	6,188	-	5,766	-	-	-	-	6,111	-	-	-	-	18,065	
Cumulative vehicle movements	-	36,482	-	5,766	23,525	6,648	12,996	600	30,591	5,280	1,920	-	-	123,808	

### Earthworks volumes & vehicle movements (Phase 5)



Project:	Kerdiffstown Landfill Remediation Project	By:	JPB
Project No:	32EW5604	Date:	10/11/2016
Task:	B - Earthworks Design	Check:	RT
Description:	Phase 6 Volumes & Vehicle Movements	Date:	14/03/2017

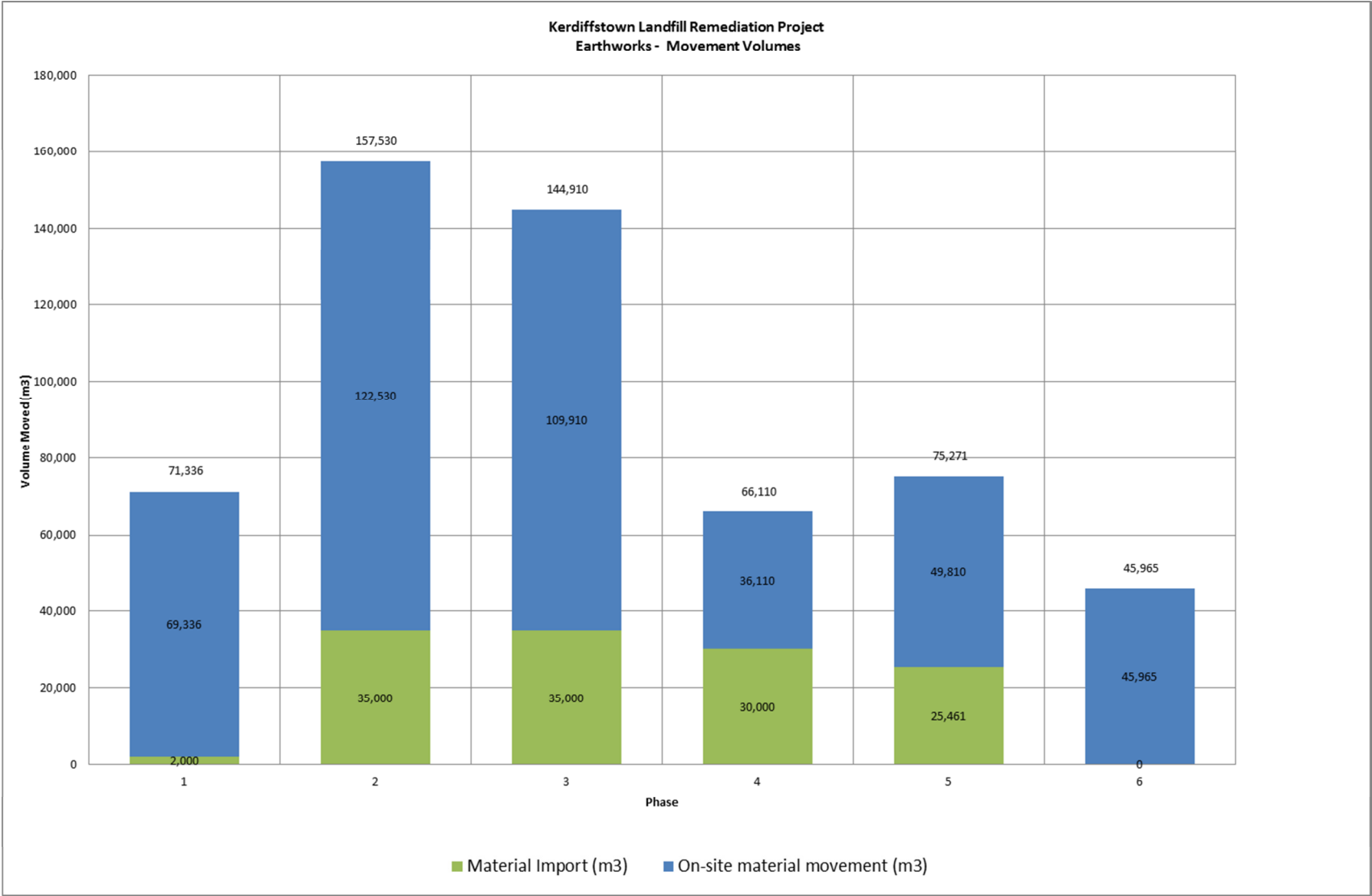
  

Material Movement														
Fill Move From	Fill Move To											Vol. moved from during phase	Cumulative vol. moved	
	Site Entrance & New Compound	Zone 1	Zone 2A	Zone 2B	Zone 3	Zone 4	Zone 4 (Pond Bunds)	Site Entrance Stockpile	Zone 2A Import Stockpiles	Zone 2B Stockpiles (Waste)	Zone 2B Stockpiles (Concrete)			
Site Entrance & New Compound	-	-	-	-	-	-	-	-	-	-	-	-	-	2,500
Zone 1	-	9,400	-	-	-	-	-	-	-	-	-	-	-	9,400
Zone 2A	-	2,200	6,300	-	-	-	-	-	-	-	-	-	-	8,500
Zone 2B	-	-	-	-	-	-	-	-	-	-	-	-	-	21,400
Zone 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zone 4	-	-	-	-	-	-	-	-	-	-	-	-	-	184,900
Site Entrance Stockpile	-	-	-	-	-	-	-	-	-	-	-	-	-	12,500
Zone 2A Import Stockpiles	-	12,155	12,450	-	-	-	-	-	-	-	-	-	-	24,605
Zone 2B Stockpiles (Waste)	-	-	-	-	-	-	-	-	-	-	-	-	-	22,000
Zone 2B Stockpiles (Concrete)	-	1,060	1,400	-	-	1,000	-	-	-	-	-	-	-	3,460
Site Import	-	-	-	-	-	-	-	-	-	-	-	-	-	127,461
Vol. carried over from previous phase	-	152,010	-	24,025	97,311	27,700	54,150	2,500	127,461	22,000	8,000	-	-	-
Vol. moved during phase	-	24,815	20,150	-	-	1,000	-	-	-	-	-	-	-	45,965
Cumulative vol. moved	-	176,825	20,150	24,025	97,311	28,700	54,150	2,500	127,461	22,000	8,000	-	-	561,122
Vol. stockpiled at start of phase	-	-	-	-	-	-	-	-	24,605	-	6,560	-	-	31,165
Vol. stockpiled at end of phase	-	-	-	-	-	-	-	-	-	-	3,100	-	-	3,100

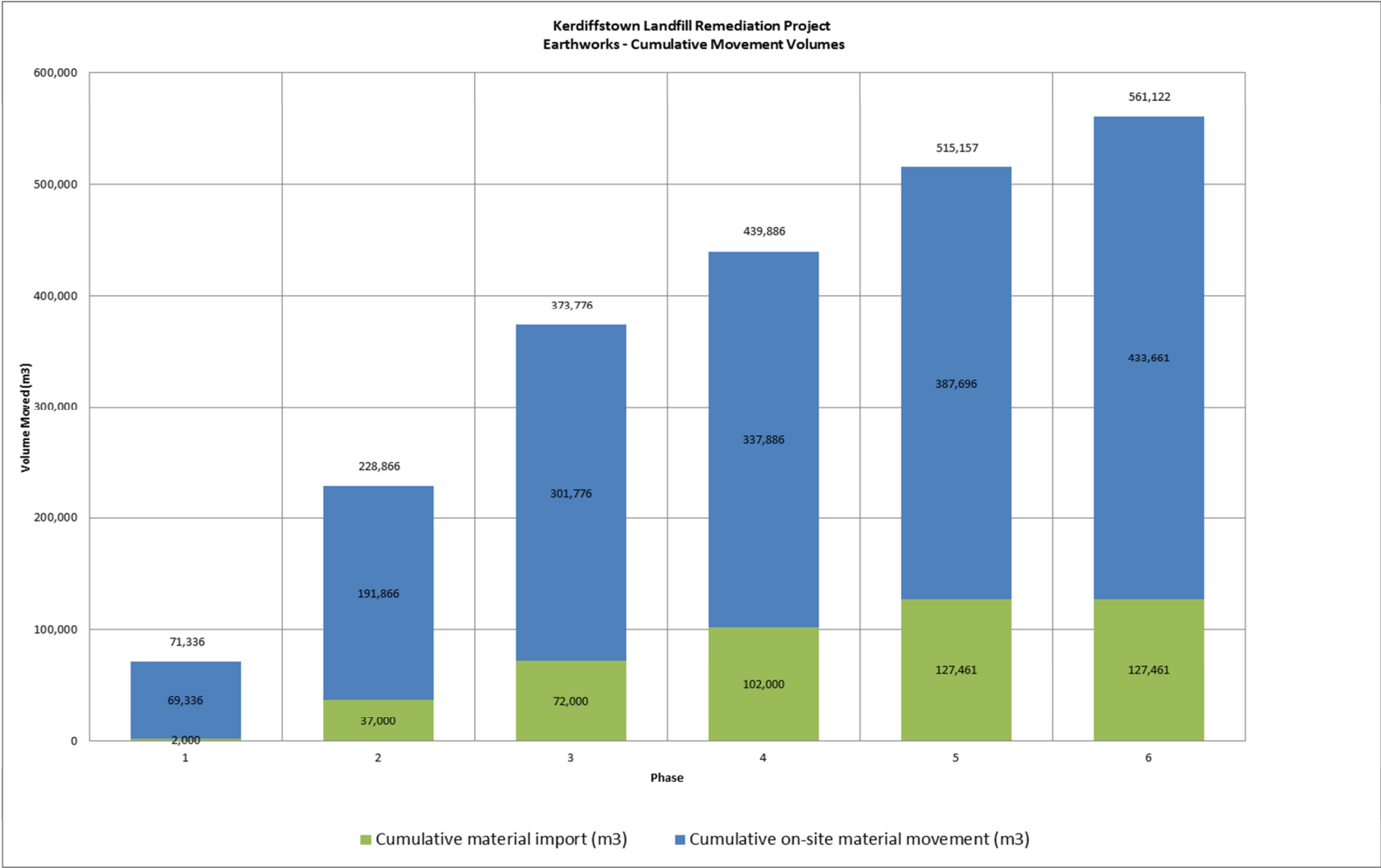
  

Vehicle Movements														
Vehicle Move From	Vehicle Move To											Vehicle movements during phase	Cumulative vehicle movements	
	Site Entrance & New Compound	Zone 1	Zone 2A	Zone 2B	Zone 3	Zone 4	Zone 4 (Pond Bunds)	Site Entrance Stockpile	Zone 2A Import Stockpiles	Zone 2B Stockpiles (Waste)	Zone 2B Stockpiles (Concrete)			
Site Entrance & New Compound	-	-	-	-	-	-	-	-	-	-	-	-	-	600
Zone 1	-	2,256	-	-	-	-	-	-	-	-	-	-	-	2,256
Zone 2A	-	528	1,512	-	-	-	-	-	-	-	-	-	-	2,040
Zone 2B	-	-	-	-	-	-	-	-	-	-	-	-	-	5,136
Zone 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zone 4	-	-	-	-	-	-	-	-	-	-	-	-	-	44,376
Site Entrance Stockpile	-	-	-	-	-	-	-	-	-	-	-	-	-	3,000
Zone 2A Import Stockpiles	-	2,917	2,988	-	-	-	-	-	-	-	-	-	-	5,905
Zone 2B Stockpiles (Waste)	-	-	-	-	-	-	-	-	-	-	-	-	-	5,280
Zone 2B Stockpiles (Concrete)	-	254	336	-	-	240	-	-	-	-	-	-	-	830
Site Import	-	-	-	-	-	-	-	-	-	-	-	-	-	30,591
Vehicle movements during phase	-	5,956	4,836	-	-	240	-	-	-	-	-	-	-	11,032
Cumulative vehicle movements	-	42,438	4,836	5,766	23,525	6,888	12,996	600	30,591	5,280	1,920	-	-	134,840

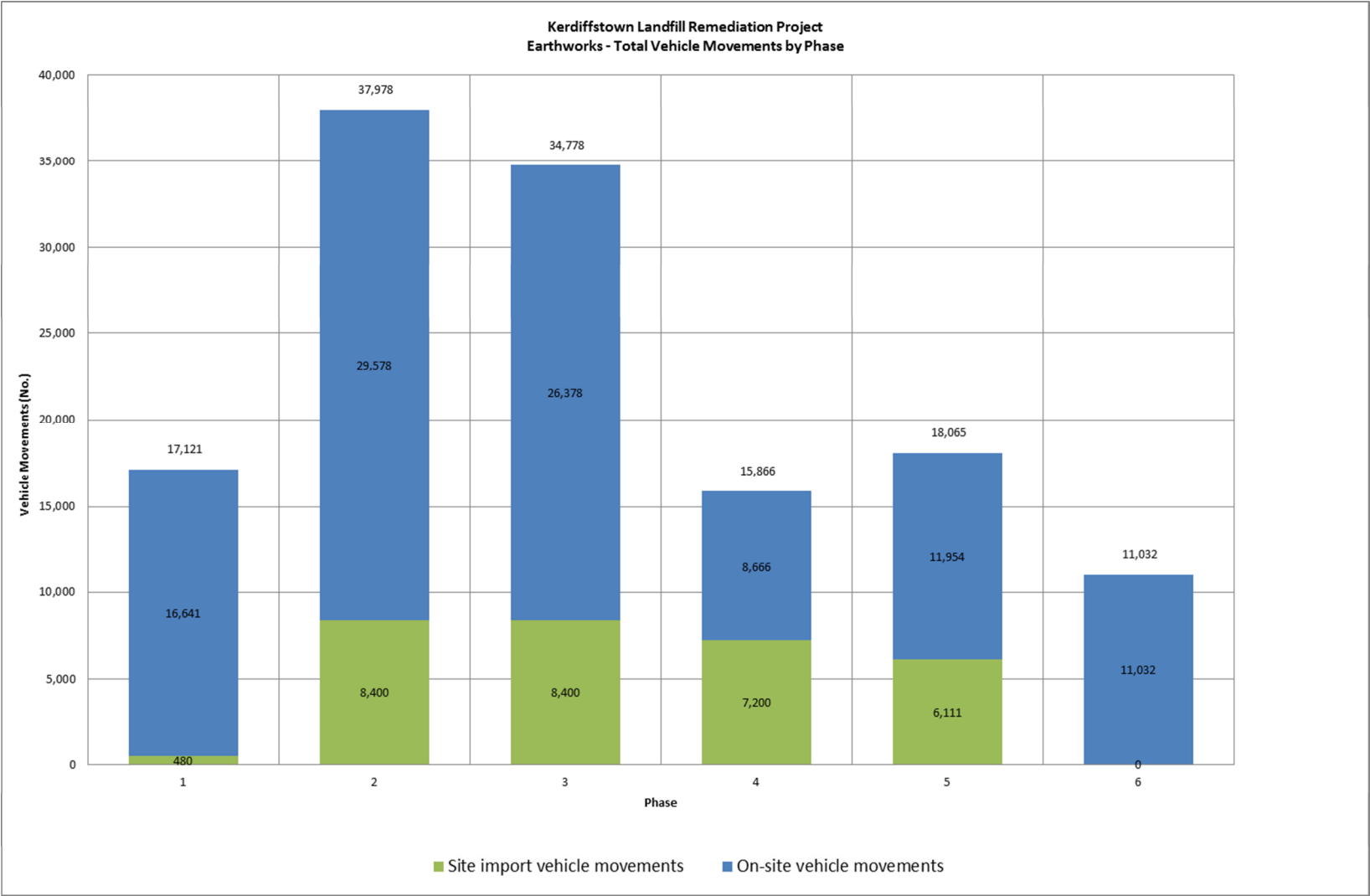
### Earthworks volumes & vehicle movements (Phase 6)



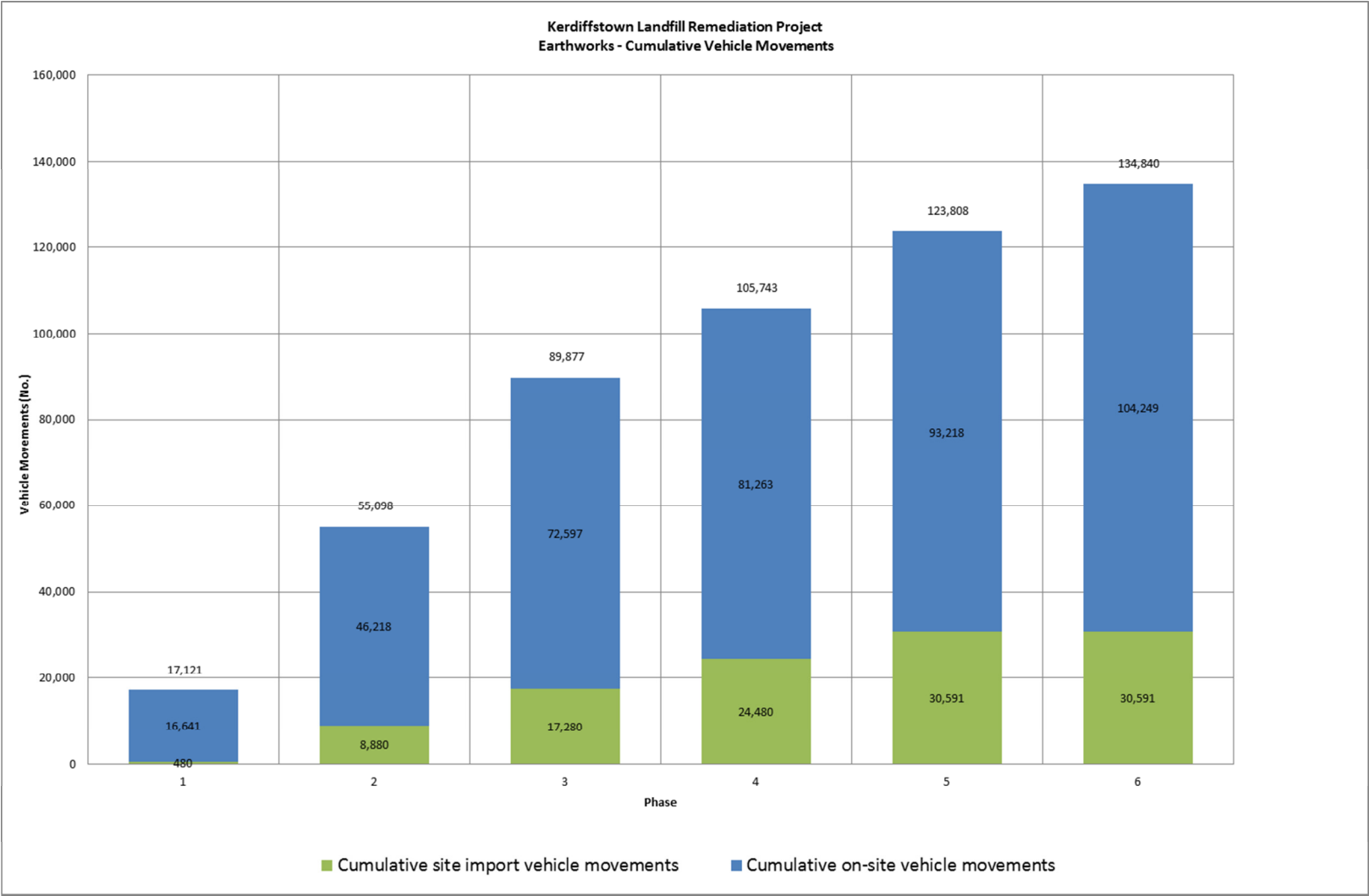
Earthworks vehicle movements summary graph



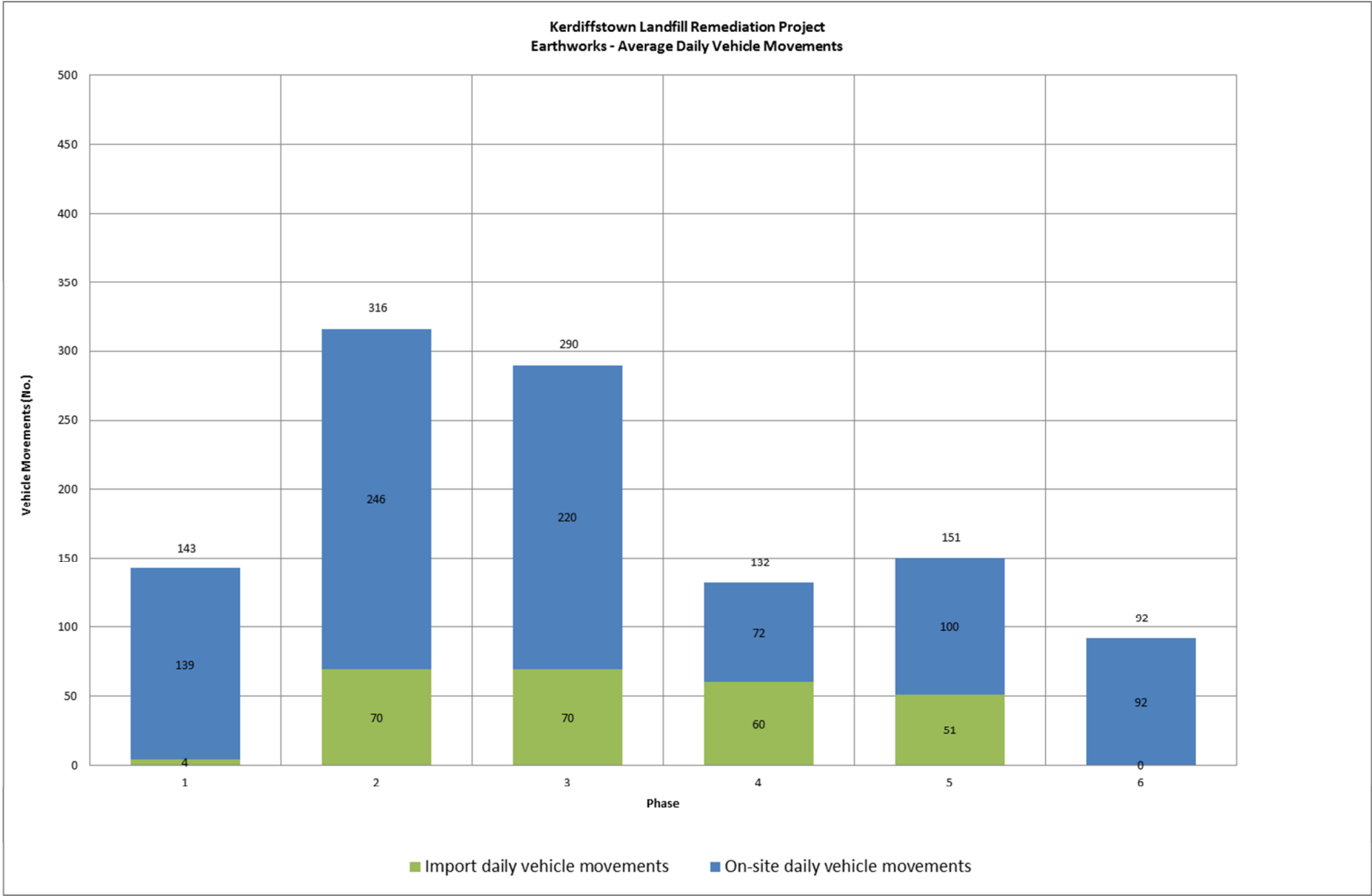
Earthworks cumulative vehicle movements summary graph



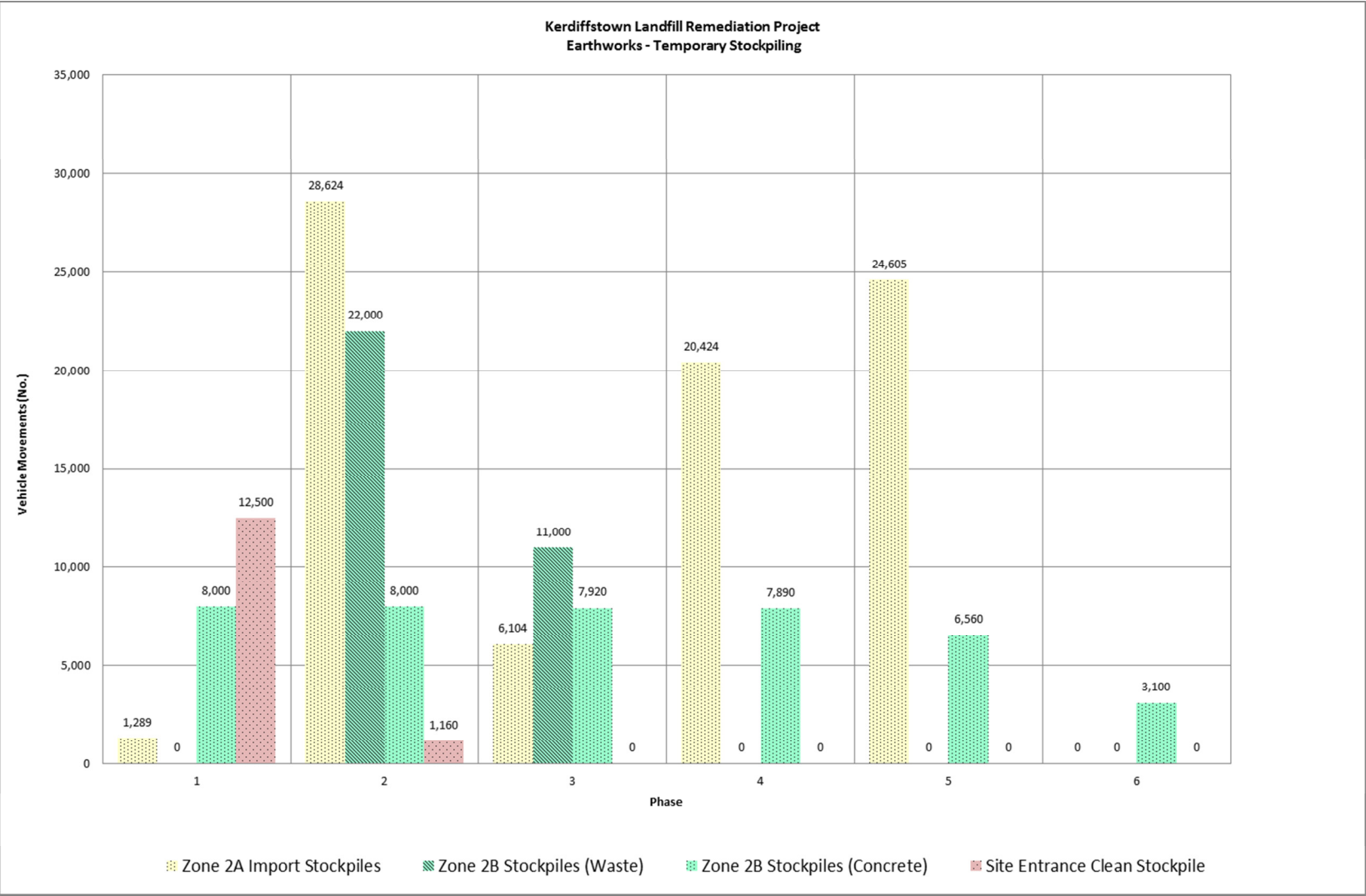
Earthworks total vehicle movements summary graph by phase



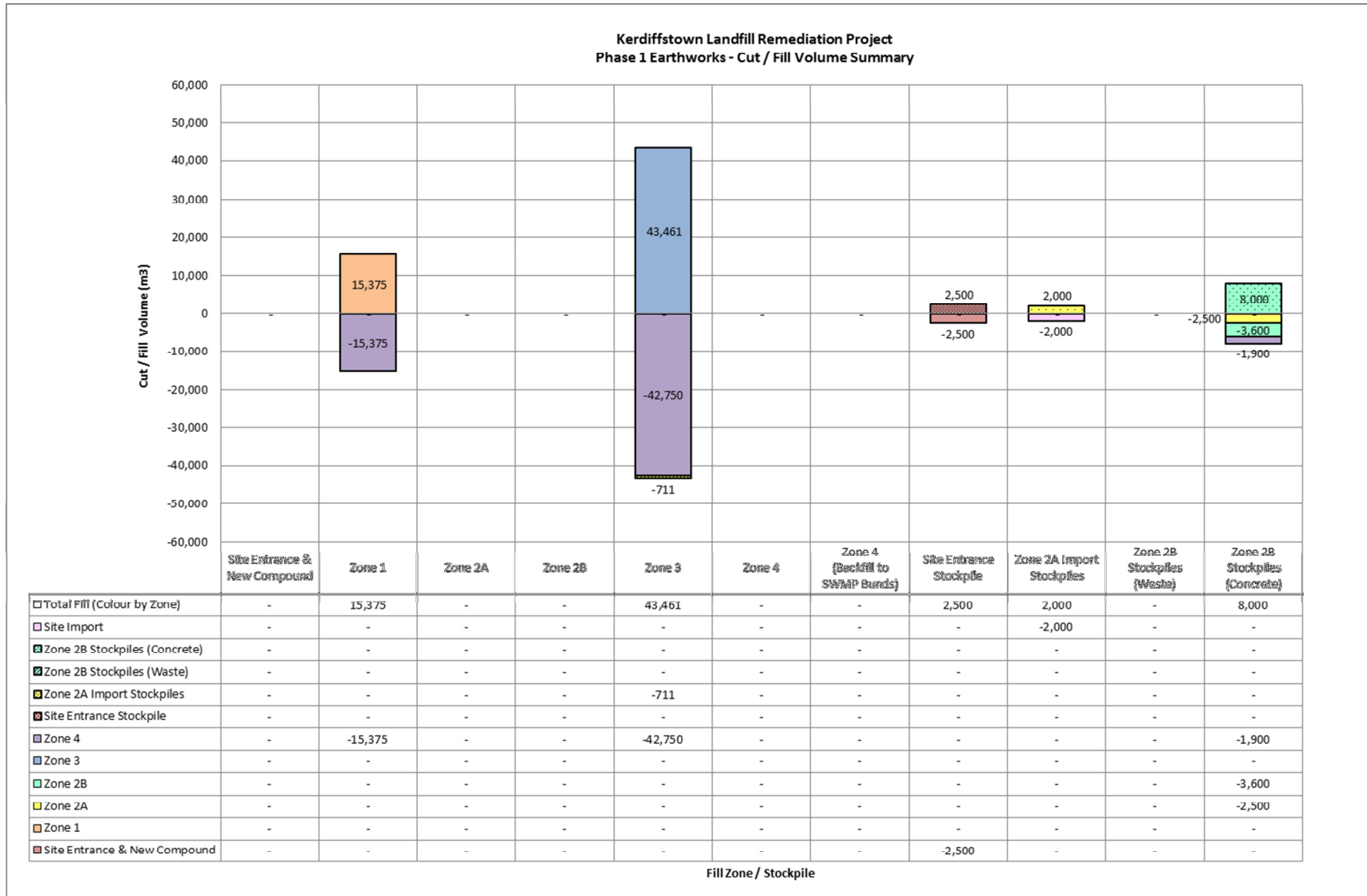
Earthworks cumulative vehicle movements by phase



Earthworks average daily vehicle movements

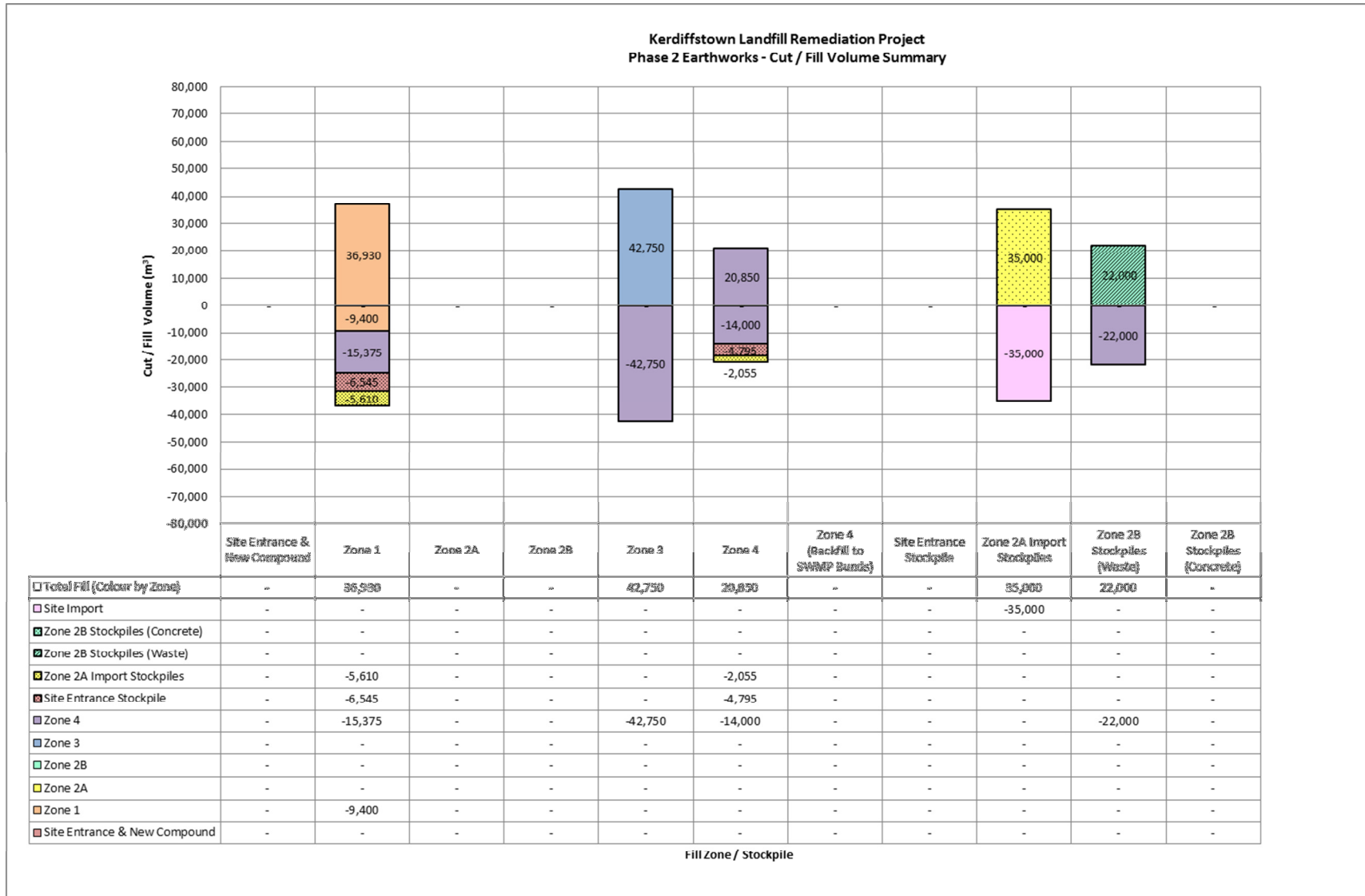


Earthworks stockpiling summary graph

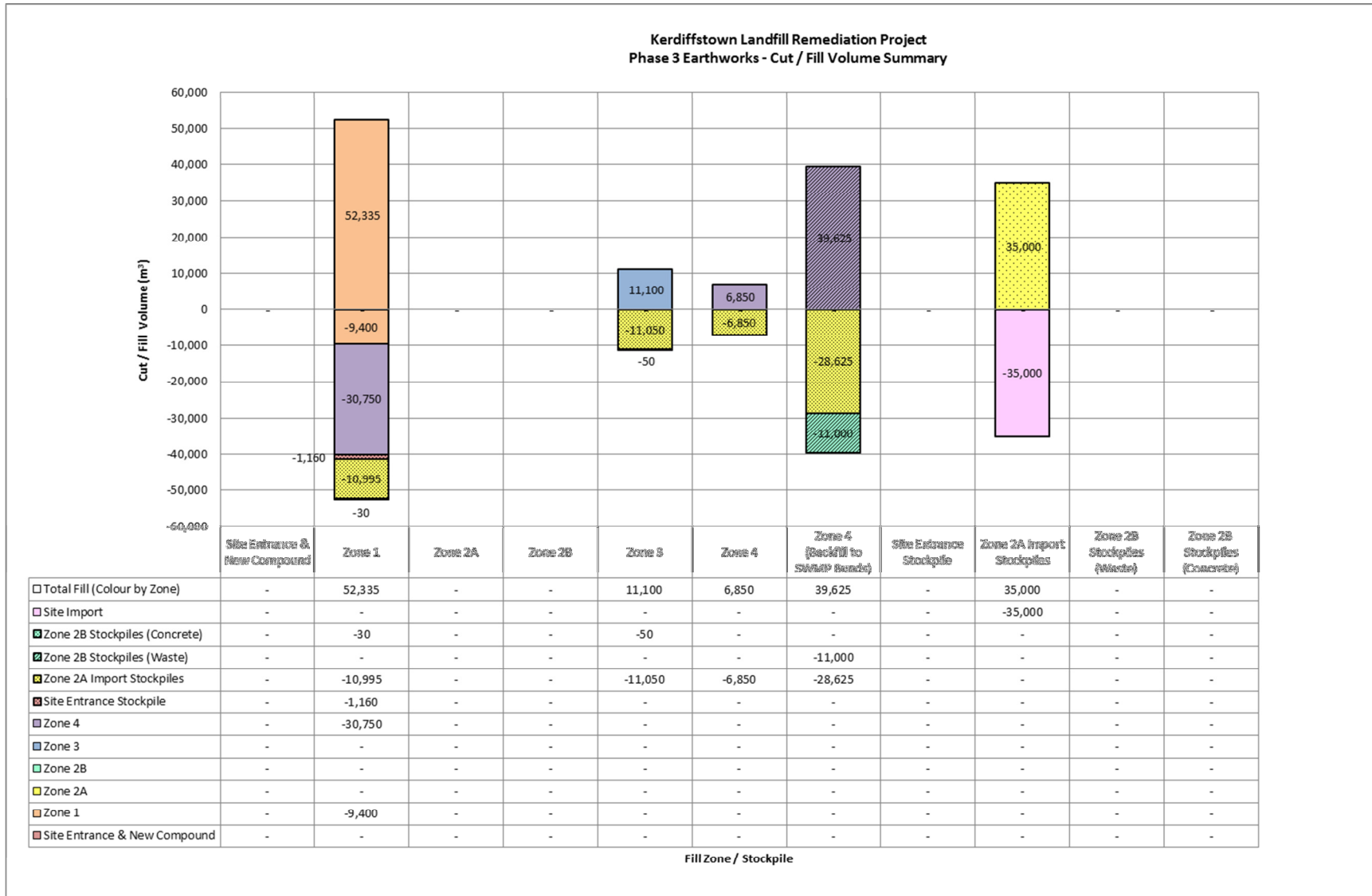


**Earthworks cut and fill by zone (Phase 1)**

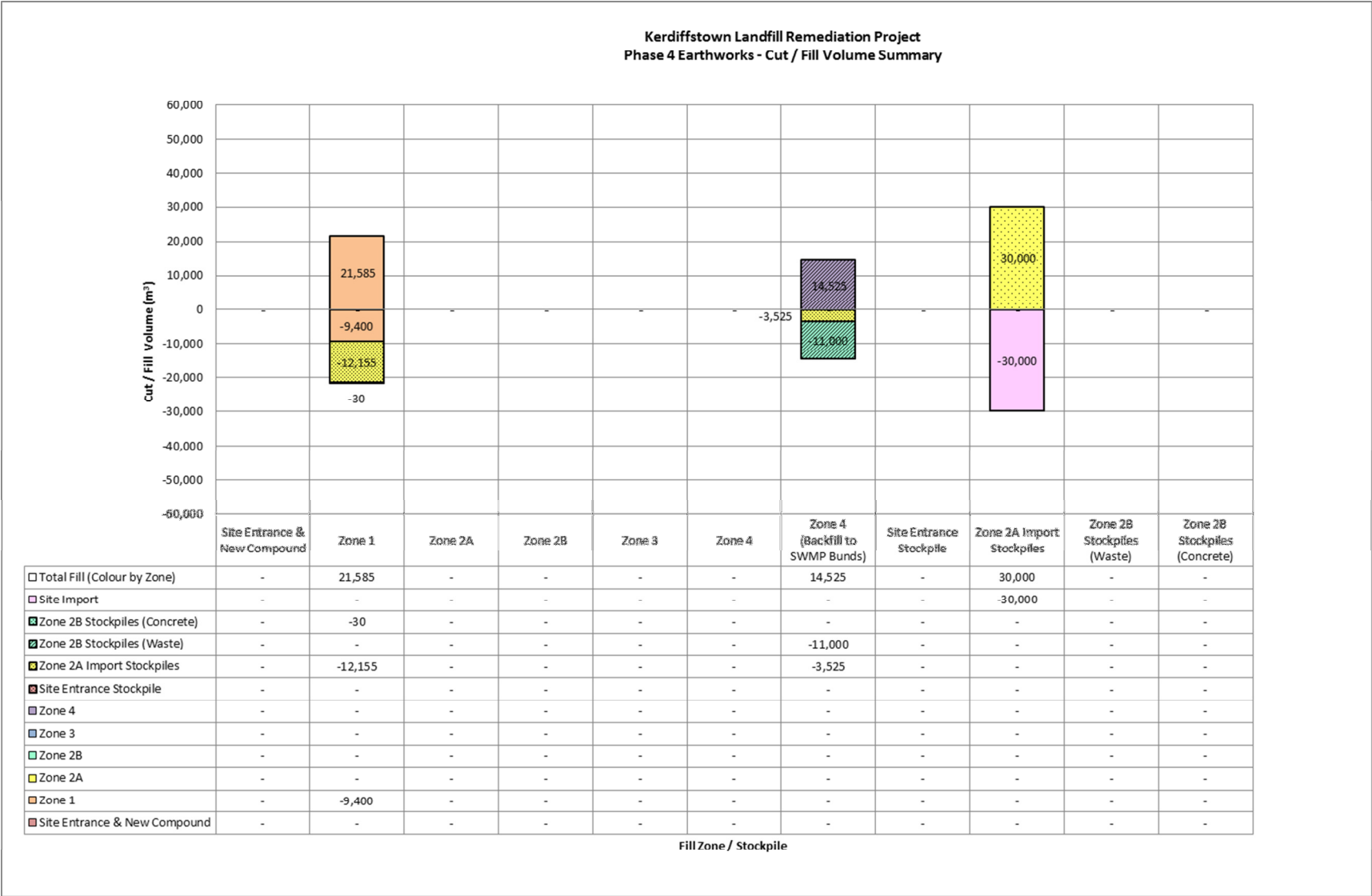




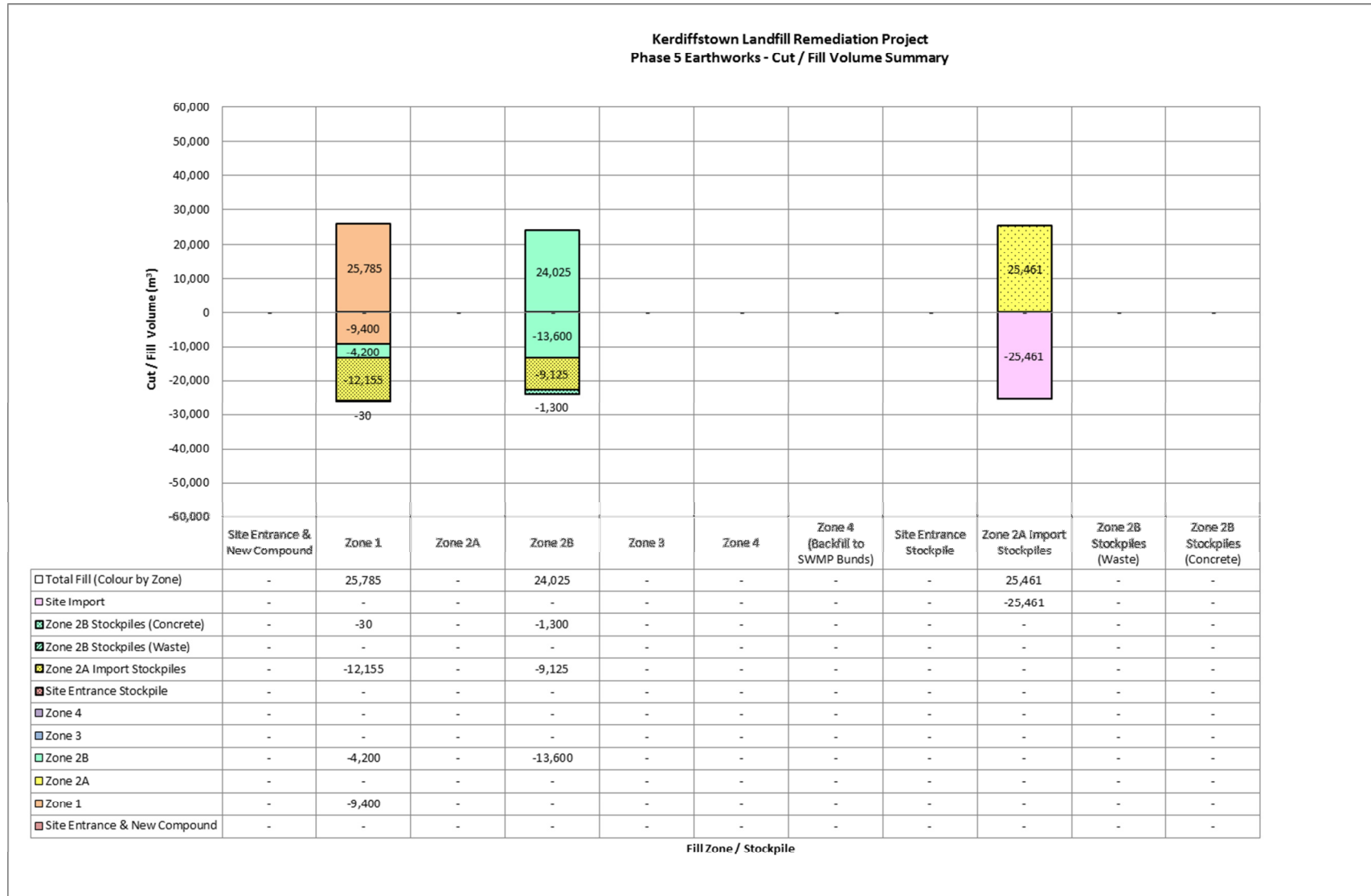
**Earthworks cut and fill by zone (Phase 2)**



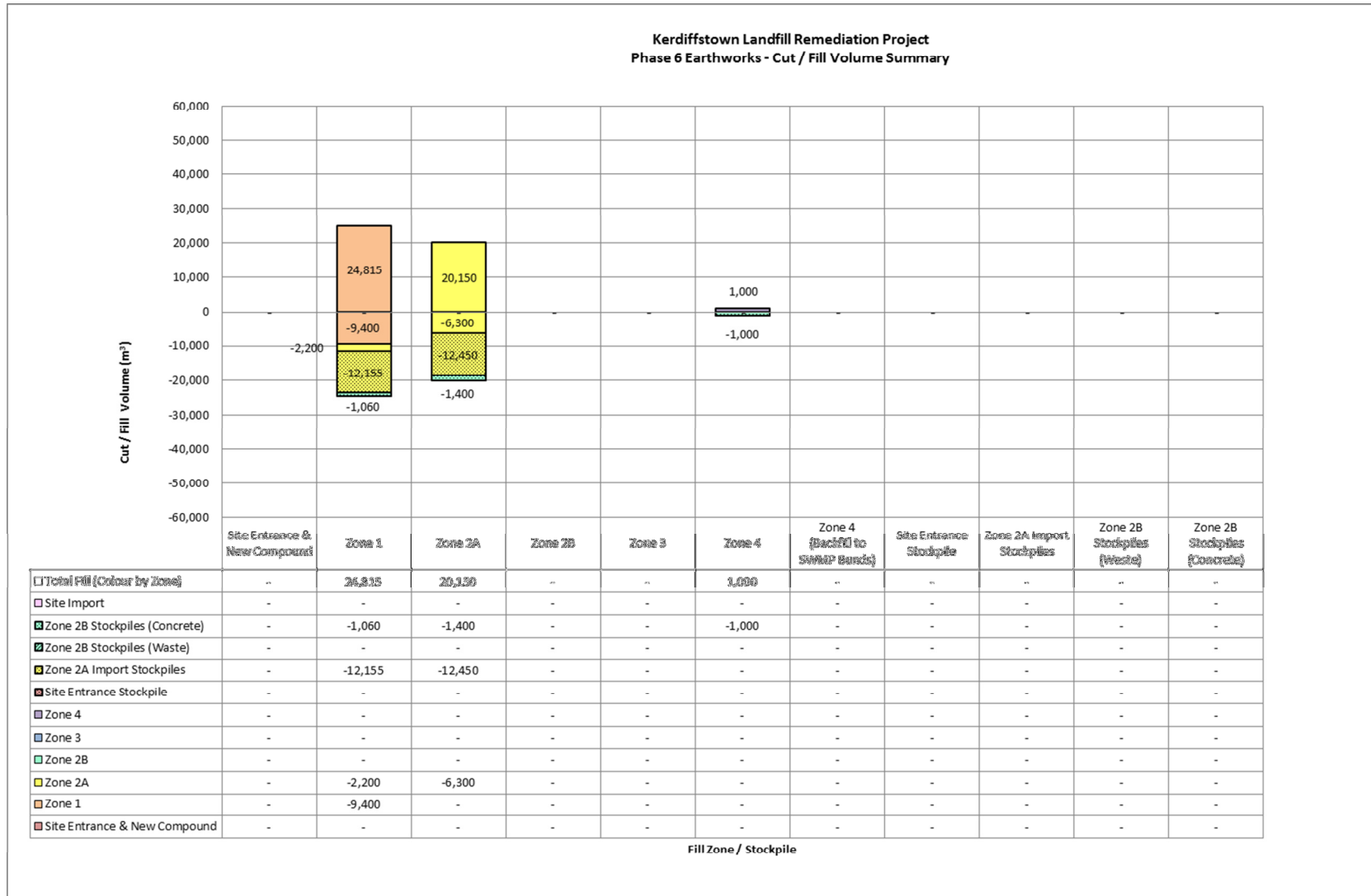
**Earthworks cut and fill by zone (Phase 3)**



Earthworks cut and fill by zone (Phase 4)



Earthworks cut and fill by zone (Phase 5)



Earthworks cut and fill by zone (Phase 6)

## **Appendix A4.8 Landscape Masterplan Statement**



# Kerdiffstown Landfill Remediation Project

Kildare County Council

## Landscape Masterplan Statement

32EW5604-DOC-0043 | 1

### Document history and status

Revision	Date	Description	By	Review	Approved
0	29/03/17	Preliminary – for Client Review	Tom Supple	Thomas Darcy	Rhianna Rose
1	30/06/17	Final for EIAR Issue	Ultan Downes	Sharon Sugrue	Rhianna Rose

### Distribution of copies

Revision	Issue approved	Date issued	Issued to	Comments
0	29/03/17	29/03/17	Kildare County Council	Preliminary – for Client Review
1	30/06/17	30/06/17	Kildare County Council	Final - EIAR Issue

## Kerdiffstown Landfill Remediation Project

Project No: 32EW5604  
Document Title: Landscape Masterplan Statement  
Document No.: 32EW5604-DOC-0043  
Revision: 1  
Date: 30 June 2017  
Client Name: Kildare County Council  
Client No:  
Project Manager: Rhianna Rose  
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# 1. Introduction

## 1.1 Background

The site of the proposed Project, is located in County Kildare, approximately 3km north-east of central Naas, approximately 400m north-west of Johnstown village and in close proximity to the strategically important M7/N7 corridor. The site is located in close proximity to a number of residential and commercial receptors as well as being a short distance away from the larger settlements of Johnstown and Naas. In addition to the above, the site neighbours a number of recreational land uses, specifically Palmerstown House Estate and Naas Golf Course to the north-east and north-west respectively.

The site occupies approximately 30 hectares and is a former sand and gravel quarry which was progressively backfilled by a number of operators from the 1950s onwards. In January 2011 a major fire developed in a mound of waste material in the northern part of the site. This required intervention of a number of state agencies including Kildare County Council and the Environmental Protection Agency (EPA). The site was under the control of Kildare Fire Service until late February 2011, when it was handed over to the care of the EPA. Since 2011, measures have been taken to secure the site and limit environmental impact.

In April 2015 the Minister for the Environment, Community and Local Government, Alan Kelly TD, announced that funding would be made available for the remediation of the landfill site, and that Kildare County Council (KCC) would take control of the site and commence remediation.

The objective in remediating the site in terms of end-use proposals is to:

- Deliver a solution that is accepted by the community.

Linked to the overarching objectives of the project is the aim to provide a future landform and end use appropriate for the site and of potential benefit to the local community. To that end, KCC is proposing to remediate the site with the vision of restoring the area into a landscaped park and recreational facilities.

## 1.2 Aims and Objectives

This document supports the outline Landscape Masterplan (LM), shown as Figure 4.30, and has been prepared in support of the planning application and summarises the mitigation for the proposed Project. In absence of equivalent methodology in Ireland, this Statement has been prepared using the methodology set out in Section 0 Environmental Objectives of the Design Manual for Roads and Bridges (DMRB) Volume 10 and the Environmental Protection Agency (EPA) Landfill Manual – Landfill Restoration and Aftercare guidance document, produced in 1999.

This document has been prepared in support of a planning application and industrial emissions licence for the remediation and operational (end-use) phases, outlined as follows:

- *Development / Remediation* – The works required to re-profile the site including excavation of waste and other materials for deposition on site to achieve the proposed final landform. The works will also include the installation of landfill infrastructure such as capping, landfill gas, leachate and surface water management. A second stage of remediation will comprise the works required to restore the site to the proposed park end use, including planting and landscaping, installation of sports pitches, changing rooms, car parks and associated services.
- *Operational / Aftercare* – The life cycle stage of the site following the remediation works when the site will be used for public access parkland and recreation. 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).

The LM is based on the engineering remediation design proposals for the scheme. It includes landscape and environmental mitigation measures put forward as part of the Environmental Impact Statement (EIS).

### 1.3 Functions and Elements

The methodology set out in DMRB uses a system of 'Functions' and 'Elements' to describe the environmental features. The use of this system enables environmental data to be recorded and developed in a consistent manner and linked through all stages of schemes from initial design through to construction requirements and the management action plans.

Environmental Functions would be determined at the future detailed design stage of the project. These functions would include:

- EFA Visual Screening
- EFB Landscape Integration
- EFD Nature Conservation and Biodiversity
- EFE Visual Amenity

The assigned 'Elements' for landscape and environmental features, describe physical attributes or designation in statutory terms. The 'Landscape Elements' are divided into types e.g. woodland, shrubs, or hedgerows.

The specific 'Elements' used in this LM are set out in Section 1.4.

### 1.4 Landscape Elements

#### Grassland

LE1.1 Amenity grassland areas:

Planned for verges and immediate area of sport pitches and changing rooms.

LE1.3 Species-rich grassland:

This includes grass and wildflower species, limited to south facing slopes near the attenuation ponds located to the south-east of the site.

LE1.6 Open grassland:

This is primarily the treatment given to areas that would be allowed to naturalise and form low grassland tussocks.

#### Native Planting

LE2.1 Woodland

LE2.2 Woodland edge

LE2.6 Shrubs

LE2.8 Scrub

#### Hedges

LE 4.4 Native hedgerows with trees

#### Trees

LE 5.1 Individual trees

## Other Landscape Treatments

- LE3.1 Amenity Tree and Shrub Planting
- LE6.1 Water Bodies and Associated Plants
- LE6.3 Reed Beds
- LE6.4 Marsh and Wet Grassland

## 1.5 Existing Features

The existing features and designations within the site vicinity are as follows:

- Record of Protected Structures (Church / ruins located to east of the site): KCC;
- Public Rights of Way: KCC data; and
- Retained vegetation/boundaries: based on the original Phase 1 Habitat Survey and aerial photography.

Reference should be made to the Figures 3.1 and 3.2 for the location and overview of the site area and context.

## 1.6 Proposed Park Design Features

The proposed end use proposals comprise a park which would also incorporate facilities suitable for recreation such as sports pitches, a play area, informal trails and defined viewpoints. It would also provide landscape improvements and an opportunity for ecological enhancements.

These proposals are outlined indicatively on the LM, with an overview list of the components of the park outlined below:

- Vehicular and pedestrian / cycle main entrance, with double gates.
- Semi-ornamental planting to roundabout.
- North-west pedestrian entrance, with security gate.
- Perimeter site fence, 2.2m palisade or high system railing, straight topped, powder coated green, or similar approved.
- Vehicular 6m wide, tarmac access road within the park, with a 2m wide footway.
- Public walkways and informal tracks within the site of varying widths (1.2m-1.8m), constructed of unbound stone. These paths would vary in gradient, with some steps possibly required in steeper sections (to be determined from detailed design and construction).
- Maintenance tracks, 4m in width, constructed of unbound, imported stone.
- One main car park for approximately 100 spaces, with opportunity for additional mobility impaired and coach/mini-bus parking. This would be constructed in tarmac, with the bays formed in Grasscrete or similar approved.
- One overspill car park for approximately 100 spaces, with close access to informal footpaths/cycle paths. This would be constructed in unbound stone, with the bays formed in Grasscrete or similar approved.
- Changing rooms (4no), store room and public toilet facilities.
- Playground area adjacent to the main changing room building.
- 2no multi-use sports pitches, sized to full GAA pitch dimensions, installed with a synthetic or similar approved surface and each lit with 6no x 18m high, hinged masts. This outline specification is based on the suppliers guidance for GAA sports lighting - <http://www.abacuslighting.com/gaelic-sports-lighting.asp>.

- 1no multi-use/ training pitch with a synthetic or similar approved surface, informally marked out as 3no five-a-side pitches, with 6no x 8m high, hinged masts. This outline specification is based on the suppliers guidance for GAA sports lighting - <http://www.abacuslighting.com/gaelic-sports-lighting.asp>.
- Ball-retention fencing (12m high x 30m wide) installed to one end of each pitch, to prevent balls going onto Kerdiffstown Road or into the attenuation ponds. This outline specification is based on GAA guidance provided in the following website, <https://www.nksports.co/find-your-needs/gaelic/>.
- 3no attenuation ponds, enhanced with marginal aquatic species planting and grouped trees.
- Surface water ditches and swales, filled with stone or seeded with wet grassland species.
- Surface water reed bed area, filled with gravel and soil substrate and planted with native reed and marginal aquatic species.
- Native mix woodland, trees, scrub, shrub and hedgerow planting.
- Native or naturalised parkland trees.
- Semi-ornamental amenity tree and shrub planting to the main entrance and roundabout.
- 2no designated wildlife areas, fenced off from public access.
- Ecological enhancement and mitigation features such as hibernacula, nesting boxes and log piles.
- Defined viewpoint areas with a Trig point at the top of the site.
- Outlet to the Morell River, with a stone clad headwall to integrate visually into the bank.

At the detailed design stage, the provision of trim trails would also be considered, which would mark out set trail lengths within the park of 1000m and 2000m with colour coded waymarkers. Future provision of outdoor fitness equipment could be implemented along these trails, along with occasional seating, cycle racks and bin provision.

## 1.7 Environmental Measures: Remediation Stage

A number of environmental mitigation measures would be carried out during the remediation works; these are not shown on the LM as they are temporary works and do not have a residual “physical” form once the construction phase of the works has been completed.

All of the environmental mitigation and proposed enhancement measures are listed within the relevant topic assessments in Volume 2 of the ES.

## 1.8 Environmental Measures: Landscape Planting

Landscape planting is proposed to replace vegetation removed during the construction phase of the remediation works and to provide landscape and visual integration with the local area. The proposed planting would also ensure a suitable level of screening to the proposed Landfill Infrastructure Compound, and the new sports facilities, which includes changing facilities located within the centre of the park. The planting proposals are shown indicatively on the LM, and the design strategy for this planting outlined as follows:

- The existing vegetation removed within the boundary of the site, would be replaced with discrete and linked areas of shrub and scrub planting to give a ‘mottled appearance’, with screen woodland planting alongside the entrance area, and smaller grouped areas of trees and woodland to the southern end of the landfill site alongside the wetland ponds. In addition to this a line of trees would be planted within the earthworks bund, alongside the proposed bio-swale to the northern boundary. Overall this approach to the planting should provide something of the parkland aesthetic to be established and set within the open natural grasslands and managed areas of grassland.
- All proposed planting would be native or naturalised species stock, other than at the main entrance and roundabout areas where semi-ornamental species such as *Amelanchier lamarkii* (Snowy mespilus), *Taxus baccata* (Yew), *Euonymus europaeus* (Spindle), and *Escallonia rubra* ‘Crimson Spire’ planting may be preferred to provide seasonal interest and structure..

- Existing vegetation retained to the perimeter edge of the site to the north-west and south-west of the site, would be infilled with new planting stock if gaps are noted, to provide a continuous cover of screening vegetation.
- Existing retained individual trees within the site perimeter edge outlined above may require arboricultural work following the remediation of the site and a post inspection tree survey would be undertaken to confirm if any action is needed.

The locations of the planting areas will be confirmed based on the extents of the capping areas installed as part of the remediation works, to ensure that the integrity of the underlying capping system is not compromised and that the gas and leachate infrastructure are accessible and free from any root growth. For the species identified additional top soil or soil forming material will require to be imported to the site, to facilitate root growth whilst maintaining the integrity of the capping system. This will be reviewed as part of the detailed design stage.

The composition of grass seeding mixes and planting species would be based on the habitat survey information for the existing site and Irish native tree and shrub listing provided by KCC. Reference should be made to Chapter 12 of the EIA with respect to habitats and flora field survey results and Kildare County Development Plan 2011-2017, Chapter 19, Table 19.2.

Final details for planting and seeding mixes, (including sowing rates and whether hydroseeding is used on steeper slopes), would be confirmed in consultation with the local authority landscape officer to achieve landscape design functions and to enhance local biodiversity.

The outline LM is based on the following proposals:

#### **Seed Mixes:**

##### LE 1.1 Amenity grassland

Low maintenance mix for verges.

##### LE1.2 Species-rich grassland

Dry Neutral and Calcareous (GS2) grasslands are proposed for defined species-rich grassland areas. Refer to Grasslands on Irish Vegetation Classification (IVC) website link: <http://www.biodiversityireland.ie/projects/national-vegetation-database/irish-vegetation-classification/explore/>

##### LE1.6 Open grassland

Low maintenance, tussocky grassland suitable for naturalising.

##### LE6.4 Marsh and Wet Grassland

Grass mix (GS4) suitable for wetland areas and open ditches/swales.

#### **Planting Mixes:**

##### LE2.1 Woodland

A mixed, deciduous woodland is proposed of a composition that matches the local area. This would , incorporate *Quercus robur* (Pendunculate Oak), *Fagus sylvatica* (Beech), *Sorbus aucuparia* (Rowan), *Alnus glutinosa* (Alder), *Betula pendula* (Birch) and understory shrub species.

Woodland would be planted at 2m centres and woodland edge planting would be planted at 1.5m centres.

Bare-root shrub and tree transplants would be used, sizes varying between 40-60cm and 60-80cm, with a small percentage of bare-root feathered trees, (175-200cm stock).

Where screening is a required environmental function, such as alongside the landfill infrastructure compound, a percentage of evergreen stock would be included in the mix. This would be containerised stock, sizes varying between 40-60cm to 60-80cm. Species to include *Taxus baccata* (Yew), *Ligustrum vulgare* (Privet) and *Ilex aquifolium* (Holly).

#### LE2.6 Shrubs and LE2.8 Scrub

Areas of shrub and scrub planting would use species that replicate the existing vegetation cover, such as *Cornus sanguinea* (Dogwood,) *Corylus avellana* (Hazel), *Prunus spinosa* (Blackthorn) and *Crataegus monogyna* (Hawthorn).

Scrub areas would be re-established in suitable locations on the site, with the planting of *Rubus fruticosus* (Bramble), *Sambucus nigra* (Elder) and *Rosa canina* (Dog Rose).

Shrubs and Scrub planting would be planted at 1.0m to 1.5m centres and planted as bareroot transplants (40-60cm and 60-80cm).

#### LE5.1 Individual Trees

The proposed individual trees would be:

20-25cm girth Semi-mature *Quercus robur* (Pedunculate oak) and *Tilia cordata* (Small leaved lime) would enhance the parkland setting along the northern boundary, which would be planted immediately adjacent to the proposed swale. This will compensate for the removal of the existing tree line, required to facilitate the remediation works.

14-16cm girth Extra Heavy Standards, grouped *Amelanchier lamarkii* (Snowy mespilus) planting to the new roundabout, and grouped *Betula pendula*, (Birch) and *Alnus glutinosa* (Alder) alongside the wetland pond area.

Planting centres for individual trees would be determined at the detailed design phase.

#### LE 4.4 Native hedgerows with trees

Perimeter edge infill planting would restore mixed native species where any gaps are identified.

Where a full length of hedgerow (LE4.4) is required this would be predominantly 80% *Crataegus monogyna* (Hawthorn), with holly, elm, and blackthorn also in the mix.

Hedgerow plants would be set out as a double staggered row at 500mm apart, with plants planted at approximately 450mm centres, at 4 plants per linear metre.

Plants would be bare-root transplants (90 to 100cm), with additional hedgerow trees planted as 14-16cm girth extra heavy standards. final number to be confirmed at at detail design.

#### LE 6.1 Water Bodies and Associated Plants

Marginal, emergent and floating aquatic plants would provide amenity and ecological benefits.

The proposed species would include species such as *Lythrum salicaria* (Purple Loosestrife), *Caltha palustris* (Marsh Marigold), *Succisa pratensis* (Devils bit scabious), *Lychnis flos-cuculi* (Ragged-Robin) and *Filipendula ulmaria* (meadowsweet). The plants would be supplied as 9cm Root trainer plants and 150cc cell plants.

### LE 6.3 Reed Bed

Native wetland species appropriate to the location, providing filtration, amenity and ecological benefits.

Reed Bed location determined on basis of reducing earthworks in locally flat area, utilising surface water run-off to create ecological enhancement through use of reeds and marginal planting. Specific details to be determined at detailed design stage, but proposals currently based on use of a widened ditch for drainage water to slowly flow through and over a prepared gravel/soil substrate.

Species mix would include 85% reed species and 15% marginal aquatics planted on a ratio of 4 reeds or plants per square metre. Reeds and marginal planting would be supplied as 9cm plugs or in 1ltr containers.

#### **Plant Specification:**

A specification would be prepared for the proposed mitigation seeding and planting, and would be based on the DMRB, Volume 1, 3000 series guidance and the Environmental Protection Agency (EPA) Landfill Manual – Landfill Restoration and Aftercare guidance document, produced in 1999.

Tree pit sizes would be as provided in Table 30/1, of the DMRB series 3000 specification, unless underlying site constraints require alterations to these dimensions. This would be confirmed at detailed design.

Provisional soil depths to be considered at the detailed design stage are:

- 0-50mm for species rich grassland areas;
- 50mm for Open Grassland areas;
- 75mm for Marsh and Wet Grassland areas;
- 75mm for Verge areas;
- 150mm for sports pitch areas (if not artificial);
- Land drainage for pitch areas (specific to surface design adopted);
- 150/200mm min for scrub/shrub planting areas; and
- 300mm min for woodland planting areas.

All planting stock would include for planting stakes and 600mm height tubular guards or spiral shelters, suitable to protect against rabbit damage. A rabbit proof fence may be considered as an alternative to this for lengths of new hedgerow. It is recorded the mammal proof fencing is to be installed in local areas where badger has been identified.

The planting areas would generally be under-seeded with grass, with the exception of replacement hedgerows and individual trees which would be mulched to a width of 1m and a depth of 50mm.

The setting out of indicative planting areas as detailed on the LM has taken into account the required remediation works, with a further review and assessment required at detailed design stage. A separate assessment of health and safety would be undertaken to ensure the end use site sufficiently complies with ATEX ('Atmosphere Explosible') regulations and also complies with Safety, Health and Welfare and Work (Construction) Regulations 2013 SI 291.

#### **Planting Maintenance:**

A five year maintenance plan is typical for a project like that being promoted. However, as this is overlying a landfill site maintenance requirements will be determined in the IED Licence to be regulated by the EPA, and are therefore likely to remain for the life-cycle of the site. This would be confirmed at detailed design stage.



The maintenance programme would be implemented following completion of the seeding and planting. This would outline all measures necessary to ensure the successful establishment of the mitigation seeding and planting and would include (as a minimum):

- Control of succession and invasive weeds;
- Mowing requirements for grassland areas;
- General and specific requirements for maintaining landscape elements and habitats;
- An annual assessment of plant failures in September (by the contractor) and replacement of all failed stock under the agreement of the supervising agent;
- Watering as required;
- Removal of rabbit shelter guards at Year 5 if planting stock sufficiently established; and
- Monitoring of wetland ponds and control of marginal vegetation.

**Programme:**

The proposed remediation works are anticipated to be undertaken over a 3.5 year period, with end-use development and landscaping taking place thereafter.

Landscape establishment across the site is estimated to take approximately 15 years. A photomontage showing an impression of the site post-completion is provided in Chapter 10 of the EIS.

## **Appendix A4.9 Accident Prevention and Emergency Response Plan**



# **Kerdiffstown Landfill Remediation Project**

Kildare County Council

## **KLRP Management Plan**

### **Accident Prevention and Emergency Response**

32EW5604/DOC/0049 | 0

19 May 2017



## Kerdiffstown Landfill Remediation Project

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# 1. Accident Prevention and Emergency Response Plan

## 1.1 General

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 (IE) Licence for remediation works to commence. Thereafter this Management Plan will be reviewed to ensure that that any related conditions of the IE Licence 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 IE Licence, 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.

It is acknowledged that the end use of the site is a multi-use public park with sports pitches that will be subject to additional emergency response procedures that covers the operation of the park. These operations will be influenced by the remediation works with respect to further monitoring data gathered, as-built details, associated risk assessments and subsequent development of park operational procedures. This Management Plan will be updated based on review of these and similar inputs prior to the commencement of park operations.

## 1.2 Accident Prevention

### 1.2.1 Statement

The following sections set out measures and procedures which are to be in place for the prevention of accidents in the undertaking of remediation works at the site, and, should an accident occur, the minimisation of effects on the environment from accidental emissions and emergency situations which may arise.

Accidents are prevented on site through the implementation of effective site management. This is achieved through the following measures:

- identification of potential sources of risk;
- assessment of the degree of risk from these sources;
- determination of procedures for addressing the risks;
- development of procedures to minimise accident/risks when they occur; and
- on-going monitoring to ensure proper implementation of safe working procedures.

Health and safety on the site is governed by the Kildare County Council (KCC) Safety Statement and a suite of standard operation procedures (SOPs) that currently provide for the safe operation and management of the site on a daily basis.

There are overarching health and safety principles that have been implemented as part of the management of the site to ensure that accidents are prevented.

- All personnel entering the site must undergo a site induction.
- Standard personal protective equipment (to include as a minimum hi-visibility vest or jacket, hard hat, safety glasses, safety boots with steel toe cap and steel midsole, and gloves) is to be worn by all personnel upon entering the site and must be maintained while present on site.
- All personnel working on site must hold an up to date SOLAS Safepass H&S Awareness Training card (or equivalent) and a Construction Skills Certification Scheme card for personnel who operate plant machinery.
- Prior to any work commencing on site all contractors must submit a risk assessment and method statement for the planned works and allow sufficient time for the review and approval of the documentation by KCC.
- Standard work procedures and safe systems of work are to be employed by all contractors.
- Permits to work may be required for certain areas on the site such as within the landfill gas flare compounds and within the ESB switch room/ substation.

### **1.2.2 Hazard Identification**

Many accidents and injuries that are suffered by those who work within the landfill industry are transport related. For site works, these are predominantly associated with workers being struck by a vehicle (road going or earth moving such as mechanical shovels). Slips and trips also form a large proportion of the number of injuries resulting from working in the industry.

The following potential hazards / accidents have been identified as being relevant to the current operation of the site:

- Security
- Accidents on site
- Migration of landfill gas
- Explosion
- Fire
- Flare shutdown
- Stability
- Detection of non-compliant wastes
- Spillages and leaks

An assessment has been carried out to determine the likelihood of occurrence of the different emergency scenarios and the consequences of such an occurrence. For each of the emergencies identified a likelihood category has been assigned and an estimate of the likely consequences made. Action plans have also been included for each of the identified scenarios.

Emergency procedures for outside of normal working hours are detailed as part of this Management Plan.

The remediation phase of the site will comprise commencement of construction works, notably installation of new perimeter security fencing, revised access arrangements, importation of waste soils and movement of materials within the boundary of the site. A competent contractor(s) will be appointed to undertake the works, hence further hazards may be identified from the detailed assessment of those works. This Management Plan will be updated to reflect revision of procedures as appropriate.

## **1.3 Assessment and Action Plans**

### **1.3.1 Security**

#### a) Assessment

The site boundary is predominately secured by means of a palisade fence with security gates provided at the site entrance. An infra-red security beam system is also used around the boundary which alerts the 24 hours security personnel to encroachment within the site boundary.

As part of the remediation works at the site a palisade or similar security fence will be installed around the entire site perimeter. Additional gated locations will also be installed to permit site personnel to access monitoring locations outwith the site boundary. A new site access junction will be constructed, comprising a roundabout which will require relocation of the entrance gates and security hut. A new Landfill Infrastructure Compound will also be constructed adjacent to the site entrance, which will have separated security fence provision around its extents.

Security measures will be maintained to prohibit unauthorised access to the site.

Assessment indicates that there is a medium risk of encroachment to the site, but with activity on site likely to draw attention, this risk will increase. The installation of a new fence supported by the action plan below will reduce this risk to an acceptable level.

#### b) Action Plan

Perimeter fencing and gates should be maintained to prevent unauthorised access as far as practicable. Security fencing will be required for vulnerable locations such as the Landfill Infrastructure Compound.

- Perimeter fencing and gated access to be inspected regularly by a nominated person.
- Perimeter fencing and gates to be maintained in good state of repair at all times.
- Additional security provisions to be considered in design of revised site access arrangements:
  - security cameras;
  - security guard(s);
  - intruder alarms, lighting, shutters and bars on accommodation.
- All incidents of unauthorised access to be reported immediately to the Site Manager.

### **1.3.2 Accidents on Site**

#### a) Assessment

Accidents have the potential to occur on site at any time during the lifecycle of the project but most especially during remediation works. Incidents involving vehicles can be greatly reduced by eliminating or keeping reversing manoeuvres to a minimum and adopting safe procedures including the correct use of warning lights, mirrors and alarms on site vehicles. Furthermore, use of CCTV and radio communication on mechanical plant on landfill sites gives operators good all round vision and the ability to communicate with those working at ground level, and will assist in reducing the number of accidents and injuries that could occur.

Personal protective equipment such as cut resistant and high visibility clothing, face masks, safety goggles and ear muffs also help in this regard alongside thorough risk assessment, provisions for the training of staff in relevant tasks and assessing the competency of all staff for tasks assigned.

The likelihood of an accident on site is low if the relevant site safety procedures are adhered to. For remediation works a competent contractor will be appointed to undertake the works and will be required to prepare appropriate and relevant risk assessments and method statements in compliance with pertinent legislation and guidance. These documents will be reviewed by KCC as Operator of the site.

Safety reviews will be undertaken routinely during the construction works, at least once per month, to involve the contractor and operator (KCC) site personnel.



b) Action Plan

The current standard operating procedures for the site detail the following action plan in the event of all accidents and near misses. These will be utilised to inform the contractor of minimum guidelines to be incorporated in the contractor's documentation.

- All accidents and near misses are to be reported to the Site Manager and the Contractor Supervisor immediately.
- Where the incident requires attendance by emergency services dial 999, state the emergency and give the site location.
- Make the area safe around the scene of the accident and cordon off.
- Qualified First aider to administer aid to the affected person/persons if feasible. First aid boxes are provided on site.
- Where required, the Site Manager will contact site security at the main gate so that the emergency services can be directed to the scene of the accident upon arrival on site.
- The Site Manager will then notify the KCC Health & Safety officer.
- The Site Manager will investigate every incident/near miss through consultation with the relevant parties and collate all the resultant information.
- An incident report form shall be filled out by the Site Manager/Line Manager once all the facts have been gathered and then reported back to the KCC Health & Safety officer.
- Corrective action procedures or mitigation measures shall be implemented by the Site Manager and recorded in the On-Site Accident Book.
- Accidents that result in more than three days absence from work will be reported to the Health and Safety Authority (HSA) in accordance with statutory requirements.

### **1.3.3 Migration of Landfill Gas**

a) Assessment

An Explosion Protection Document (EPD) exists for the current site condition and details considerations with respect to landfill gas. This document will require to be revised and updated as remediation works on site are progressed.

As the site is currently uncapped (other than Zone 3), gas emissions emit through the surface of the waste. As remediation works progress, with the application of a capping system, the risk of landfill gas migration towards uncapped areas of the site and potentially to the site boundary will temporarily increase until the extended landfill gas management system has been fully completed.

A temporary capping liner has been constructed over Zone 3 with gas wells installed to permit active gas abstraction. The cell has been constructed with basal and sidewall liners, hence landfill gas migration potential is low.

b) Action Plan

The following action plan should be followed with respect to landfill gas migration.

- Perimeter gas monitoring boreholes, located beyond the extents of waste, to be installed in advance of remediation works to permit data collection and baseline determination.
- Maintain gas management system at the site to actively extract gas where feasible.
- Monitor perimeter and on site gas boreholes and assess against baseline data for evidence of migration.
- Report any exceedances in compliance with requirements of the site IE Licence.
- Undertake further monitoring and sampling where required.
- Review emergency procedures in relation to proximity to receptors.

### 1.3.4 Explosion

#### a) Assessment

Landfills, both operational and closed, are installations where flammable substances are present and where the degradation of putrescible wastes and leachate generates flammable gases that could accumulate to explosive concentrations. The site has an active landfill gas management system in place to manage gas. This will be augmented during the remediation works with management maintained throughout.

The degradation of waste materials generates a number of gases. Methane (CH<sub>4</sub>) is generated and can represent a fire/explosion hazard. Between the concentrations of 5% and 15% by volume in air methane, is explosive. At other concentrations, the risks are less, although with concentrations higher than 15% mixing can cause concentrations to drop into the explosive range or can asphyxiate if oxygen is depleted.

Hydrogen sulphide (H<sub>2</sub>S) is a possible degradation product and is also a flammable gas. Its lower explosive limit (LEL) in air is approximately 4.5%. There is a very low risk in the landfill environment, since this concentration is very unlikely to be reached.

In order to ignite, the flammable gas must be present in its explosive range and have an ignition source. There is the potential for an explosion in any confined space where gas is present in its explosive range. An explosion could cause burns of varying degrees, and impact damage through the mobilisation of solid objects either of which could cause death.

A further risk of explosion at the site is where explosive materials are discovered within deposited waste. The likelihood of this occurring is low.

#### b) Action Plan

To minimise the risk of explosion, the following measures should be applied:

- No smoking on site (a cigarette can act as an ignition source).
- No naked flames.
- No unearthed or faulty electrical equipment should be used on site.

To mitigate introduction of ignition sources:

- Only ATEX (ATmosphères EXplosives) approved equipment should be used in defined zoned areas. Details of the application of ATEX to the site infrastructure are provided in the EPD.
- All confined environments should be monitored prior to them being entered. Entry should only be allowed if the monitoring indicates that it is safe to do so. All confined spaces should be adequately vented to prevent the accumulation of hazardous gases and the confined space should be placed as far as possible from the areas of placed waste.
- Management of the landfill gas management system should only be undertaken by staff with sufficient knowledge or appropriate supervision or approval, and relevant training should have been provided.
- A system of 'Permit to Work' or similar should be in place and designed such that any planned actions involving a contractor or other party will require permission from the Site Manager prior to the works being undertaken. Care must be taken whilst working adjacent to the gas extraction system to ensure that no damage occurs.

In the event of an explosion the action taken by installation personnel would be the same as that taken in the event of fire.

In the event that explosive materials are discovered within the waste or in a skip, the following action would be taken:

- Evacuate the area and keep clear;
- Dial 999 and state the nature of the emergency;
- Follow all instructions given; and
- Contact Site Manager immediately.

### 1.3.5 Fire

#### a) Assessment

##### Landfill

Fire is an ever-present hazard at landfill sites when the combination of heat, oxygen and fuel reach a critical level. The work practices outlined below are designed to prevent these elements from forming an uncontrolled outbreak. The procedures in place are designed to guard against an outbreak of fire and to ensure, so far as is reasonably practicable, the safety of the persons at the site in the event of an outbreak of fire.

There are two primary causes of landfill fires: vandalism and poor landfill gas management. Maintaining site security as detailed in this Management Plan reduces the opportunity for vandalism. As the usage of the site changes during the remediation phase and, most notably, the aftercare phase whereby operation of the park will commence, this Management Plan and associated risk assessments will require to be updated. Active landfill gas management is undertaken on Zones 1 and 3 at the site. These arrangements will continue and will be augmented during the remediation phase. The system is operated by trained personnel only and maintained by a competent contractor.

The following measures have been initiated at the site to minimise the risk of fires:

- Site security to prevent unauthorised access;
- Capping of areas where feasible (Zone 3);
- Prevention of air ingress in to the waste and gas extraction and collection systems (Zone 3).
- Soil stockpiled on site is available for firefighting purposes.
- Construction equipment is required to be fitted with vertical exhaust and spark arrestors.
- Monitoring of landfill gas management system is maintained to ensure appropriate balancing of the field. Refer also to Landfill Gas Management Plan and Monitoring and Control Management Plan.
- Motors utilised in waste excavation areas or ATEX defined zone areas will be explosion proof.
- Start-up and shutdown of equipment should not be done in areas of exposed waste or ATEX defined zones.
- Only ATEX zone compatible equipment should be used within defined zones (unless the equipment has been shown to be safe to use through risk assessment).

The EPD includes the following actions to mitigate the risk of fires at the site:

- Classify the site as 'Non-Smoking' except for a specially designated area and erect suitable signs to inform employees, contractors and visitors to that effect;
- Ensure employees, contractors and, where applicable, visitors wear suitable anti-static clothing, including footwear, conforming to EN347, when operating in zoned hazardous areas in order to reduce the risk of electrostatic discharges;
- Zoning signs have been erected as recommended in the EPD, with a record of the zoning locations available on site at all times for reference purposes;
- The leachate holding tanks and drainage system inspection chambers have been designated as confined spaces as defined in the Safety Health and Welfare at Work (Confined Spaces) Regulations 2001 and warning signs fixed accordingly.
- Safe systems of work are in place for entry into any of the spaces and work carried out within them. This includes measures for adequate ventilation during access by personnel;
- Implementation of a Permit to Work system;

##### Site Office

Fire Prevention Measures:

- Waste materials shall not be allowed to accumulate; such materials shall be removed from offices areas, at regular intervals, and stored in suitable designated areas, pending disposal (off site).

- Flammable liquids, gases and other potentially dangerous substances shall be limited to small quantities, handled with extreme care, and stored in labelled suitable containers in designated suitable storage areas.
- Smoking is prohibited throughout the site, in all indoor work areas and fire risk areas apart from designated smoking area(s).
- Electrical and gas appliances and associated fittings shall be checked on a regular basis and defects remedied as soon as possible. Defective items should be rendered safe until repairs are carried out.
- Where installed, cookers, extractor fans, filters, air ducts and machinery shall be regularly cleared of oil, grease and dust. A competent person shall perform servicing regularly.
- Portable gas and liquid fuel heaters shall not be used on the premises at any time.
- Building and plant maintenance involving the use of equipment such as oxy-acetylene cylinders, welding equipment, liquefied gas appliances and flammable liquid containers must be subject to a hot work permit and shall be restricted to those periods when the premises is not occupied in so far as this is practicable.
- Extinguishers are strategically placed throughout the facility at the main site offices, at the security huts and in the site vehicle(s). A competent person employed by KCC shall test all firefighting equipment each year. The date and results of each inspection will be recorded and filed by the Site Manager.
- Fire instruction notices are displayed in suitable locations on the premises. All exits are clearly marked.
- All entrances, exits and will be kept clear at all times. Equipment or goods will not be stored in such a way as to impede traffic.
- Training in the theory and practical use of fire extinguishers has been given to project staff. All new site based project staff will be trained within one year of starting at the site.

Emergency procedures associated with fires at the site are detailed in Section 1.4.

The risk of fire at the site is low given the controls as detailed above, supported by current SOPs and the Landfill Gas Management Plan.

#### b) Action Plan

In the event of fire being discovered the following action plan should be followed.

- Any fire discovered must be reported to the Fire Brigade by dialling 999 and subsequently the Site Manager or deputy without delay.
- In most cases the decision to evacuate will be made by the Site Manager or their deputy.
- The evacuation procedure will be implemented by a call over site radios.
- Notify all other persons within the vicinity of the situation and leave the site offices/area.
- Upon hearing an alarm all persons will move to the designated assembly point for the site.
- Upon reaching the assembly point all persons will remain in the area until accounted for by a designated person by means of a roll call or similar.
- Do not return to the offices or facility until informed that it is safe to do so by a designated member of project staff or a member of the Fire Brigade.
- Assembly Point for Facility – Main gate

### 1.3.6 Flare Shutdown

#### a) Assessment

A flare (termed the '250 flare') currently operates 24 hours per day, 7 days per week. However, occasionally flare shutdown may occur as a result of poor landfill gas quality, mechanical failure and/ or inclement weather conditions. This may result in odour nuisance to neighbouring receptors or an increase in fire risk due to build-up of landfill gas and possible ingress of oxygen to the gas fields.

The gas field will be extended during the remediation phase with a new gas flare (and back-up) installed to the Landfill Infrastructure Compound at the site. Measures for the operation of the flare will be reassessed on confirmation of plant details and this Management Plan will be updated accordingly.

b) Action Plan

In all cases of flare shut down the following action plan will be followed.

- In the event of a flare shutdown for any reason a text and email alert will be sent to KCC (nominated representatives) and Security Personnel in case of out of hours shut down (text sent mobile phone held in the security hut at the site's main gate). Site Security on receipt of a text message stating that a flare has shut down should contact the Site Manager immediately.
- In the event of a flare shutdown KCC will make an assessment to either restart the flare remotely or make a decision to allow the flare to restart automatically at 07:00am. This decision will be based on prevailing conditions at the time such as gas quality prior to the shutdown, weather conditions or other faults evident from the information system for the flare.

### **1.3.7 Stability**

a) Assessment

A major slope failure could be caused by instability of the substrata, being waste. Ongoing geotechnical assessment of site has indicated that the risk of a large scale slope failure ranges from medium to medium/high along external slopes due to infilled gradients and low-to-high in various internal areas of the site. Inspection of slopes is ongoing at the site.

Topographical surveys are undertaken on an annual basis to assess settlement, and check for areas indicative of stability issues.

Remediation phase works include the re-profiling of current over-steep slopes, to lesser gradients as determined from stability assessments for the waste mass and capping system. During detailed design these assessments will be updated and this Management Plan adjusted accordingly. Similarly procedures for the ongoing assessment of settlement and stability are detailed in the Monitoring and Control Management Plan.

b) Action Plan

In the event of major slope failure the following steps should be undertaken:

- Site management to be made aware of any slope failures immediately.
- All personnel present on site should be notified and a roll call should be completed on site at the designated assembly point for the facility, the Main Gate. If a person is missing, the emergency services should be notified immediately.
- Area should be suitable cordoned off to prevent pedestrian and vehicular access in case of further slope failures.
- If the slope failure is associated with leachate breakout further actions may be required to contain the liquid as outlined in Section 1.3.9.

### **1.3.8 Non-Compliant Wastes**

a) Assessment

The Site was previously licensed to accept non-hazardous and inert wastes hence there is a low risk of other, non-compliant waste materials being present. However, the remediation works could encounter non-compliant wastes during slope regrading and stockpile excavation.

b) Action Plan

Should inspections undertaken during waste operations by the contractor determine that waste is suspected to be non-compliant with the original waste acceptance criteria the contractor shall undertake the following actions:

- Quarantine that waste by constructing a perimeter bund and placement of a tarpaulin or other suitable cover over the waste until such time as testing is undertaken and waste classification confirmed. A quarantine area will be defined for use by the contractor in the eventuality of non-compliant waste being encountered.
- Stop works in immediate area.
- Notify KCC without delay regarding any suspected non-compliant wastes that have been detected.
- Ensure appropriate PPE is worn before re-entering the area;
- Ensure a personal gas monitor is worn at all times when working in the vicinity of suspected hazardous wastes;
- Following agreement by inspection by KCC waste acceptance criteria testing to be undertaken with results made available to KCC. Take photographs and representative samples for further analysis as per EPA guidance;
- Do not re-enter the area or recommence works until it has been established if the material is hazardous or non-hazardous;
- The Contractor shall note that certain wastes may not fall within the criteria of a hazardous waste under the Waste Management Act 1996. However, they may fall into the category of being a “difficult waste” for the reason that their properties require special arrangements for disposal to landfill. This typically means that such wastes cannot be placed with other materials on the working face and compacted alongside other wastes. An example of difficult waste is light materials such as polystyrene and dusty wastes. Liquid wastes may arise which can be disposed of to landfill, provided that the quantities deposited are small and that they are of a low hazard. Examples of low hazard liquids include cement bearing liquids from concrete production facilities. On detection and agreement with KCC, difficult wastes should be placed in front of the working face and not over the working area and immediately covered with other waste.
- Any noxious material should not be located within one metre of the surface or two metres from the flanks or face.
- Dusty waste may need to be delivered in sealed bags. Alternatively, this waste should be sprayed with water.
- If the material is classified as hazardous contact an appropriate hazardous waste specialist to seek advice regarding removal from site and subsequent treatment/disposal at a licenced facility;
- Once an approved contractor has been appointed excavate and transfer the hazardous material into covered skips/sealed containers for subsequent transportation to a licenced facility;
- Ensure all documentation is in place prior to handling/ moving hazardous waste i.e. waste transfer from, waste permits, waste licences and that specialist contractors with experience of handling/ moving hazardous wastes are used throughout.

### **1.3.9 Spillages and Leakages**

a) Assessment

Currently spillages and leakages can occur during loading of leachate from the temporary storage tankers located at the top of the south bank of the lined cell (Zone 3). During the remediation phase of works where there are construction activities being undertaken spillages and leakages may occur during the refuelling of vehicles, fuel deliveries, vehicle servicing, vehicle breakdowns, accidents and/ or damage to tanks and bunds.

In order to prevent spillages and leaks of potentially polluting materials and minimise the impact of any spillages that do occur the following measures will be implemented on site.

The management of leachate is currently governed by the Standard Operating Procedure 01 Leachate Management. This procedure sets out the following elements in relation to potential spillages of leachate.

- The leachate tankers are positioned on a concrete containment area with a sump located in the centre of the concrete slab.
- Any spillages of leachate from the tankers flows into the sump which redirects the leachate back into the lined cell through a connecting pipeline.
- The leachate tankers are positioned and levelled in such a way that in the case of an overflow situation any leachate that escapes from the top of the tankers flows onto the concrete containment area and into the sump.
- Two concrete blocks have been installed at the back of the tankers to act as a safety blocks to prevent the articulated tanker from driving off with the pipe work connected and damaging the leachate storage tanks.
- A level sensor float switch has been installed in each of the storage tanks which knocks off the leachate pump once a high level mark is reached.
- If leachate reaches a high level within the sump a red indicator light is switched on at the control panel indicating that immediate tankering is required in this instance.

Remediation works include provision for a new Landfill Infrastructure Compound. A new leachate management system will be installed, to include automated security provisions and alarms, to be developed during the detailed design stage.

General provisions for assessment of spillages and leakages are set out below.

- **Unloading Procedure**  
All polluting materials delivered to site will be unloaded by suitably qualified employees from the delivery company and overseen by a designated site operative or equivalent.
- **Storage Vessels**  
All potentially polluting materials shall be stored within tanks constructed to the appropriate standard.
- **Bunding**  
All storage tanks will be located within an area bunded to contain 110% of the volume of the largest vessel contained within the bund, or 25% of the aggregated total capacity, whichever is the greater.
- **Inspection**  
All bunded tanks will be inspected at regular intervals by the Site Manager or designated deputy to ensure the continued integrity of the tanks and identify the requirement for any remedial action.  
Any minor spillages or rainwater that has accumulated within the bund will be removed at regular intervals to ensure the capacity of the bund is maintained.
- **Absorbent Materials**  
A supply of materials suitable for absorbing and containing any minor spillage will be maintained at the site.  
Suitable materials include the following:
  - Sand and earth;
  - Proprietary absorbents; and
  - Sealants
- **Spill Containment Equipment**  
Materials suitable for containing spills including sealing devices and substances for damaged containers, drain seals and booms will be maintained at the site.
- **Monitoring Techniques**  
All installation personnel will be tasked with monitoring for evidence of spillage and leakage, during their day to day routine. The condition of bunds and tanks will also be inspected on a daily basis.

Any evidence of spillage or leakage will be reported to the Site Manager or his deputy for appropriate remedial action.

b) Action Plan

In the event of spillage of polluting materials, immediate action will be taken to contain the spillage. The spillage will be reported to the Site Manager who will assess the situation and decide on the most appropriate course of action. The action taken will depend upon the size of the spillage, the location of the spillage in relation to sensitive receptors and the nature of the spilled material.

Actions will include some or all of the following:

- Stop work causing spillage immediately, if it safe to do so.
- Identify the source of the spill and rectify the problem, if possible (e.g. turn off valves or taps, or patch a hole).
- Notify the Site Manager immediately.
- The Site Manager will complete a Non-conformance and Accident / Incident Report Form.
- If it safe to do so the cause of the spill or leak will be isolated and / or moved to a bunded area.
- If spilled material is flammable extinguish all possible sources of ignition.
- Ensure the appropriate PPE is worn at all times while cleaning up a spill.
- If the spillage is small spill granules will be used immediately to prevent the spill spreading. The area will be cleared and all contaminated material will be sent to an appropriately licensed site for disposal.
- If the spill is larger inert materials such as clay or sand will be used to make a containment bund and specialist help will be sought to assist in clean up.
- Spillages are not to be hosed to a drainage system.
- If any spillage enters a flowing watercourse EPA will be contacted immediately and appropriate action will be taken to contain the spill by using for example oil absorbent booms.
- If the spillage cannot be contained using approved materials EPA and Senior Management will be contacted immediately and specialist help obtained.
- If a vehicle is found to be leaking it should be moved to a position where the spillage can be contained, i.e. a quarantine area or other hard surfaced area if it is safe to do so.
- Ensure clothes/overall/gloves are disposed of in an appropriate manner and good hygiene practices are maintained at all times. Wash hands immediately after area has been cleaned up.
- All personnel will follow instructions provided by the Site Manager or other competent person.

## **1.4 Emergency Response**

### **1.4.1 Emergency situations outside of normal working hours**

During operational periods i.e. 09:00 – 17:00, Monday to Friday, the Site Manager has responsibility for the operation and maintenance of the facility.

During non-operational periods i.e. before 09:00 and after 17:00 Monday to Friday, weekends and during holiday periods no Site Manager will be present, however, security retain a full time presence on site with responsibility for reporting of any issues that are outside of the normal working hours of the site. A copy of this Management Plan will be made available to security personnel.

Representatives from KCC may also visit site during out of office hours/over weekends to ensure that control systems are operating to specified conditions and that the site is maintained in a compliant and environmentally safe manner.



### **1.4.2 Fire Incident**

Fire evacuation practice drills will be held annually and the Site Manager shall maintain records. Circumstances may arise where it is considered necessary to evacuate the facility. The most likely reason is a serious outbreak of fire. The following procedures should be followed in the event of a fire incident:

- In the event of a visible fire contact the Fire Brigade immediately (999) and inform the Site Manager as soon as possible.
- Notify all other personnel present on site and instruct everyone to go to the designated Assembly Point 1 for the site being the car parking opposite the Site Offices.
- If Assembly Area 1 is not accessible then all personnel will be directed to Assembly Area 2 located outside the main gate.
- All personnel should remain in the assembly area until all have been accounted for by means of a roll call using the sign in log sheet.
- Do not return to work/site offices until informed by the fire services or Site Manager that it is safe to do so.

### **1.4.3 First Aid**

First aid boxes are currently provided at the following locations:

- Site Offices
- Security office – Main Gate
- Security office – Zone 1

All employees are to be made aware of the location of first aid boxes in the Site Induction.

KCC first aiders on site are James Mulligan (Project Manager) and Enda Hoey (Site Manager).

## **1.5 Work Instructions**

### **Duty of the Site Manager**

- Ensure that Emergency Procedures are maintained and updated as necessary;
- Ensure that all site personnel are aware of the location and contents of the Emergency Procedures;
- Ensure inspections are undertaken of the infrastructure as set out in this Management Plan;
- Ensure that all equipment such as fire extinguishers and first aid boxes are maintained in working order/ with stocked supplies as appropriate;
- In the event of any accident, discharge or spillage that may be harmful or polluting, provide written details to EPA. Where appropriate notify EPA verbally as soon after the incident as practicably possible;
- Maintain all training records;
- Maintain all safety related records, including inspections, site inductions, current versions of SOPs/ Management Plans, risk assessments and method statements, incidents reports and records of Management Plan revisions.

### **Duty of Site Personnel**

- Ensure awareness of the location and contents of the Emergency Procedures;
- In the event of any accident, discharge or spillage that may be harmful or polluting contact the Site Manager immediately;
- In the event of any accident, discharge or spillage that may be harmful or polluting take immediate action to terminate any discharge or contain the discharge from further polluting effects;

Where it is considered safe to do so smother or contain any fire on the operational face.

## **Appendix A4.10 Monitoring and Control Plan**



# **Kerdiffstown Landfill Remediation Project**

Kildare County Council

## **KLRP Management Plan**

### **Monitoring and Control**

32EW5604/DOC/0050 | 1

11 August 2017



## **Kerdiffstown Landfill Remediation Project**

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### **Document history and status**

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0	14 July 2017	First Draft for KCC Review	UD	CD	RR
1	11 August 2017	IEAL Submission	CD	UD	RR



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**Appendix A. Monitoring and Sampling Locations Tabular Data**

**Appendix B. Drawings**

**Drawings**

<b>Drawing Number</b>	<b>Revision</b>	<b>Title</b>
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 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 public 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, 2<sup>nd</sup> 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
<i>Off-waste, down hydraulic gradient</i>				
<u>BB02</u>	✓		✓	✓
DB02	✓		✓	✓
DB03	✓		✓	✓
EMW02		✓		
<u>EMW03</u>	✓		✓	✓
<u>EMW04</u>		✓		
EMW05	✓		✓	✓
EMW07		✓		
<u>EMW18</u>		✓		
<u>EMW19</u>	✓		✓	✓
EMW20	✓		✓	✓



Location:	Frequency:			
	Monthly	Quarterly		Annually
Analysis:	Suite G 1	Suite G 1	Suite G 2	Suite G 3
EMW22		✓		
EMW23		✓		
EMW24		✓		
EMW31		✓		
EMW33		✓		
<i>Off-site, up-hydraulic gradient</i>				
EMW27	✓		✓	✓
EMW29	✓		✓	✓
EMW30	✓		✓	✓
<i>On-site</i>				
<u>BH2</u>		✓		
<u>BH6</u>		✓		
<u>BH7</u>		✓		
<u>BH26</u>		✓		
<u>BH42</u>		✓		
BH68	✓		✓	✓
EMW11	✓		✓	✓
EMW13	✓		✓	✓
<u>EMW15</u>	✓		✓	✓
<u>EMW16</u>	✓		✓	✓
<u>GW1D</u>		✓		
<u>GW2S</u>		✓		
<u>EMW14</u>		✓		
<u>EMW17</u>		✓		
<u>BH36B</u>		✓		
<i>Groundwater Levels only (monthly)</i>				
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
<b>Field Measurements</b>			
Water Levels, pH, Dissolved Oxygen, Electrical Conductivity, Redox (Eh), Temperature	✓	✓	✓
<b>Laboratory Analysis</b>			
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
<b>Monthly</b>	<b>Field Measurements:</b> pH, Dissolved Oxygen, Electrical Conductivity, Temperature <b>Laboratory Analysis:</b> BOD, COD, Ammoniacal Nitrogen, Chloride, Total Oxidised Nitrogen, Suspended Solids*
<b>Quarterly</b>	<b>As Monthly plus:</b> Arsenic, Calcium, Iron, Manganese, Potassium, Sodium <b>Laboratory Analysis:</b> Total Alkalinity, Sulphate, Total Cyanide
<b>Annually</b>	<b>As Quarterly plus:</b> <b>Laboratory Analysis:</b> 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 <b>**Biological assessment:</b> 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 <sub>4</sub> , CO <sub>2</sub> , O <sub>2</sub> , N <sub>2</sub> , gas balance, H <sub>2</sub> S, 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 <sub>4</sub> , CO <sub>2</sub> , O <sub>2</sub> , N <sub>2</sub> , gas balance, H <sub>2</sub> S, CO, Flow, Relative pressure
Perimeter	Perimeter boreholes	Weekly	CH <sub>4</sub> , CO <sub>2</sub> , O <sub>2</sub> , N <sub>2</sub> , gas balance, Flow, Relative pressure, Atmospheric pressure
Flare	Inlet	Automated continuous monitoring	Temperature, CH <sub>4</sub> , CO <sub>2</sub> , O <sub>2</sub> , gas flow rate
	Inlet	Manual monitoring (monthly)	Inlet pressure CH <sub>4</sub> , CO <sub>2</sub> , O <sub>2</sub> , N <sub>2</sub> , gas balance, H <sub>2</sub> S, CO
	Output	Annually	Emissions monitoring to include: NO <sub>x</sub> , 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 <sub>4</sub> , CO <sub>2</sub> , H <sub>2</sub> S and CO (to be confirmed via risk assessment).
Surface emissions*	Zones 1, 2A, 2B & 3	Annually	VOC and CH <sub>4</sub> 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 <sub>4</sub>	1% v/v
CO <sub>2</sub>	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 <sup>3</sup> )*
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<sub>2</sub>.

#### 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	<ul style="list-style-type: none"> <li>• Report incident to Site Manager.</li> <li>• Refer to Landfill Gas Management Plan</li> </ul>
Landfill gas detected in buildings above trigger levels (1% methane v/v and 1.5% v/v carbon dioxide)	<ul style="list-style-type: none"> <li>• Affected areas should be evacuated and Emergency services notified</li> <li>• Report incident to Site Manager</li> <li>• Monitoring should be undertaken to identify the point of gas ingress and control measures should be implemented to prevent further ingress.</li> </ul>
Capping compromised (gas emissions detected during FID survey, air ingress or gas escape noted, settlement, or erosion issues etc.)	<ul style="list-style-type: none"> <li>• Report incident to Site Manager.</li> <li>• Refer to Landfill Gas Management Plan for further instructions.</li> </ul>
Landfill fire detected (trigger 100ppm CO)	<ul style="list-style-type: none"> <li>• Report incident to Site Manager and emergency services if appropriate.</li> <li>• Refer to Landfill Gas Management Plan for further instructions.</li> </ul>
Flare Emission Standards exceeded	<ul style="list-style-type: none"> <li>• Report incident to Site Manager</li> <li>• Ensure gas wells have been re-balanced.</li> <li>• Ensure Flare maintenance has been completed and call service engineer if fault identified.</li> <li>• If the above does not resolve the issue hen further specialist assistance to be sought to recommend further actions.</li> </ul>

#### 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	Weekly	Leachate level
	LMW2	Monthly	Suite L1
	LMW3		Suite L2
	LMW4	Quarterly	Suite L2
	LR1 LR2	Annually	Suite L3
Leachate Discharge Points	LT1*	Monthly	Suite L1
		Quarterly	Suite L2
		Annually	Suite L3
	SE2	Daily	Flow, Methane <sup>+</sup>
		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 <sup>3</sup>
	Hourly (max)	6 m <sup>3</sup>
pH	6 - 8.5	
Temperature	<30°C	
	<b>Concentration mg/l</b>	<b>Load kg/d</b>
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 workforce 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<sup>3</sup>/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 <sub>A,r,T</sub> (07:00 to 19:00 hrs)	Evening Noise Criterion dB L <sub>A,r,T</sub> (19:00 to 23:00 hrs)	Night-time Noise Criterion dB L <sub>A,r,T</sub> (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, Baldonnell – 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 <sup>2</sup> /day)	Four times a year <sup>Note 2</sup>	Standard Method <sup>Note 1</sup>
PM <sub>10</sub> (mg/m <sup>2</sup> /day)	Annually	See <sup>Note 3</sup>

**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<sub>10</sub>) 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
<b>Gas Monitoring Boreholes</b>						
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.
<b>Gas Extraction Wells</b>						
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.

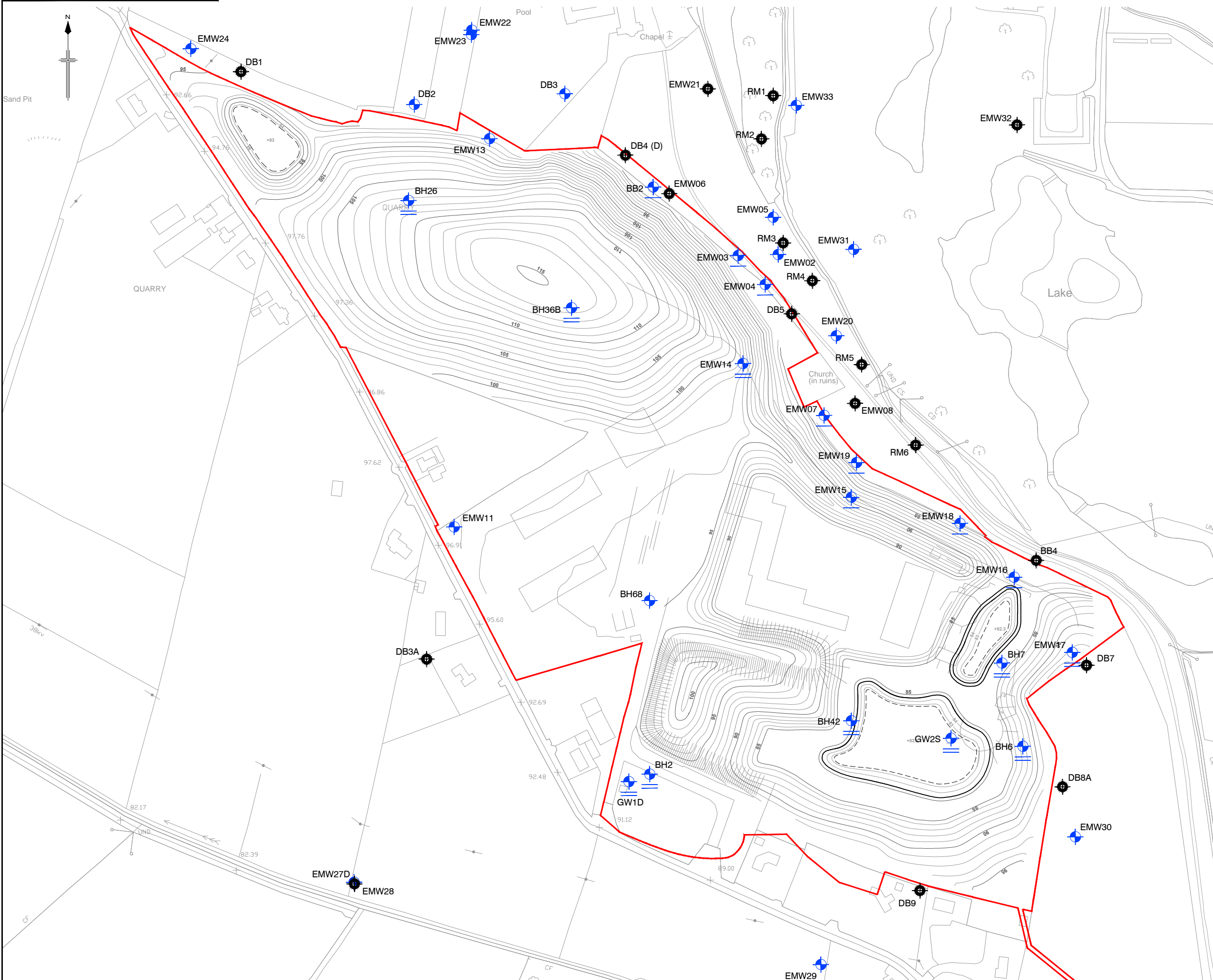
## Appendix B. Drawings











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- 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.

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

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Project  
**KERRIFFSTOWN 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	<b>32EW5604-00-057</b>	Rev	<b>1</b>
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This drawing is not to be used in whole or part other than for the intended purpose and project as defined on this drawing. Refer to the contract for full terms and conditions.

I:\dub\1-000\1\Sustainable Solutions\Kerdiffstown Landfill\5 - Drawings\CAD\Engineering Design - EIS\32EW5604-00-057-1.dwg - 11/08/2017 11:19:07 - A3Frame - aliberts



## **Appendix A4.10 Monitoring and Control Plan**



# **Kerdiffstown Landfill Remediation Project**

Kildare County Council

## **KLRP Management Plan**

### **Monitoring and Control**

32EW5604/DOC/0050 | 1

11 August 2017



## Kerdiffstown Landfill Remediation Project

Project No: 32EW5604  
Document Title: Monitoring and Control  
Document No.: 32EW5604/DOC/0050  
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Client Name: Kildare County Council  
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### Document history and status

Revision	Date	Description	By	Review	Approved
0	14 July 2017	First Draft for KCC Review	UD	CD	RR
1	11 August 2017	IEAL Submission	CD	UD	RR



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### Appendix A. Monitoring and Sampling Locations Tabular Data

### Appendix B. Drawings

#### 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 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 public 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 determinands found during routine monitoring;
- Changes in control systems;
- Changes in the site environs (e.g. progressive remediation);
- Guidance given in EPA Landfill Monitoring Manual, 2<sup>nd</sup> 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 GW1	Suite GW1	Suite GW2	Suite GW3
<i>Off-waste, down hydraulic gradient</i>				
<u>BB02</u>	✓		✓	✓
DB02	✓		✓	✓
DB03	✓		✓	✓
EMW02		✓		
<u>EMW03</u>	✓		✓	✓
<u>EMW04</u>		✓		
EMW05	✓		✓	✓
EMW07		✓		
<u>EMW18</u>		✓		
<u>EMW19</u>	✓		✓	✓
EMW20	✓		✓	✓

Location:	Frequency:			
	Monthly	Quarterly		Annually
Analysis:	Suite GW1	Suite GW1	Suite GW2	Suite GW3
EMW22		✓		
EMW23		✓		
EMW24		✓		
EMW31		✓		
EMW33		✓		
<i>Off-site, up-hydraulic gradient</i>				
EMW27	✓		✓	✓
EMW29	✓		✓	✓
EMW30	✓		✓	✓
<i>On-site</i>				
<u>BH2</u>		✓		
<u>BH6</u>		✓		
<u>BH7</u>		✓		
<u>BH26</u>		✓		
<u>BH42</u>		✓		
BH68	✓		✓	✓
EMW11	✓		✓	✓
EMW13	✓		✓	✓
<u>EMW15</u>	✓		✓	✓
<u>EMW16</u>	✓		✓	✓
<u>GW1D</u>		✓		
<u>GW2S</u>		✓		
<u>EMW14</u>		✓		
<u>EMW17</u>		✓		
<u>BH36B</u>		✓		
<i>Groundwater Levels only (monthly)</i>				
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**

Determinand	Suite GW1	Suite GW2	Suite GW3
<b>Field Measurements</b>			
Water Levels, pH, Dissolved Oxygen, Electrical Conductivity, Redox (Eh), Temperature	✓	✓	✓
<b>Laboratory Analysis</b>			
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			✓

Determinand	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 determinands will be modified and adjusted as appropriate.

If stable conditions are present, the frequency and / or number of determinands 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 determinands 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 Determinands**

Frequency	Determinands
<b>Monthly</b>	<b>Field Measurements:</b> pH, Dissolved Oxygen, Electrical Conductivity, Temperature <b>Laboratory Analysis:</b> BOD, COD, Ammoniacal Nitrogen, Chloride, Total Oxidised Nitrogen, Suspended Solids*
<b>Quarterly</b>	<b>As Monthly plus:</b> Arsenic, Calcium, Iron, Manganese, Potassium, Sodium <b>Laboratory Analysis:</b> Total Alkalinity, Sulphate, Total Cyanide
<b>Annually</b>	<b>As Quarterly plus:</b> <b>Laboratory Analysis:</b> 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 <b>**Biological assessment:</b> 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 determinands 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 determinands detailed in Table 1.5.

**Table 1.5: Landfill Gas Monitoring Locations, Frequency and Determinands**

Monitoring	Location	Frequency	Determinands
In-waste monitoring and gas field balancing	Landfill gas wells/manifolds (Zones 1 & 3)	Monthly	CH <sub>4</sub> , CO <sub>2</sub> , O <sub>2</sub> , N <sub>2</sub> , gas balance, H <sub>2</sub> S, 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 <sub>4</sub> , CO <sub>2</sub> , O <sub>2</sub> , N <sub>2</sub> , gas balance, H <sub>2</sub> S, CO, Flow, Relative pressure
Perimeter	Perimeter boreholes	Weekly	CH <sub>4</sub> , CO <sub>2</sub> , O <sub>2</sub> , N <sub>2</sub> , gas balance, Flow, Relative pressure, Atmospheric pressure
Flare	Inlet	Automated continuous monitoring	Temperature, CH <sub>4</sub> , CO <sub>2</sub> , O <sub>2</sub> , gas flow rate
	Inlet	Manual monitoring (monthly)	Inlet pressure CH <sub>4</sub> , CO <sub>2</sub> , O <sub>2</sub> , N <sub>2</sub> , gas balance, H <sub>2</sub> S, CO
	Output	Annually	Emissions monitoring to include: NO <sub>x</sub> , 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 <sub>4</sub> , CO <sub>2</sub> , H <sub>2</sub> S and CO (to be confirmed via risk assessment).
Surface emissions*	Zones 1, 2A, 2B & 3	Annually	VOC and CH <sub>4</sub> 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 <sub>4</sub>	1% v/v
CO <sub>2</sub>	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 <sup>3</sup> )*
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<sub>2</sub>.

#### 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	<ul style="list-style-type: none"> <li>• Report incident to Site Manager.</li> <li>• Refer to Landfill Gas Management Plan</li> </ul>
Landfill gas detected in buildings above trigger levels (1% methane v/v and 1.5% v/v carbon dioxide)	<ul style="list-style-type: none"> <li>• Affected areas should be evacuated and Emergency services notified</li> <li>• Report incident to Site Manager</li> <li>• Monitoring should be undertaken to identify the point of gas ingress and control measures should be implemented to prevent further ingress.</li> </ul>
Capping compromised (gas emissions detected during FID survey, air ingress or gas escape noted, settlement, or erosion issues etc.)	<ul style="list-style-type: none"> <li>• Report incident to Site Manager.</li> <li>• Refer to Landfill Gas Management Plan for further instructions.</li> </ul>
Landfill fire detected (trigger 100ppm CO)	<ul style="list-style-type: none"> <li>• Report incident to Site Manager and emergency services if appropriate.</li> <li>• Refer to Landfill Gas Management Plan for further instructions.</li> </ul>
Flare Emission Standards exceeded	<ul style="list-style-type: none"> <li>• Report incident to Site Manager</li> <li>• Ensure gas wells have been re-balanced.</li> <li>• Ensure Flare maintenance has been completed and call service engineer if fault identified.</li> <li>• If the above does not resolve the issue hen further specialist assistance to be sought to recommend further actions.</li> </ul>

#### 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	Weekly	Leachate level
	LMW2	Monthly	Suite L1
	LMW3		Suite L2
	LMW4	Quarterly	Suite L2
	LR1 LR2	Annually	Suite L3
Leachate Discharge Points	LT1*	Monthly	Suite L1
		Quarterly	Suite L2
		Annually	Suite L3
	SE2	Daily	Flow, Methane <sup>+</sup>
		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**

Determinand	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 determinands 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 determinands 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**

Determinands	Limit	
Flow	Daily (max)	60 m <sup>3</sup>
	Hourly (max)	6 m <sup>3</sup>
pH	6 - 8.5	
Temperature	<30°C	
	<b>Concentration mg/l</b>	<b>Load kg/d</b>
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

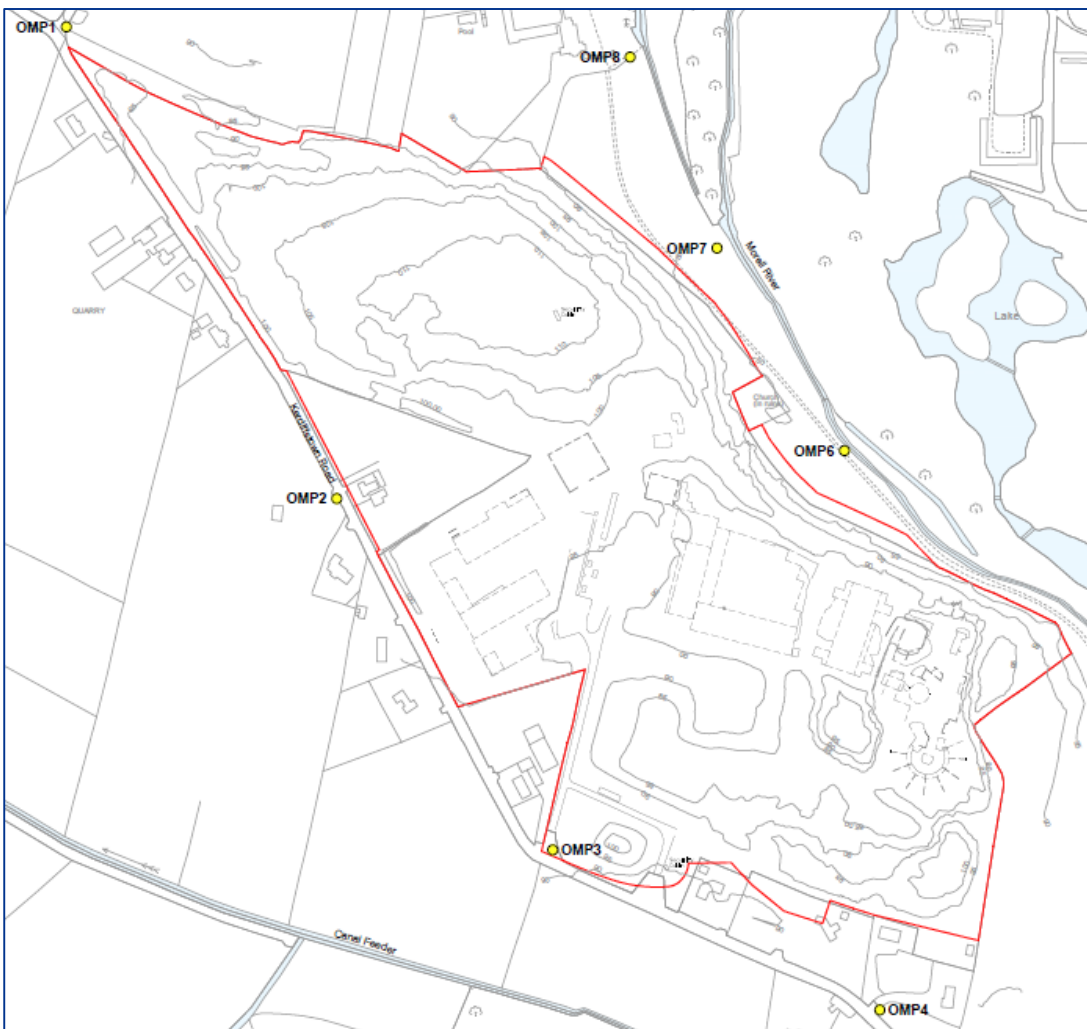
#### a) Current Operations

Odour monitoring is currently carried out at the locations and according to the frequency and for the determinands 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 workforce 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<sup>3</sup>/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 <sub>A,r,T</sub> (07:00 to 19:00 hrs)	Evening Noise Criterion dB L <sub>A,r,T</sub> (19:00 to 23:00 hrs)	Night-time Noise Criterion dB L <sub>A,r,T</sub> (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, Baldonnell – 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 <sup>2</sup> /day)	Four times a year <sup>Note 2</sup>	Standard Method <sup>Note 1</sup>
PM <sub>10</sub> (mg/m <sup>2</sup> /day)	Annually	See <sup>Note 3</sup>

**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<sub>10</sub>) 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
<b>Gas Monitoring Boreholes</b>						
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.
<b>Gas Extraction Wells</b>						
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.

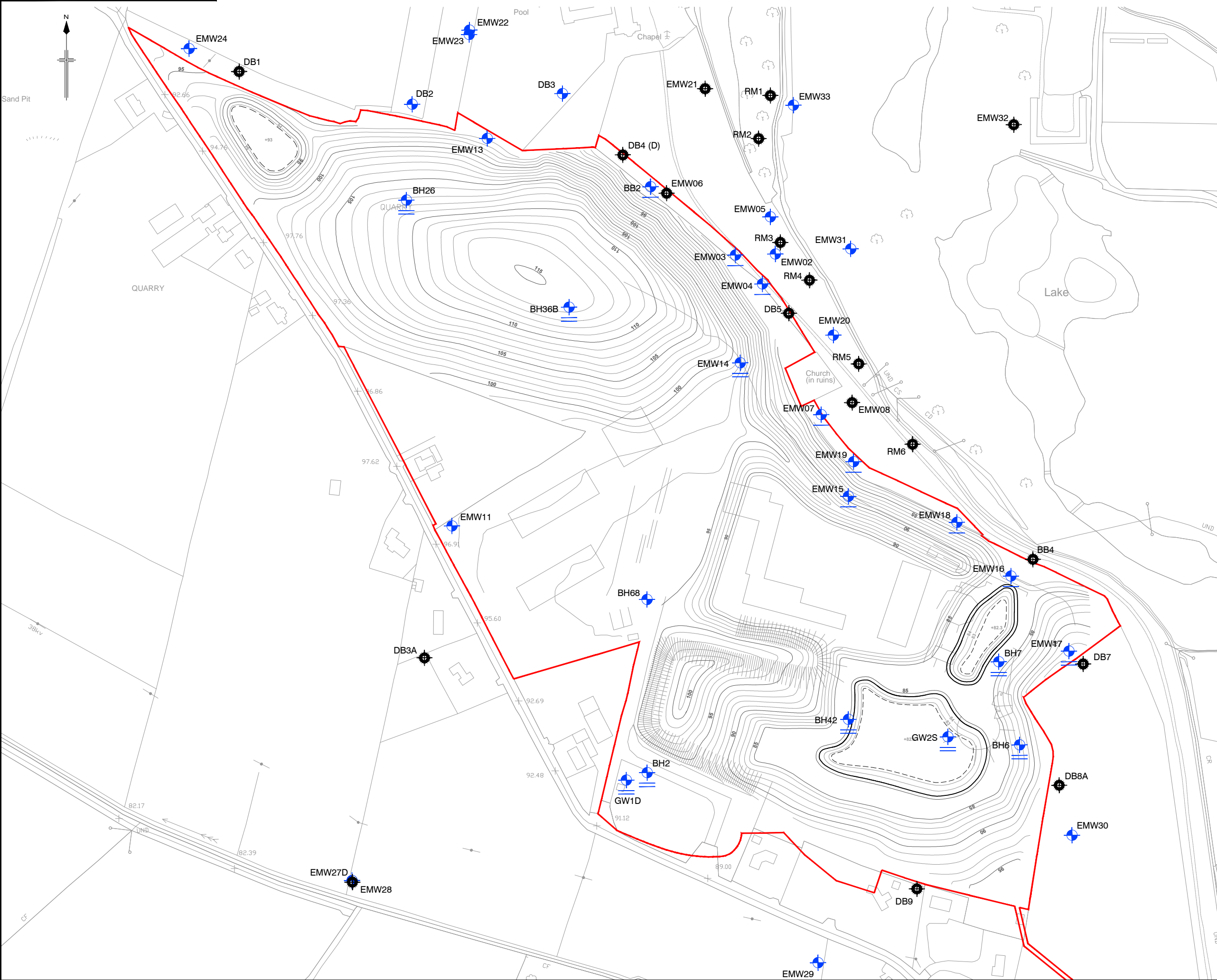
## Appendix B. Drawings











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- 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.

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

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Client  
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 Comhairle Contae Chill Dara

Project  
**KERRIFFSTOWN LANDFILL  
 REMEDIATION PROJECT**

Drawing title  
**MONITORING & CONTROL  
 MANAGEMENT PLAN  
 GROUNDWATER  
 MONITORING LOCATIONS**

Drawing status  
**EIAR SUBMISSION**

Scale  
 NTS @A3

Jacobs No.  
 32EW5604

Client No.  
 6286

Drawing number  
**32EW5604-00-057**

Rev  
**1**

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This drawing is not to be used in whole or part other than for the intended purpose and project as defined on this drawing. Refer to the contract for full terms and conditions.