Kildare County Council
Comhairle Contae Chill Dara

JACOBS

Kerdiffstown Landfill Remediation Project

Kildare County Council

Environmental Impact Assessment Report (EIAR) Volume 2 of 4: Main Report

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Glossary

Below is provided a partial glossary of terms used in this Environmental Impact Assessment Report. The definitions therein are not to be taken as comprehensive but solely as an aid to the non-technical reader.

Term	Definition
AA	Appropriate Assessment
AADT	Annual Average Daily Traffic
AASS	Appropriate Assessment Screening Statement
AEP	Annual Exceedance Probability
AG	Air Guidance – Guidance notes published by the Environmental Protection Agency
Alluvium	Deposits from a river or stream.
Amelioration (of impacts, etc.)	"Ameliorate" means to make less severe or to amend. Impact amelioration proposals suggest ways to improve the negative effects of a project on the environment.
Annual Mean Concentration	The average concentration of a substance over the period of a year
Anthropocentric	Human-centric
Anthropogenic	"Anthropogenic" is a term of, relating to, or resulting from the influence of human beings on nature
AOD	Above Ordnance Datum
AQS	Air Quality Standards
Aquifer	A subsurface layer or layers of rock or other geological strata of sufficient porosity and permeability to allow either a significant flow of groundwater or the abstraction of significant quantities of groundwater.
Archaeology	The study of past societies through its surviving structures, artefacts and environmental data.
Architectural Heritage	Structures, buildings, traditional and designed, and groups of buildings including streetscapes and urban vistas, which are of historical, archaeological, artistic, engineering, scientific or technical interest, together with their setting, attendant grounds, fixtures, fittings and contents.
ATCs	Automatic Traffic Counters
At-Grade Junction	Road junction at which at least one road meets another at the same level.
BAP	Biodiversity Action Plan
Baseline survey	A description of the existing environment against which future changes can be measured.
BAT	Best Available Techniques
BCI	Bat Conservation Ireland
BCT	Bat Conservation Trust
BH	Borehole
Biotic	Processes which relate to living organisms.
BoCCI	Birds of Conservation Concern in Ireland
BOD	Biochemical Oxygen Demand / Biological Oxygen Demand
BRE	Building Research Establishment
BRP	Bat Roost Potential
BS	British Standard
BSBI	Botanical Society of Britain & Ireland
BTEX	Benzene, Toluene, Ethyl Benzene and Xylenes
BTO	British Trust for Ornithology
C&D	Construction and Demolition
c.	Circa (approximately)
$CaCO_3$	Calcium Carbonate
CAFE	Clean Air for Europe
Catchment	That area determined by topographic features within which falling rain will contribute to runoff at a particular point under consideration.
CDP	County Development Plan
CEMP	Construction Environmental Management Plan
CER	Commission for Energy Regulation
CFRAM	Catchment Flood Risk Assessment and Management
CH_4	Methane

Term	Definition
CIE	Coras Iompair Éireann
CIEEM	Chartered Institute of Ecology and Environmental Management
CIRIA	Construction Industry Research and Information Association
CLG	Community Liaison Group
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COBA	Cost Benefit Analysis
COD	Chemical Oxygen Demand
COMXXX	Commercial Receptor
CORINE	Coordination of Information on the Environment
CPO	Compulsory Purchase Order
CQA	Construction Quality Assurance
CQC	Construction Quality Control
cSAC	candidate Special Area of Conservation
CSM	Conceptual Site Model
CSO	Central Statistics Office
CTMP	Construction Traffic Management Plan
Cumulative Impact	The addition of many small impacts to create one larger, more significant, impact.
DAHG	Department of Arts, Heritage and the Gaeltacht
DAU	Development Application Unit
dB	decibels
DCC	Dublin City Council
DCCAE	Department of Communications, Climate Action and Environment
DECLG	Department of Environment, Community and Local Government
DEFRA	Department of Environment, Food and Rural Affairs
DHPCLG	Department of Housing, Planning, Community and Local Government
DMURS	Design Manual for Urban Roads and Streets
DO	Dissolved Oxygen
DoAHRRGA	Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs
DoEHLG	Department of the Environment, Heritage and Local Government
“Do-Minimum” Scenario	The situation or environment that would exist if minimal intervention or development were carried out.
DQRA	Detailed Quantitative Risk Assessment
EC	Electrical Conductivity
EC	European Commission
Eh	Redox potential
EHS	Environmental Health Service
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EIS	Environmental Impact Statement
EOP	Environmental Operating Plan
EPA	Environmental Protection Agency
EQS	Environmental Quality Standards
ERBD	Eastern River Basin District
ESB	Electricity Supply Board
ESCP	Erosion and Sediment Control Plan
Estuarine	Environment associated with semi-enclosed coastal body of water which has a free connection with the open sea and where fresh water, derived from land drainage, is mixed with sea water.
EU	European Union
EWC	European Waste Catalogue
Fauna	A collective term for the animals of a region.
FBA	Freshwater Biological Association
FID	Flame Ionisation Detector

Term	Definition
Flora	A collective term for the plants of a region.
Fluvial	Pertaining to a river.
FML	Flexible Membrane Liner
FPO	Flora Protection Order
FRA	Flood Risk Assessment
FTE	Full Time Equivalent
g/m^3	Grams per metre cubed.
GAC	Generic Assessment Criteria
GDA	Greater Dublin Area – the area encompassing the Dublin and Mid-East Regions, respectively, comprising Dublin City and counties Dun Laoghaire-Rathdown, Fingal and South Dublin in the Dublin Region, together with the counties of Kildare, Meath and Wicklow in the Mid-East Region
GDL	Geocomposite Drainage Layer
GHG	Greenhouse Gases
GI	Green Infrastructure
GLC	Ground Level Concentration
GLVIA	Guidelines for Landscape and Visual Impact Assessment
GPA	Guidelines for Planning Authorities
GSI	Geological Survey of Ireland
H_2S	Hydrogen Sulphide
ha	Hectares = 10,000 square metres.
HA	Hydrometric Area
HAZOP	Hazard and Operability Study
HDPE	High-Density Polyethylene
HGVs	Heavy Goods Vehicles
HMWB	Heavily Modified Water Bodies
HSA	Health and Safety Authority
HSE	Health Service Executive
Hydrocarbons	A compound of hydrogen and carbon, such as any of those which are the chief components of petroleum and natural gas.
Hz	Hertz
ID	Identification
IED	Industrial Emissions Directive
IEAL	Industrial Emissions Activities Licence
IEMA	Institute of Environmental Management and Assessment
IFI	Inland Fisheries Ireland
IGI	Institute of Geologists of Ireland
Impact Interactions	The reactions between impacts on different environmental factors, whether between the impacts of just one project or between the impacts of the other projects in the area.
IMS	Industrial Methylated Spirits
Indirect Impact	Impacts on the environment which are not a direct result of the project, often produced away from the project or as a result of a complex pathway.
Infrastructure	Basic public facilities e.g. roads, sewers, water supply, telephones and electricity.
IPH	Institute of Public Health in Ireland
IPPC	Integrated Pollution Prevention and Control
Isopleth	A line on a map connecting points having equal values.
ISR	In Stack Ratio
IUCN	International Union for Conservation of Nature and Natural Resources
IW	Irish Water
IWAI	Inland Waterways Association of Ireland
IWeBS	Irish Wetland Bird Survey Data
KCC	Kildare County Council
KCDP	Kildare County Development Plan
KER's	Key Ecological Receptor's

Term	Definition
KLRP	Kerdiffstown Landfill Remediation Project
km	Kilometre
kph	Kilometres per hour
l/s	Litres per second.
LAP	Local Area Plan
LCA	Landscape Character Area
LCT	Landscape Character Types
LFG	Landfill Gas
LGV	Light Goods Vehicles
LI	Locally Important
LIA	Landscape Impact Assessment
LLDPE	Linear Low Density Polyethylene
LoW	List of Waste
LVIA	Landscape and Visual Impact Assessment
m/s	Metres per second.
m^3/s	Metres cubed per second
MDPE	Medium Density Polyethylene Pipe
Method Statement	A document outlining the work task or process to be completed, along with the potential hazards involved and mitigation measures to reduce or avoid risk.
Methodology	The specific approach or techniques used to analyse impacts or describe environmental features and conditions
mg/l	Milligrams per litre.
mg/m^2-day	Milligrams per metre squared per day.
mg/m^3	Milligrams per metre cubed.
Mitigation	Measures designed to avoid, reduce, remedy or compensate for adverse impacts
mm	Millimetre
MMP	Mobility Management Plan
mOD	Metres above Ordnance Datum
Moderate Impact	An impact that alters the character of the environment in a manner that is consistent with the existing and emerging trends.
MSW	Municipal Solid Wastes
N	Nitrogen
N_2O	Nitrous oxide
NAAQS	National Ambient Air Quality Standard
NBDC	National Biodiversity Data Centre
NCM	National Cycle Manual
NECD	National Emissions Ceiling Directive
Negative Impact	A change which reduces the quality of the environment (for example, by lessening species diversity and the reproductive capacity of the ecosystem, by damaging health, property or by causing nuisance).
Neutral Impact	No effects or effects that are imperceptible, within normal bounds of variation or within the margin of forecasting error.
NG	Noise Guidance – Guidance notes published by the Environmental Protection Agency
NH_3	Ammonia
NHA	National Heritage Area
NIAH	National Inventory of Architectural Heritage
NMI	National Museum of Ireland
NMVOCs	Non-methane VOCs
NNG	Naas Neighbourhood Greenway
NO_2	Nitrogen Dioxide
NOx	Nitrogen Oxides
NPWS	National Parks and Wildlife Service
NRA	National Road Authority (Now Transport Infrastructure Ireland)

Term	Definition
NRS	National Road Schemes
NSR	Noise Sensitive Receptor
NTA	National Transport Authority
NTS	Non-Technical Summary
NTS (in relation to drawings)	Not to scale
NVMP	Noise and Vibration Management Plan
OCP	Odour Control Plan
OPW	Office of Public Works
OS	Ordnance Survey
OSI	Ordnance Survey Ireland
OUE/m^3	Odour Unit per Cubic Metre
P	Phosphorus
P & ID	Piping and Instrumentation Drawing
PAH	Polycyclic Aromatic Hydrocarbons
pESCP	Preliminary Erosion and Sediment Control Plan
PM_{10}	PM_{10} is particulate matter 10 micrometres (µm) or less in diameter
$PM_{2.5}$	$PM_{2.5}$ is particulate matter 2.5 micrometres (µm) or less in diameter
pNHA	Proposed Natural Heritage Area
Positive Impact	A change which improves the quality of the environment (for example, by increasing species diversity and the reproductive capacity of the ecosystem, or by removing nuisances or improving amenities).
ppb	Parts per Billion
ppmv	Parts per Million by Volume
PPV	Peak Particle Velocity
PRFs	Potential Roost Features
Profound Impact	An impact which obliterates all previous characteristics.
PVMRM	Plume Volume Molar Ratio Method
QI	Qualifying Interest
RBD	River Basin District
RBMPs	River Basin Management Plans
Receptor	Any element in the environment which is subject to impacts.
RECXXX	Residential Receptor
Residual Impact	The degree of environmental change that will occur after the proposed mitigation measures have taken effect.
Return Period	The frequency with which a certain event would be expected to occur on average over a long period of record.
RFCs	Ratios of flow to capacity
RMP	Record of Monuments and Places
RMS	Root Mean Square
RPA	Root Protection Area
RPSs	Record of Protected Structures
RQD	Rock Quality Designation
RSA	Road Safety Audit
S.I.	Statutory Instrument - An order, regulation, rule, scheme or bye-law made in exercise of power conferred by statute.
SAC	Special Area of Conservation
SCADA	Supervisory Control and Data Acquisition
SCI	Site of Community Importance
Scope / Scoping	The process of identifying the significant issues (scope) which should be addressed by a particular Environmental Impact Assessment.
Sensitivity	The potential of a receptor to be significantly impacted.
SEPA	Scottish Environmental Protection Agency

Term	Definition
Services	The conduits, pipes and lines that carry water, telephone signal, electricity, sewage, etc.
Severance	A term used to describe the possibility that a development may disrupt activities or movements in an area or divide an area, community, etc. in an adverse manner.
Significance	The sensitivity of the environment to change or the consequence of change for the receiving environment.
SMR	Sites and Monuments Record
SO_2	Sulfur Dioxide
SPA	Special Protection Area
SPL	Sound pressure levels
SPM	Suspended particulate matter
Spring	A flow of water that occurs where the water table intercepts the ground surface.
SuDS	Sustainable Drainage System
SVOCs	Semi-Volatile Organic Compounds
SVP	Saint Vincent de Paul
SW01	Surface Water Monitoring Point 1
SW02	Surface Water Monitoring Point 2
SWMP	Surface Water Management Ponds
Temporary Impact	An impact which is not permanent or lasting.
TFS	Transfrontier Shipment
TII	Transport Infrastructure Ireland
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbons
TSS	Total Suspended Solids
TTA	Traffic and Transport Assessment
µg	Micrograms
$\mu g/m^3$	Micrograms per metre cubed
µm	Micrometres
UNESCO	United Nations Educational, Scientific and Cultural Organisation
Unsaturated zone	The zone between the land surface and the water table, in which pores and fissures are only partially filled with water. Also known as the vadose zone.
UWWTP	Urban Wastewater Treatment Plant
VIA	Visual Impact Assessment
VOCs	Volatile Organic Compounds
VP	View Point
VRP	Viewshed Reference Point
VRU	Vulnerable Road Users
Water Table	The surface at which pore water pressure in an aquifer is equal to atmospheric pressure, and which separates the saturated zone from the unsaturated zone.
WBXXX	Waterbody receptors
WeBS	Wetland Bird Survey
WFD	Water Framework Directive
WFP	Waste Facility Permit
WHO	World Health Organisation
WIR	Water Industry Research
WMU	Water Management Unit
WTF	Waste Transfer Form
WWTP	Wastewater Treatment Plant
ZoI	Zone of Influence
250 Flare	The current operational landfill gas flare operating at Kerdiffstown Landfill
500 Flare	The current back-up landfill gas flare available at Kerdiffstown Landfill,
600 Flare	The proposed new landfill gas flare to be installed in the Landfill Infrastructure Compound as part of the remediation works

Term	Definition
98 Percentile Flow	The flow rate (expressed in m^3/s) at a given location on a river which over the long-term is equalled or exceeded 98% of the time.
99.8 Percentile Flow	The flow rate (expressed in m^3/s) at a given location on a river which over the long-term is equalled or exceeded 99.8% of the time.

1. Introduction

1.1 Purpose of this Report

This Environmental Impact Assessment Report (EIAR) presents the assessment of environmental impacts and applicable mitigation measures associated with the proposed Kerdiffstown Landfill Remediation Project (hereafter referred to as the proposed Project).

1.2 Kerdiffstown Landfill Remediation Project (the proposed Project)

Kerdiffstown Landfill in County Kildare is a former quarry which has been progressively backfilled with wastes. In June 2010, the former operator of the landfill vacated the site and it was left in an unsecured condition. In January 2011, a major fire developed within the mass of mounded waste material present in the site which required the intervention of a number of state agencies, including Kildare County Council (KCC) and the Environmental Protection Agency (EPA). The former landfill poses a number of risks due to large areas of uncapped waste, remnants of buildings and structures on-site, man-made ponds, steep slopes and the lined cell with a temporary cap. As part of their commitment to manage the immediate environmental and health and safety risks the EPA and, latterly, KCC have implemented a range of interim measures to address the key environmental and health and safety concerns posed by the site, particularly addressing leachate and landfill gas production at the site.

The former landfill requires remediation to reduce the risks to public health and safety and the environment. The proposed Project is to remediate the site by providing an engineered capping system, providing a landscaped profile and improving the management of landfill gas, leachate and surface water to ultimately provide a multi-use public park. More details on the background and site history can be found in Chapter 3 The Need for the Proposed Project.

1.3 Client

The Client for this proposed Project is KCC following the novation of a Framework Contract from the EPA in 2015.

1.4 Objectives of the Proposed Project

The overall objective of the proposed Project is to remediate the land contained within the Kerdiffstown Landfill site. Currently the site is in a disused state and poses a risk to the environment.

Specific objectives of the proposed Project are:

- The removal of risks to public health and safety;
- A reduction in the environmental risk profile of the site to an acceptable level;
- Delivery of a remediation solution which is acceptable to the local community;
- Completion of the remediation works within 8 years; and
- Integration of sustainability and sustainable design and development in both the remediation and post closure works (operation of the multi-use public park).

1.5 Environmental Impact Assessment

Environmental Impact Assessment (EIA) is the process by which the anticipated effects on the environment of a proposed development or project are measured. The assessment has evaluated the Remediation Phase (construction works to remediate the site and achieve the proposed end-use as a multi-use public park) and Operational Phase (operation of the multi-use public park) of the proposed Project. If the anticipated effects are unacceptable, design measures or other relevant mitigation measures have been identified to reduce or avoid those effects.

The EIAR generally focuses on describing the existing environment, identifying the potential impacts and describing any mitigation measures required to reduce or eliminate potential impacts and is the document produced and used to record this assessment.

Diagram 1.1 below provides a high level overview of the EIA Process and the steps involved. Further information on the approach to EIA can be found in Chapter 2 Approach to Environmental Impact Assessment (EIA).

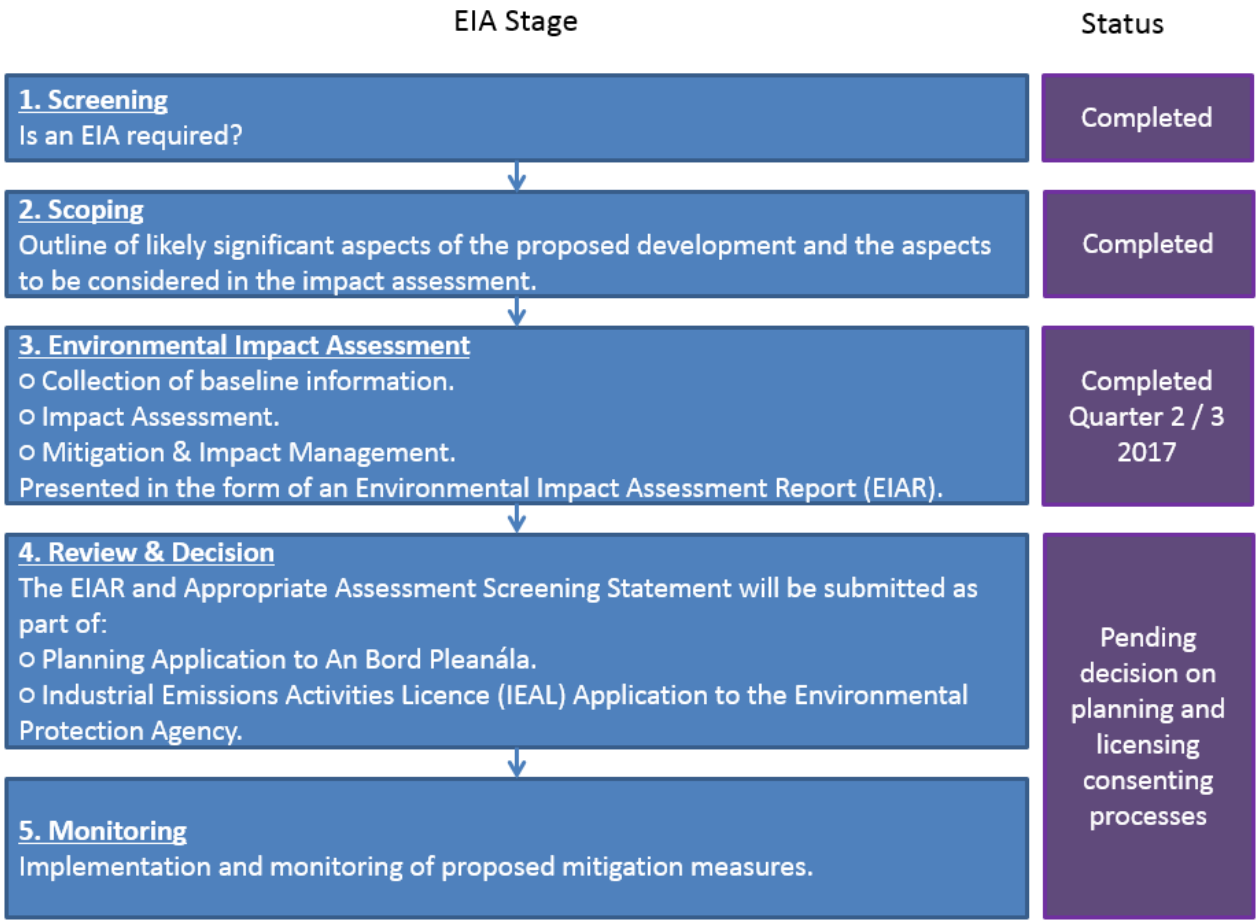


Diagram 1.1 High Level Overview of the EIA Process

1.6 Report Structure

Table 1.1 sets out the structure of the EIAR along with a summary of what is included in each Chapter.

Table 1.1: Structure of the Environmental Impact Assessment Report

Title	Description
Volume 1: Non-Technical Summary	
Non-Technical Summary	Summary of the EIAR in non-technical language.
Volume 2: Main EIAR Report	
Chapters 1 – 4	Provide project background and information on the proposed Project assessed in the EIA, including the need for the proposed Project and descriptions of the works required as part of the Remediation Phase and Operational Phase.
Chapter 5	Presents the alternatives considered for remediation and end-use of Kerdiffstown Landfill.
Chapter 6	Presents the consultation process associated with the EIA
Chapters 7 – 17	Reporting of the EIA for each specialist environmental topic, including the introduction of the subject area, approach and methodology of assessment, a description of the existing environment, assessment of the potential effects of the proposed Project, mitigation and potential residual effects. As part of this report the following environmental aspects are assessed. The environmental aspect as defined under the EIA Directive is stated in brackets: • Air Quality, Odour and Climate (Air and Climate); • Noise and Vibration; • Landscape and Visual (Landscape); • Archaeology, Cultural Heritage and Architectural Heritage (Cultural Heritage); • Biodiversity; • Soils, Geology, Contaminated Land and Groundwater (Land & Soils); • Water – Hydrology (Water); • Traffic and Transport (Material Assets); • Waste (Material Assets); • Population and Human Health - Socio Economics (Population and Human Health); • Material Assets
Chapter 18	Presents an overview of all the major interactions between the different environmental aspects as outlined above.
Chapter 19	Presents a summary of environmental commitments made in the EIAR.
Chapter 20	Summarises any significant residual impacts after the implementation of mitigation measures.
Volume 3: Figures	
Figures 3.1 – 17.1	Graphics and plans supporting the EIAR Chapters, illustrating the proposed Project and environmental information. Figure reference numbers correspond to the relevant EIAR Chapter (e.g. Figure 3.1 relates to Chapter 3)
Volume 3A: Photomontages	
Photomontages for Viewpoints 1 to 9	Imagery depicting the current view of the site and representing the way in which the proposed Project will appear within a particular view
Volume 4: Appendices	
Appendices A4.1 – A14.3	Technical reference information supporting the EIAR Chapters, such as calculations and detailed background data. Appendix numbers correspond to the relevant EIAR Chapter (e.g. Appendix A4.1 relates to Chapter 4)

2. Approach to Environmental Impact Assessment (EIA)

2.1 Introduction to the EIA Process

EIA is the process for anticipating the effects on the environment caused by a proposed development or project at a particular site. Where effects are unacceptable, design or other measures can be taken to avoid or reduce these effects to acceptable levels.

The initial Environmental Impact Assessment (EIA) Directive has been in place since 1985 (85/337/EEC). This Directive along with three amendments was amalgamated into Directive 2011/92/EU in December 2011.

Proposed changes to the directive were adopted by the Council of the European Union in May 2014 with a 3-year period to transpose the changes. These changes will form the first revision of the Directive 2011/92/EU and it is expected that Ireland along with all other member states will adopt the revised directive in 2017.

The EIA Directive aims to provide a high level of protection of the environment and to contribute to the integration of environmental considerations into the preparation of proposed developments with a view to reducing their environmental impact. EIA ensures public participation in decision-making and thereby strengthens the quality of decisions.

The EIA Directive requires that certain developments be assessed for the likely environmental effects before planning approval can be granted. When submitting a planning application for such a development, the applicant must also submit an EIAR.

Ahead of the transposition of the directive, the Department of Housing, Planning, Community and Local Government has issued Circular letter PL1/2017 on Implementation of Directive 2014/52/EU on the effects of certain public and private projects on the environment (EIA Directive) - Advice on Administrative Provisions in Advance of Transposition. This circular advises that:

> *"In respect of applications for planning permission or other development consent received on or after 16 May 2017 falling within the scope of Directive 2011/92/EU, or within the scope of Directive 2014/52/EU, competent authorities are advised to consider applying the requirements of Directive 2014/52/EU by way of administrative provisions in advance of the transposition of Directive 2014/52/EU into Irish law."*

It is noted that the provisions of the Directive 2014/52/EU had not been transposed into Irish law by the date for transposition, 16 May 2017. In accordance with the advice contained within the Circular and in order to ensure compliance with the requirements of EU law, this Environmental Impact Assessment Report (EIAR) has been prepared in order to meet the requirements of Directive 2014/52/EU.

It is noted, in this regard, that the terminology used in the Directive for what has previously been described as an Environmental Impact Statement (EIS) in Irish law, is Environmental Impact Assessment Report (EIAR). That term has been used here with a view to making clear that it is intended that the EIAR meet the requirements of the new Directive. It should be noted, however, that the EIAR, in meeting the requirements of Directive 2014/52/EU, necessarily satisfies the requirements for an EIS.

The EIA process can generally be summarised as follows:

- Screening – Is an EIA required?;
- Scoping – What issues should be considered with the EIAR?;
- Baseline Data Collection – Establishing a robust baseline of the existing environment on and around the site. The stage includes a review of existing available information and undertaking any surveys identified during the scoping phase;
- Impact Assessment – Assessment of the environmental impacts and establishing their significance;

- Mitigation – Formulation of mitigation measures to ameliorate the potential impacts of the proposed Project which cannot be avoided practically through design;
- Consultation – With Statutory Stakeholders, the public and other bodies;
- Decision – The competent authority, in this case An Bord Pleanála, decides, taking into consideration the results of consultations, if the proposed Project can be authorised;
- Announcement – The public is informed of the decision; and
- Monitoring – Implementation and monitoring of mitigation measures.

2.2 EIA Screening Assessment

2.2.1 Is an EIA Required?

In order to determine whether an environmental impact assessment is required for the proposed Project, it is necessary to determine whether it is a project listed in one of the Annexes to the Directive 2011/92/EU (as amended by Directive 2014/52/EU).

These Annexes have been transposed in to domestic law. The prescribed classes of development which require EIA are outlined in Schedule 5 of the Planning and Development Regulations 2001 (S.I. 600 of 2001, as amended). The proposed Project is not listed in Part 1 of that Schedule (or Annex 1 of the EIA Directive) and therefore an EIA is not mandatory. The relevant classes of development from Part 2 are as follows:

- 11(b): “Installations for the disposal of waste with an annual intake greater than 25,000 tonnes not included in Part 1 of this Schedule.”;
- 13(c): Any change or extension of development being of a class listed in Part 1 or paragraphs 1 to 12 of Part 2 of this Schedule, which would result in the demolition of structures, the demolition of which had not previously been authorised, and where such demolition would be likely to have significant effects on the environment, having regard to the criteria set out under Schedule 7; and
- 15: Any project listed in this Part which does not exceed a quantity, area or other limit specified in this Part in respect of the relevant class of development but which would be likely to have significant effects on the environment, having regard to the criteria set out in Schedule 7.

As part of the proposed Project it is not anticipated that the site will accept waste for disposal at the site, however the construction works associated with the Remediation Phase will require the importation of engineering materials, such as aggregate, subsoil and top soil which may still be classed as waste, depending on its origin. In addition, some waste will be moved within the footprint of the proposed Project for deposition in the lined cell in Zone 3. On this basis, an application for an Industrial Emissions Activities Licence (IEAL) will be submitted by KCC to the Environmental Protection Agency (EPA). Acceptance of such engineering material will be controlled under specifications and acceptance criteria, to comply with the IEAL regulated by the EPA. There will also be a requirement to re-profile and relocate some areas of existing waste within the site boundary in order to reduce the risk to health and safety and the risk of environmental harm.

The existing Kerdiffstown development can be regarded as a development falling within Class 11(b) of Part 2 of Schedule 5 of the Planning and Development Regulations 2001. The proposed Project involves changes to that development, including the demolition of certain structures. It can therefore be regarded as a development listed in Part 2 of the Schedule which does not meet a limit specified in the Schedule and/or as a change to an existing development involving the demolition of structures. In the circumstances, although a mandatory EIA is not triggered for the proposed Project, if it is likely to have a significant effect on the environment having regard to the criteria set out in Schedule 7, an EIA will be required.

The criteria set out in Schedule 7 require regard to be had to:

- The characteristics of the proposed development;
- The location of the proposed development; and
- The characteristics of potential impacts.

Having regard to those criteria and the matters more particularly set out in Schedule 7, it is considered that the works required to remediate the site and develop the proposed multi-use public park end-use, including the excavation and movement of waste material within the site boundary would be likely to have significant effects on the environment and that an EIA should be carried out to fully assess potential impacts and to make recommendations for mitigation measures to reduce or eliminate impacts.

2.2.2 Industrial Emissions Activities Licensing Process

The Industrial Emissions Directive (IED) (EU 2010/75/EU) was implemented in Ireland in 2013 by the following regulations:

- EU (Industrial Emissions) (Licensing) Regulations 2013 (S.I. No. 137 of 2013); and
- EU (Industrial Emissions) Regulations 2013 (S.I. No. 138 of 2013).

The IED includes licensing of major waste management activities, such as landfill sites and their remediation, which previously required Waste Licensing under the Waste Management Act 1996 (as amended). The waste activities that are subject to the IED are contained in Annex I to the Directive, and set out in amendments to the First Schedule to the EPA Act 1992 (as amended), Section 11.5, Waste Activities. This sets out the following thresholds:

> *"Landfills, within the meaning of section 5 (amended by Regulation 11(1) of the Waste Management (Certification of Historic Unlicenced Waste Disposal and Recovery Activity) Regulations 2008 (S.I. No. 524 of 2008)) of the Act of 1996, receiving more than 10 tonnes of waste per day or with a total capacity exceeding 25,000 tonnes, other than landfills of inert waste."*

Note: Landfills that receive less than 10 tonnes of waste per day or less than 25,000 tonnes per year continue to be licensed by the EPA under the Waste Management Act 1996 (as amended).

As part of the proposed Project it is not anticipated that the site will accept waste for disposal at the site, however the construction works associated with the Remediation Phase will require the importation of engineering materials, such as aggregate, subsoil and top soil which may still be classed as waste, depending on its origin. Acceptance of such material will be controlled under specifications and acceptance criteria, to comply with the IEAL regulated by the EPA.

2.2.3 Appropriate Assessment

The Birds Directive (79/409/EEC) and the Habitats Directive (92/43/EEC) set out various procedures and obligations in relation to nature conservation management, and in particular the conservation of European sites. "European site" replaced the term "Natura 2000 site" under the EU Environmental Impact Assessment and Habitats Regulations 2011 (S.I. No. 473 of 2011). European sites comprise Special Area of Conservation (SAC) and Special Protection Areas (SPAs). A key protection mechanism is the requirement to consider the possible nature conservation implications of any plan or project on European sites. Appropriate Assessment (AA) is the process which considers the possible effects of a plan or project on the European sites network.

In accordance with these requirements the proposed Project has been assessed to consider whether there are likely significant effects from the proposed Project on European sites. The Appropriate Assessment Screening Statement (AASS) has concluded that an Appropriate Assessment of the proposed Project is not required. It can be excluded, on the basis of objective scientific information, and in light of no implications for the conservation objectives of relevant sites from the proposed Project that the proposed Project, either individually or in-combination with other plans or projects, will have likely significant effects on any European site. Refer to Chapter 11 Biodiversity for further details and Appendix A11.10 for a copy of the AASS.

2.3 EIA Scoping

Following screening, 'scoping' is the process of determining the content and extent of matters that should be covered in the environmental information submitted to the competent authority. Scoping requires the consideration of the nature and likely scale of the potential environmental impacts likely to arise from a proposed

development or project. As part of the scoping process for the proposed Project the Kerdiffstown Landfill Remediation Project Environmental Impact Statement Scoping Report (Jacobs, September 2016) has been provided to stakeholders for review and comment. Details on the consultation process undertaken as part of the proposed Project can be found in Chapter 6 The Consultation Process.

2.4 EIA Methodology

2.4.1 EIA Guidance

This assessment of environmental impacts has been conducted in accordance with current industry practice and relevant guidance. The EPA has produced the following guidance for the development of an EIAR:

- EPA Guidelines on the Information to be Contained in Environmental Impact Statements (EPA, 2002) (and revised and draft guidelines 2015/2017); and
- EPA Advice Notes on Current Practice in the Preparation of Environmental Impact Statements (EPA, 2003a) (and revised advice notes 2015).

In addition to these overarching guidance documents, each environmental aspect (e.g. Air Quality) has been assessed in accordance with specific guidance and best practice for the environmental aspect. The specific guidance which has been used is detailed under each environmental aspect in Chapters 7 to 17 of this report.

The following key stages formed the basis of the assessment process:

- Consultation with statutory and non-statutory bodies and relevant interested parties/stakeholders;
- Establishing a robust baseline of the existing environment on and around the proposed Project. The existing environmental baseline of the proposed Project and its surroundings has been established for each environmental aspect under consideration. This has been achieved by close co-operation with the Client and other relevant authorities and organisations, a desktop review of available data, and literature and detailed interpretation of field surveys. The ultimate goal of the proposed Project is to take the existing condition of the site and remediate it to a satisfactory standard which presents significantly reduced adverse effects to the surrounding and wider environment;
- Assessment of the environmental impact and establishing their significance (primarily the assessment of residual effects once mitigation has been adopted); and
- Formulation of mitigation measures to ameliorate the potential impacts of the proposed Project that cannot be avoided practically through site design.

2.4.2 Consultation

Consultation with relevant authorities, organisations and stakeholders has already commenced and will be continued throughout the assessment and development design process. The consultations serve three main purposes:

- To establish a sufficiently robust environmental baseline of the proposed Project and its surroundings;
- To identify, early in the process, specific concerns and issues relating to the proposed Project in order that they can be discussed and appropriately accounted for in the design and assessment; and
- To ensure the appropriate involvement of the public and authorities in the assessment and design process.

To date consultation has included:

- Liaison between the EPA/KCC and members of a Community Liaison Group, which includes the Kerdiffstown Residents Association, St. Vincent de Paul, Clean Air Naas and the Naas Chamber of Commerce.
- In April 2016 a Public Consultation Day was held in the Kildare County Council offices to announce potential end-use options for the site and welcoming comments and observations from the public.

- In October 2016 a consultation letter and copy of the Kerdiffstown Landfill Remediation Project Environmental Impact Statement Scoping Report (Jacobs, September 2016) was issued to statutory stakeholders, inviting their review of the proposed EIA approach and inviting comments.
- Presentation to the Municipal District Council and public announcement in November 2016 that the proposed end-use for the Project is a multi-use public park.
- In March 2017 a Public Information Day was held in Naas to provide a public update on project progress and to invite any comments or concerns on the scope of the EIA.

Refer to Chapter 6 The Consultation Process for details on the consultation undertaken as part of the proposed Project.

2.4.3 Impact Assessment

The assessment has been structured to ensure that assessment criteria which includes the receptors which are considered sensitive, standards of significance and magnitude used as part of the assessment are identified and documented and that the level of certainty of data is recorded. An explanation has been provided for each environmental aspect on the criteria that have been applied, including reference to the appropriate published guidance for each of the environmental aspects. Direct and indirect impacts of the proposed Project have been considered as well as impacts which could occur in the short, medium and long term.

The assessments have evaluated:

- The Remediation Phase – this is the construction works required to remediate the site and achieve the proposed final landform. The Remediation Phase will involve profiling works to minimise volumes associated with the excavation, movement and deposition of materials within the site, the installation of an engineered capping system, the installation of new environmental management and control systems including leachate and landfill gas management, upgrading the road/ pedestrian access to the proposed Project from the L2005 Kerdiffstown Road and development of a multi-use public park including construction of multi-use sports pitches, car parking, changing room building, children's playground and a network of paths across the site and appropriate seeding and planting; and
- The Operational Phase – this is the operation of the proposed Project as a multi-use public park as well as the ongoing operation and maintenance of the landfill management infrastructure.

For all environmental aspects, the significance of residual impacts, i.e. those impacts predicted once mitigation is taken into account, have also been assessed, along with potential cumulative impacts with other developments and potential interactions between environmental topics.

2.4.4 Mitigation Measures

The EIAR addresses all potential environmental effects associated with the proposed Project and proposes mitigation where significant effects have been identified. All measures proposed as mitigation for the proposed Project are reported within the relevant Sections of the EIAR. The EIAR also includes a Schedule of Environmental Commitments, which brings together all of the mitigation measures recommended in the various EIAR Chapters for ease of reference. Refer to Chapter 19 for the Schedule of Environmental Commitments.

2.4.5 Monitoring

The continued measurement of effects on the environment through monitoring provides assurance that the proposed systems and mitigation measures are operating as intended. It is anticipated that ongoing monitoring of the proposed Project will be agreed by the EPA as part of the IEAL. Monitoring required as part of the Remediation Phase and the Operational Phase are outlined within the relevant Sections of the EIAR.

Maintenance and active management of the landfill infrastructure is integral to the Operational Phase of the proposed Project. As described in this EIAR the continued monitoring and management of the site will provide assurance that the landfill management systems are operating effectively. KCC will appoint a Site Manager for the Operational Phase who shall be responsible for the control, operation and maintenance of the site and emissions shall take place as set out in the IEAL.

The KCC Site Manager will be responsible for managing the sampling, analyses, measurements, examinations, maintenance and calibrations as set out in the IEAL and for reporting to the EPA, in the format specified in the IEAL.

The KCC Site Manager will establish procedures to ensure that corrective action is taken should the specified limits of the IEAL not be fulfilled. These procedures will include the actions for initiating further investigation and implementing corrective action where appropriate. In the development of the outline design of the proposed Project consideration has been given to the nature of the works and where appropriate potential future management solutions have been identified. These solutions are available for KCC to implement in the future should they be required.

3. The Need for the Proposed Project

3.1 Introduction

The Kerdiffstown Landfill site is currently closed, in a disused state and poses a long term risk to human health and the environment due to pollution by landfill gases, odour and leachate. If the site continues in its current scenario (Do Minimum) it will breach current environmental legislation, a Do Nothing scenario would increase the risks still further. Therefore, there is a need to remediate the site as soon as practicable to reduce or avoid the risks to human health and the environment.

Remediation is required to meet the following broad objectives:

- Reduce or limit future leachate impact upon groundwater and surface water receptors and reduce/control the future production of leachate from the site;
- Ensure landfill gas is managed and controlled in such a way that it does not pose a future risk to nearby properties, residents and other identified receptors;
- Stabilise steep and undulating slopes across the landform;
- Address odour generation, both in the long term and during future remedial works; and
- Provide an end-use which fits within planning and any other relevant licencing conditions.

This Chapter sets out the site history, the site layout, expands on the need for the project, details the area around the proposed Project and explains the current environmental controls on site.

3.2 Site History

Kerdiffstown Landfill is a former sand and gravel quarry which had been progressively backfilled with wastes by a variety of operators from the 1950s onwards (Evaluation of Environmental Liabilities at Kerdiffstown Landfill, SKM Enviros 2010). The site is located approximately 3km north-east of central Naas and the closest site boundary is approximately 400m north-west of Johnstown village as shown in full in Figure 3.1 and indicated on Diagram 3.1 below.

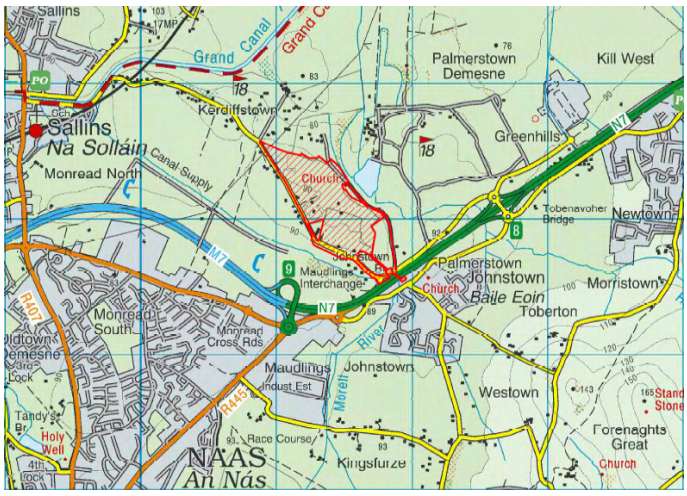


Diagram 3.1: Location of Kerdiffstown Landfill – Indicative Proposed Project Boundary shown in Red

The facility at Kerdiffstown was operated under a local authority waste permit followed by a waste licence, W0047-01, issued by the Environmental Protection Agency (EPA) in 2003, with a revised licence W0047-02 issued in 2006. Most recently the site consisted of an extensive recycling facility, a lined landfill cell which had been partially filled with waste and large areas of the site in which substantial quantities of waste have been

deposited in a non-compliant manner. The main area of waste deposition is in the unlined north-western area of the landfill. There are also smaller quantities of waste stockpiled around the site. The presence of such large quantities of waste and the lack of appropriate infrastructure to manage polluting emissions arising from this waste gives rise to significant risk of environmental pollution.

In June 2010 all waste disposal activities ceased when the former operator of the landfill vacated the site and it was left in an unsecured condition. In January 2011 a major fire developed within the mass of mounded waste material present in the centre of the site which required the intervention of a number of state agencies, including Kildare County Council (KCC) and the EPA.

The facility at Kerdiffstown is now in the early stages of remediation. In February 2011 the EPA intervened under Section 56 of the Waste Management Act 1996 (as amended), taking control of the site as a temporary measure to limit impacts in absence of the operator. The EPA retained control until the transfer of the project in June 2015 to KCC. Since February 2011 the EPA and then KCC have been using powers under Section 56 of the Waste Management Act 1996 (as amended) in order to take measures to prevent or limit environmental pollution arising from the site.

Section 56 of the Waste Management Act 1996 (as amended) allows a local authority to take measures to prevent or limit environmental pollution caused by waste:

> *"Where it appears to a local authority that measures are required to be taken in order to prevent or limit environmental pollution in its functional area caused, or likely to be caused, by the holding, recovery or disposal of waste, the local authority may take such steps, carry out such operations, recover or dispose of, or arrange for the recovery or disposal of, such waste or give such assistance as it considers necessary to prevent or limit such pollution or to mitigate or remedy the effects on the environment of any such activity."*

The Kerdiffstown Landfill Remediation Project (hereafter referred to as the proposed Project) is intended to remediate the former landfill to reduce risks to the environment and to public health and safety. The remediation of the site and development of the multi-use public park is anticipated to take approximately five to seven years, with approximately four years of intensive construction works to remediate the site, see Section 4.3.1 for details on the outline phasing of the works. The Operational Phase will create a public park with multi-use sports pitches, changing rooms, a children's playground, etc. Further detail on the scope of the proposed Project is provided in Chapter 4 Description of the Proposed Project.

Section 56

Section 56 of the Waste Management Act 1996 (as amended) empowers local authorities to takes measures to prevent or limit environmental pollution due to waste activities. While the scope of Section 56 is not defined in the legislation it could be argued that the scope of the powers is very wide-ranging and allow a Local Authority to undertake very large-scale works. To date both the EPA and KCC have taken limited actions at the Kerdiffstown Landfill site to limit the impact the site was having by installation of temporary containment measures such as placement of a temporary cap on part of the site and capturing and flaring landfill gas from certain areas. Some dangerous structures have also been demolished to improve health and safety conditions at the site.

However, with regards to the full remediation of the site and any significant engineering works proposed, KCC has chosen to use the route of applying to An Bord Pleanála for planning approval; and applying to the EPA for an Industrial Emissions Activities Licence (IEAL). Therefore, the proposed remediation solution for the site will be subjected to external scrutiny and decided upon by independent state bodies rather than KCC itself. The applications for formal consents from An Bord Pleanála and the EPA will also facilitate formal public consultation, with opportunities for 3rd parties to make submissions and object to the proposals or any proposed decision. Subsequent to any licence being granted by the EPA, the conditions of that licence and the implementation of the remediation will be subject to enforcement by the EPA, again providing oversight to the performance of KCC in undertaking the remediation.

3.3 Project Boundaries

For the purposes of developing the remediation strategy and describing and undertaking the impact assessment, a number of boundaries have been relevant to the proposed Project.

These boundaries along with their purpose are described below. Note that each figure relevant to the EIAR (Volume 3) will reference the appropriate boundary being shown.

Permanent CPO Boundary: The permanent Compulsory Purchase Order (CPO) boundary represents the areas of land where the ownership will transfer to KCC on a permanent basis.

Temporary CPO Boundary: This boundary represents the extents of the temporary land required to be under the control of KCC in order to execute the proposed Project during the Remediation Phase. Areas include the L2005 Kerdiffstown Road to be realigned and areas beyond the extents of the permanent CPO boundary to facilitate access for construction activities.

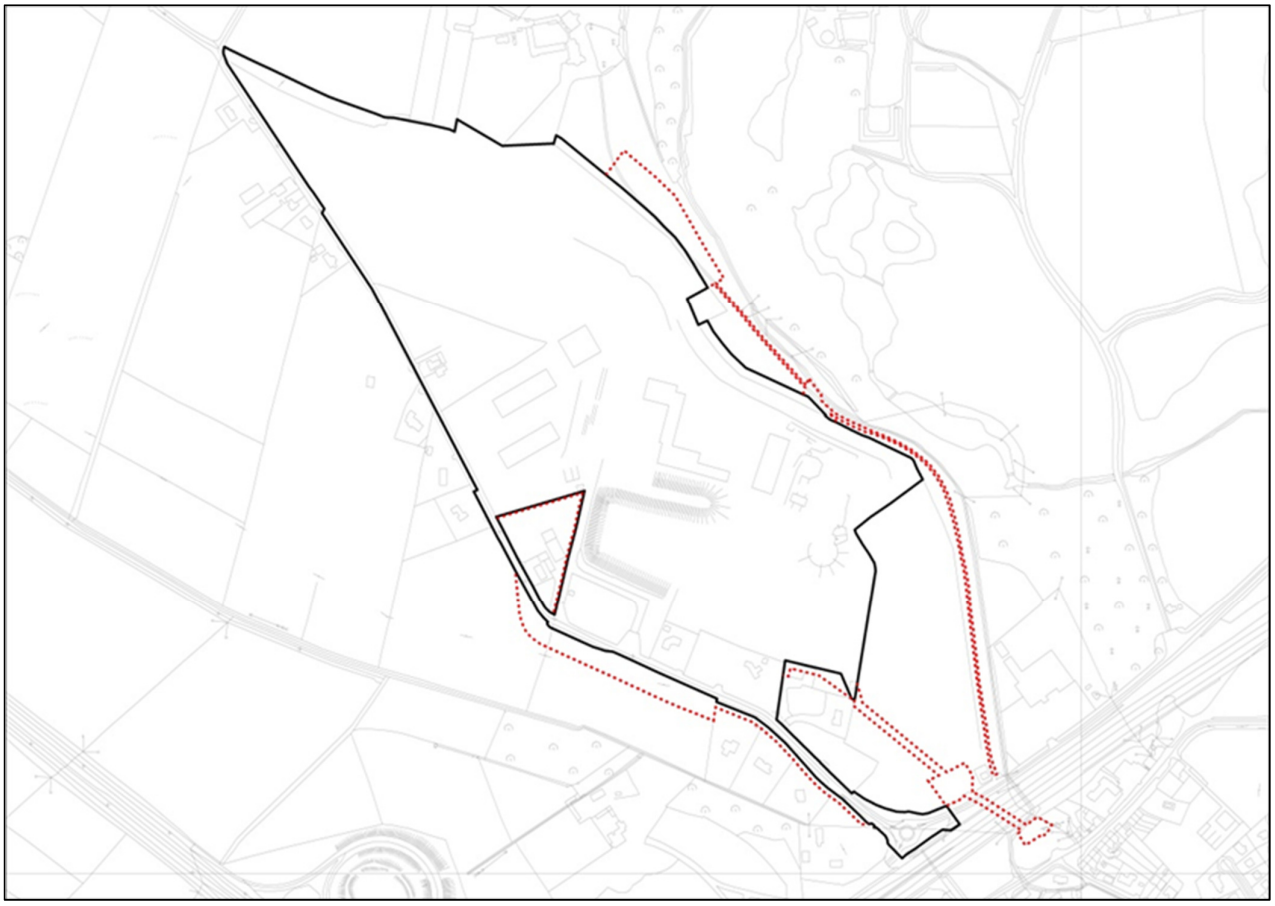


Diagram 3.2: Permanent and Temporary CPO Boundary (Permanent CPO areas are shown in black and temporary CPO areas are shown in red)

Industrial Emissions Activities Licence Boundary: The IEAL boundary falls within the permanent CPO boundary and represents the area of the site that will be subject to control under the IEAL as licenced by the EPA (subject to application).

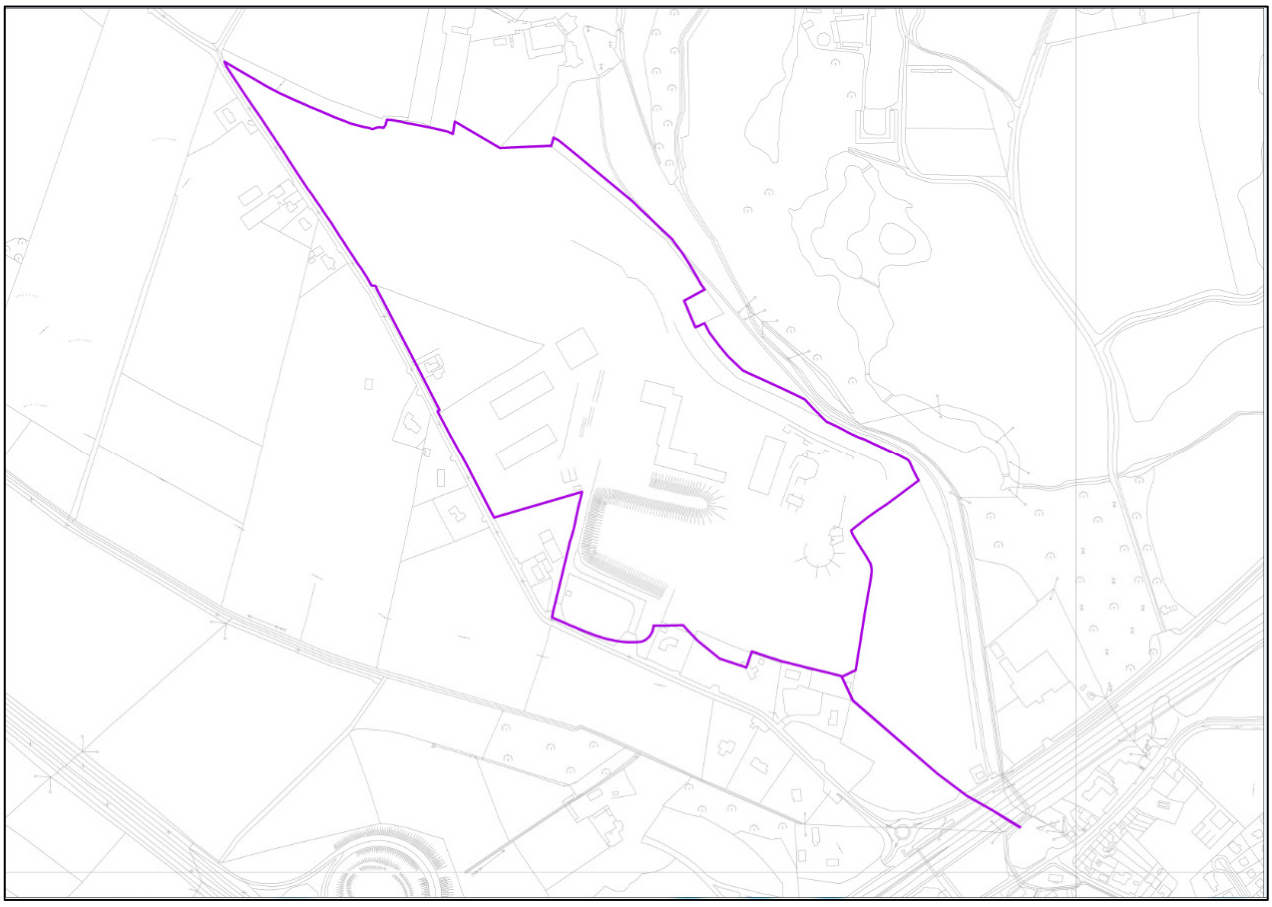


Diagram 3.3: Industrial Emissions Activities Licence Boundary

End-Use / Park Boundary: This boundary represents the area of the proposed Project that will be used as part of the multi-use public park during the Operational Phase.

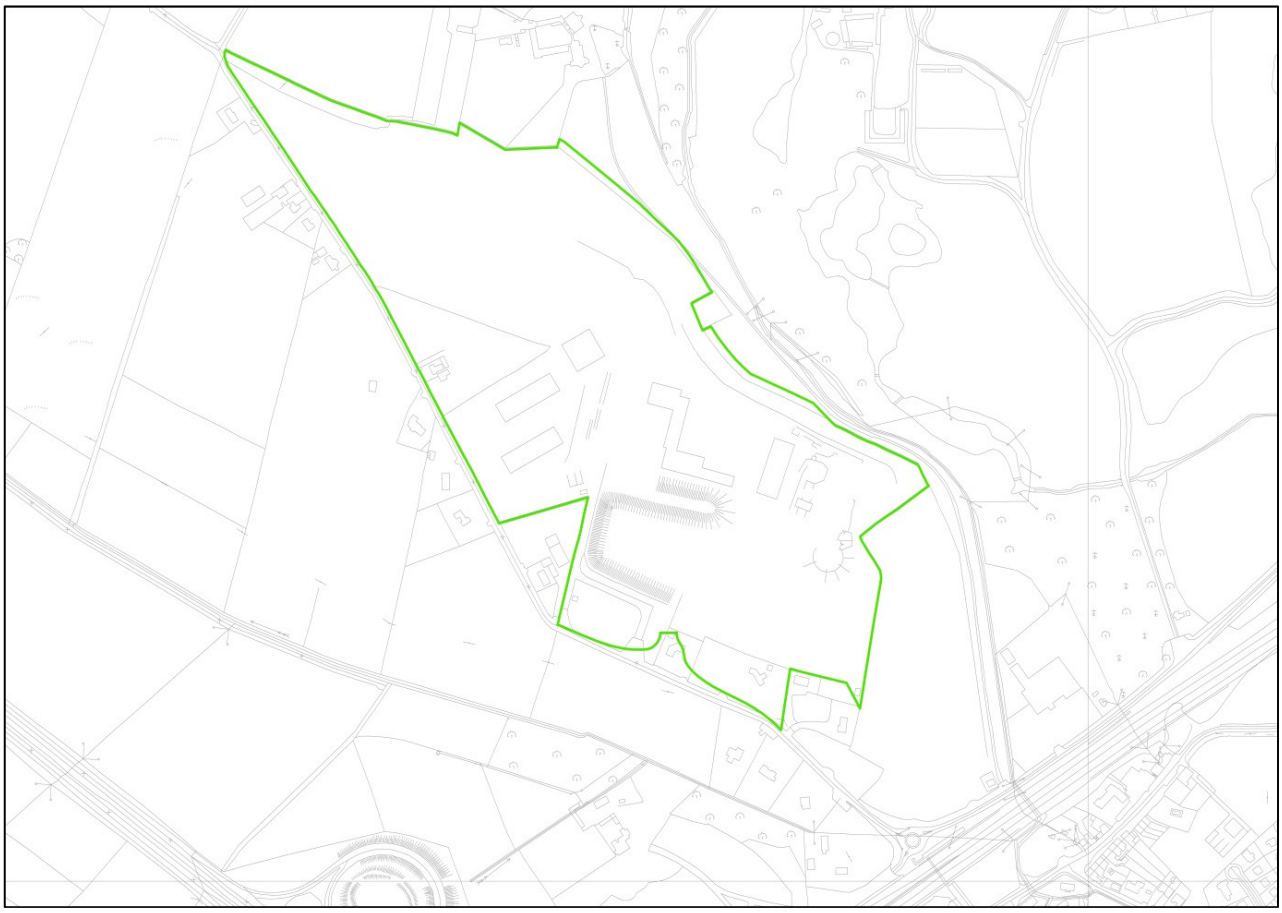


Diagram 3.4: End-Use / Park Boundary

In the consideration of environmental impacts, the assessments have been undertaken using the permanent and temporary CPO boundaries, as the area within these boundaries requires the greatest extent of land and incorporates the areas included within the Industrial Emission Activities Licence boundary and the End-Use / Park boundary.

3.4 Current Site Layout

Infrastructure currently present on site includes:

- Residual concrete walls and hardstandings from buildings and structures used as part of the historical waste processing and concrete batching activities;
- Temporary buildings housing KCC project staff and site security;
- Roads and pathways;
- Landfill gas flares (2 No.) and associated gas wells/pipework;
- Temporary low permeability cap placed over the waste mass in the lined cell to limit fugitive landfill gas emissions;
- Environmental monitoring boreholes (gas, groundwater);
- Surface water drainage infrastructure (silt separation tank, interceptor etc.);

- Lighting infrastructure; and
- Leachate collection system in Zone 3 and leachate tankers for the storage of leachate prior to off-site disposal.

The current site layout is sub-divided into a number of discrete geographical areas, or zones, each of which has its own unique characteristics, as outlined in Diagram 3.5 below. The layout of the various zones along with information on the key characteristics of the materials within each zone is summarised in the Table 3.1. The indicative location of these zones within the site is shown on Figure 3.2. Figure 3.3 shows the results of an aerial survey of the proposed Project carried out in February 2016. Refer to Chapter 12 Soils, Geology, Contaminated Land and Groundwater for information on ground investigations at the site and refer to the drawings associated with this Chapter for the locations of boreholes (BH).

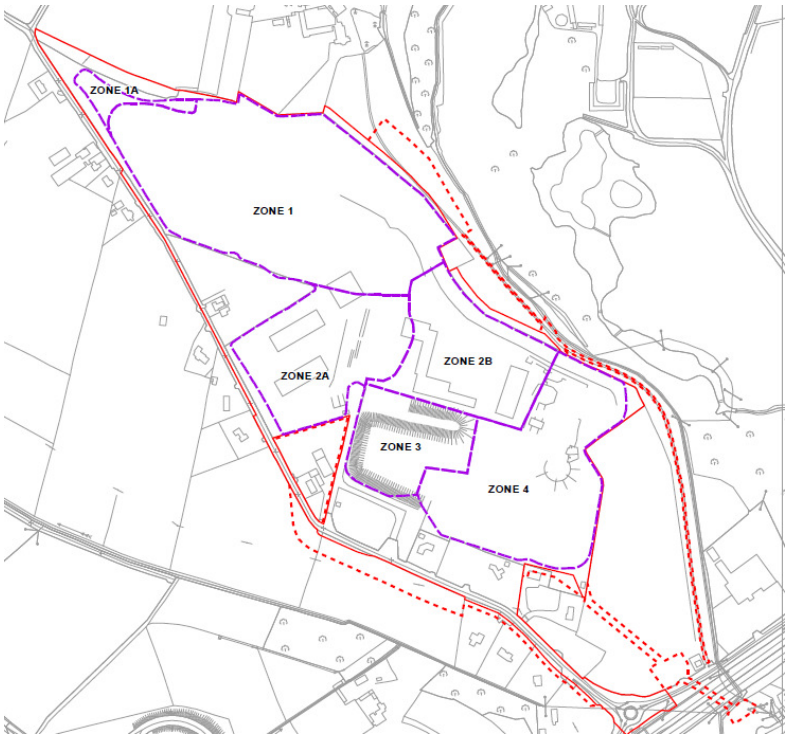
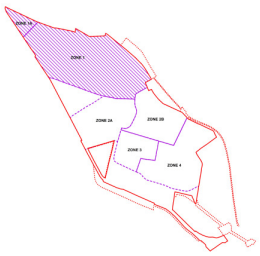
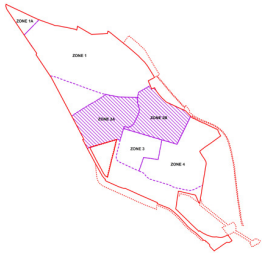
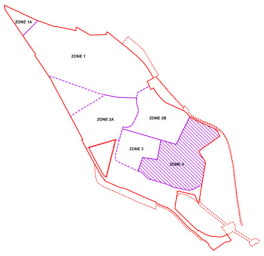


Diagram 3.5: Existing Site Layout

Table 3.1: Zones within the Proposed Project and Key Characteristics of Each Zone

Zone Number	Zone Key Characteristics
Zone 1; comprising sub Zones 1 & 1A 	• Estimated Area: 100,000m^2 • Estimated Waste Volume: 2,023,000m^3 Wastes deposited in Zone 1 located to the north-west area of the site accounts for approximately 65% of the entire estimated volume of waste on site. The wastes in this area are typically unprocessed, highly odorous and principally comprise non-hazardous mixed construction and demolition (C&D) wastes and household / Municipal Solid Wastes (MSW). C&D wastes are noted to contain varying amounts of clay, gravel, concrete, brick, wood, textile, plastic, rubber and metal. The MSW within this zone is described as having plastic, textiles, wood, ash paper, cables and steel in varying proportions. The MSW wastes are found over most of the zone, although there appears to be more C&D waste in the north-west corner of the zone (e.g. borehole EMW12 and BH18). This area has therefore been designated as Zone 1A to reflect this reduced risk profile. To the southern end of Zone 1, wastes are observed to be more silty (e.g. BH11, BH12) with C&D and MSW waste within the silt. Throughout Zone 1, where waste is encountered, it is considered that there is sufficient putrescible material (material that contains organic material which capable of decomposing) within the waste to class the wastes as non-hazardous biodegradable waste. Zone 1 is unlined and uncapped, with no means of limiting leachate generation or management. There are a series of landfill gas wells present across Zone 1, extracting gas to a flare. The average overall quality of gas from Zone 1, based on values recorded in the landfill gas extraction wells, is methane 23%v/v carbon dioxide 25% v/v and <1% v/v oxygen. The gas wells cover selected areas of the zone based on targeting areas of odour generation.
Zone 2; comprising sub Zones 2A & 2B 	• Estimated Area: 83,000m^2 • Estimated Waste Volume: 660,000m^3 Zone 2 comprises largely flat areas with thick reinforced concrete hardstandings covering an area of approximately 58,000m^2 which form an impermeable layer over the wastes and prevent direct rainwater ingress. Walls from the former buildings of the waste processing facility also remain. Wastes in this zone were observed to be unprocessed non-hazardous mixed C&D waste with varying amounts of clay, gravel, brick, concrete, wood, textile, paper, plastic, rubber and metal. Domestic waste (MSW) is also present in this area at varying depths mixed in with C&D materials. This area was originally assessed as one zone, however, review of ground investigations and subsequent monitoring data confirms that wastes in Zone 2A comprise more MSW than that in Zone 2B. Initial readings of gas shown on borehole logs show that relatively high concentrations of methane and carbon dioxide have been present in Zone 2A and 2B with two locations exceeding 20% methane. Monitoring undertaken in May and June 2017 shows a variable picture in Zone 2A with the average methane concentration ranging between 1.4% and 30 % v/v. Zone 2B shows very low concentrations of methane between 0.0% v/v and 0.9% v/v. The majority of waste in Zone 2B is reported in the borehole logs to comprise unprocessed non-hazardous mixed C&D waste with varying amounts of clay, gravel, brick, concrete, wood, textile, paper, plastic, rubber (including tyres) and metal but with MSW also present at varying depths mixed in within the C&D materials. The wastes are generally described as being dry, although damp or wet wastes are identified closer to the groundwater table with saturated wastes shown in the boreholes where waste is at the lowest elevation in Zone 2B (e.g. in BH9 and BH50). No saturated wastes have been identified in Zone 2A. The areas beyond the hardstandings are uncapped in Zones 2A and 2B. Like Zone 1, there is no means of managing leachate generated in the waste although the presence of hardstanding will limit leachate generation through infiltration.

Zone Number	Zone Key Characteristics
Zone 3 	• Estimated Area: 24,000m^2 • Estimated Waste Volume: 193,000m^3 Zone 3 comprises a cell with engineered basal and side slopes lining system, and is referred to as the 'Lined Cell'. The wastes in Zone 3 comprise a mixture of waste similar to the wastes elsewhere on site including processed non-hazardous waste derived from composting tunnels, C&D materials and unprocessed domestic waste mixed through. Substantial quantities of woodchip were used as daily cover for the waste in the cell. C&D wastes contain varying amounts of clay, gravel, concrete, brick, wood, textile, plastic, rubber and metal. Non-hazardous waste excavated from the location of the fire at the site in 2011 was also deposited in the lined cell; volume approximately 35,000m^3. Following demolition of the site buildings in 2016, non-hazardous wastes that had been stockpiled in and around the buildings was removed and deposited to the lined cell; approximate volume 14,000m^3. Zone 3 has a temporary cap applied over the existing waste mass. Landfill gas wells extract gas to a flare. The average overall quality of gas from Zone 3, based on values recorded in the landfill gas extraction wells, is methane 25%v/v, carbon dioxide 25 %v/v and <1%v/v oxygen. Pumps located within inclined risers extending to the base of the cell extract leachate for transfer to tankers and removal from the site.
Zone 4 	• Estimated Area: 45,000m^2 • Estimated Waste Volume: 227,000m^3 Zone 4 contains large waste stockpiles, redundant infrastructure and concrete tanks/bays/walls in the lower yard area, with thick reinforced concrete hardstandings covering an area of approximately 12,000m^2. The area also contains a surface water soakaway lagoon which is cut into waste deposits and into which leachate from the adjacent waste stockpiles currently drains. Stockpiles comprise both processed and unprocessed non-hazardous mixed C&D waste and household waste. The majority of waste in Zone 4 is reported in borehole and trial pit logs to comprise C&D waste with a high proportion of inert material (predominantly reported as gravelly clay) with varying amounts of plastic, timber, textiles, steel, concrete, brick, PVC pipes. The logs (30 No.) do not generally report any MSW to be present (although the logs for BH4 to BH6 do describe the wastes as MSW. However, based on the actual description of the materials and proportion of these the materials are indicative of C&D waste rather than MSW). Where gas readings have been taken and reported in the borehole logs, it is reported that methane and carbon dioxide concentrations are largely absent from the wastes or less than 1%v/v within this zone. The bottom 1 to 2m of wastes are below the water table in this area. The areas beyond the hardstandings are uncapped. The hardstandings will limit rainwater and surface water infiltration to an extent.

Interim environmental control measures currently being employed at the site are outlined in Section 3.7.

3.5 The Need for the Proposed Project

Notwithstanding the environmental controls that have been established on the site since 2011 the site (refer to Section 3.7), in its current condition, presents a significant risk and likelihood of impacts to the environment. These risks and impacts are primarily due to the presence of approximately 3.1Mm^3 of waste, off-site migration of gases, odours emanating from the uncapped waste mass, leachate migration from the site, the inability to control surface water runoff and steep and undulating slopes across the waste landform. An outline of typical key infrastructure that would be required in the development of a landfill site is provided in Table 3.2 below in comparison to the current context of the Kerdiffstown Landfill site.

Table 3.2: Typical Key Landfill Infrastructure and Current Site Condition

Site Design Element	Typical Infrastructure Provision	Current Site Condition
Groundwater Management	Landfill liner system and capping system	Minimal
Surface Water Management	Separation of waste from restored areas	Minimal
Lining System	Landfill liner system and capping system	Minimal
Leachate Management	Landfill liner system, with collection and extraction system, and capping system	Minimal
Leachate Handling	Sewer Discharge/Sustainable tankering solution	None
Landfill Gas Management	Landfill gas wells and flare/ or utilisation plant and capping system	Partial
Capping	Engineered capping system	Minimal

Key

None	no current provision
Minimal	lined cell only; 24,000m^2 of 252,000m^2, or 9%of site area
Partial	local areas across Zones 1 and 3 only.

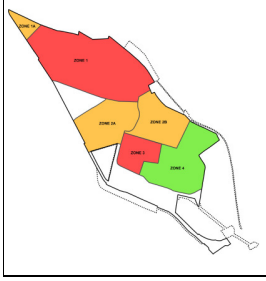
It is of note that the provision of an adequate capping system would assist in the management of several key environmental issues at the site, namely: groundwater, surface water, leachate and landfill gas control.

Table 3.2 demonstrates that there is an environmental imperative to remediate the site. This is further examined on a zonal basis below, where Table 3.1 above had shown that each zone currently has varying characteristics posing environmental risks. Identification of these key risks utilising a simplistic Red-Amber-Green (RAG) assessment based on the site layout with indicative zone layout is shown below in Table 3.3 and illustrates in broad terms the identified environmental risks posed by each of the discrete zones. Further details are presented in the relevant Chapters as referenced in the table.

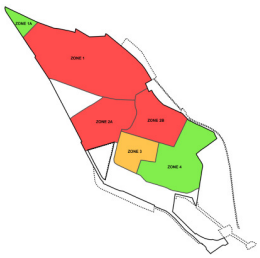
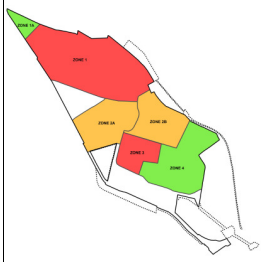
Table 3.3: Current Environmental Risks Associated with each Zone

Waste Types

Results of ground investigations have been reviewed and allowed for the assignment of relevant European Waste Catalogue (EWC) from harmonised List of Waste (LoW) codes to the waste types recorded in the borehole logs and trial pits. Further details are provided in Section 12.3.5.



Zones 1 & 3	Zones 1 and 3 present the highest risk in terms of waste types present on site as borne out by the details below in relation to groundwater contamination, landfill gas risk and odour potential. The predominant waste type located in Zone 1 and 3 is '20 03 01 Mixed Municipal Waste'.
Zones 1A, 2A & 2B	Zones 1A, 2A & 2B present a moderate risk with respect to waste types due to no '20 03 01 Mixed Municipal Waste' being identified in Zone 1A or 2A and one recorded instance in Zone 2B.
Zone 4	Principally the waste in Zone 4 has been found to be C&D waste with varying quantities of hard-core, timber, concrete and brick representing a low risk with respect to groundwater, odour and gas risk.

Groundwater Contamination For further description details see hydrogeology risk assessment in Section 12.3.17.		
	**Zones 1, 2A & 2B**	Zone 1 contains waste that lies both above and below the water table thereby representing the highest risk to groundwater contamination. Zones 2A and 2B contain both MSW and C&D waste above the groundwater table.
	Zone 3	Zone 3 (the lined cell) currently presents a low risk to groundwater as the cell was constructed with a composite liner system in accordance with EPA landfill site design guidance (compacted clay liner, GCL, geomembrane (welded)) with CQA records produced at the time of construction. However due to the presence of mixed municipal waste, the potential for rainfall infiltration through the capping system, leaching of contaminants from the wastes, deterioration of the basal liner (circa 60 years) and thus leakage through the basal liner over time with vertical and lateral groundwater migration the future risk of groundwater contamination is moderate.
	Zone 1A & 4	Zone 1A contains no significant putrescible waste deposits. This area therefore presents a low risk of groundwater contamination. In Zone 4 the principal wastes are C&D in nature and as a result largely inert. Thereby presenting a low risk of groundwater contamination.
Landfill Gas Chapter 7 Air Quality, Odour and Climate details the impacts associated with the generation of landfill gas on the site. Appendix A4.5 Landfill Gas Management Plan presents a risk assessment undertaken for the proposed Project.		
	**Zones 1 & 3**	Zones 1 and 3 will continue to generate significant quantities of landfill gas requiring active extraction and management. These zones therefore present the highest risk associated with landfill gas generation.
	Zones 2A & 2B	Zones 2A and 2B have varying depths of waste materials which have relatively lower biodegradability than the wastes within Zones 1 and 3 and are therefore predicted to produce lower quantities of landfill gas. The overall risk of landfill gas generation from these zones is considered to be moderate.
	Zone 1A & 4	In Zone 4 the principal wastes are C&D in nature and as a result are largely inert. There are no significant putrescible waste deposits present in Zone 1A. These zones present a low risk of landfill gas generation.
Odour Potential The below assessment is based upon the nature of the waste as recorded in the ground investigations, site observations and monitoring undertaken since 2011. Chapter 7 Air Quality, Odour and Climate provides details of the impact assessment of odour as part of the proposed Project.		
	**Zones 1 & 3**	Zones 1 and 3 present the highest risk in terms of odour generation potential due to the presence of MSW and C&D waste. Zone 1 is currently unlined and uncapped with a series of landfill gas wells extracting gas to a flare. Zone 3 has a temporary cap applied over the existing waste mass.
	Zones 2A & 2B	Across Zones 2A and 2B the wastes are generally described as being dry, although damp or wet wastes are identified closer to the groundwater table with saturated wastes shown in the boreholes where waste is at the lowest elevation in Zone 2B. No saturated wastes have been identified in Zone 2A. The zones are also covered with thick concrete hardstanding which act as a cap to the waste mass.
	Zone 1A and 4	Zone 1A to the north-west extents of the site does not contain MSW and hence is unlikely to generate odour. Zone 4 contains predominantly C&D waste with a high proportion of inert material and presents a low risk in terms of odour generation.

The remediation proposals are discussed in Chapter 4 Description of the Proposed Project.

In terms of engagement and consultation with the public and commitment to the Aarhus Convention, KCC is committed to:

- Clearly articulating how key decisions forced on the project by the constraints of the site have been arrived at; and
- How alternatives were considered, including the grounds on which they were rejected in favour of the overall best environmental risk reduction profile.

A description of the alternative remediation options is provided in Chapter 5 Consideration of Alternatives. A range of consultation has been undertaken with statutory stakeholders and the public, with details of the consultations provided in Chapter 6 The Consultation Process.

3.5.1 Remediation

Potential scenarios for long term remediation of the site were identified to address the key environmental liability issues. Remediation is required to meet the following broad objectives:

- Reduce or limit future leachate impact upon groundwater and surface water receptors and reduce/control the future production of leachate from the site;
- Ensure landfill gas is managed and controlled in such a way that it does not constitute a future risk to nearby properties, residents and other identified receptors;
- Address odour generation, both in the long term and also potentially of more significance during future remedial works; and
- Provide a future landform and end-use which fits within planning and any other relevant licencing conditions.

Taking cognisance of these objectives, current on-site environmental controls, and constraints of planning and licensing status of the site, the following Sections set out the key activities and the requirements for remediation.

3.5.2 Leachate Management and Groundwater Control

Contamination of groundwater beneath the site largely arises from the high organic and inorganic contaminant concentrations found in landfill leachate. The majority of the site is unlined and therefore there is a potential migration pathway for the leachate into the underlying aquifer systems.

Contaminants typical of landfill leachate have been found in groundwater samples taken from the sand and gravel overburden deposits beneath the site.

The absence of current evidence to show contamination linkage between the site and the Morell River does not remove the need for remediation measures. The European Communities Environmental Objectives (Groundwater) Regulations 2010 (S.I. No. 9 of 2010) places a duty on public authorities to take all reasonable steps to prevent the input of hazardous substances and limit the input of non-hazardous substances to groundwater and reverse any significant and sustained upward trend in the concentration of any pollutant resulting from the impact of human activity in order to progressively reduce pollution of groundwater. The ‘prevent’ objective relates to hazardous substances, whereby all necessary and reasonable measures should be taken to avoid the entry of such substances into groundwater and to avoid any significant increase in concentration in groundwater, even at a local scale. The ‘limit’ objective relates to non-hazardous substances, whereby all necessary measures should be taken to limit inputs into groundwater to ensure that such inputs do not cause deterioration in status of groundwater bodies, or a significant and sustained upward trends in groundwater concentrations.

Given the potential impacts of the contaminants associated with leachate on water quality and ecology within the Morell River, principally through potential migration in a shallow groundwater pathway, leachate must be managed to prevent it entering water or to ensure the risk of impact is at an acceptable level. This would be achieved by installing a capping system over the predominant areas of waste in the site to reduce infiltration and managing leachate head in Zone 3 (lined cell) to an appropriate level. The assessment of viable remediation options has established that the complete prevention of leachate ingress into the groundwater system is not technically feasible and/or would be disproportionally costly, where the Groundwater Directive permits exemptions in this scenario.

Leachate abstracted from the lined cell is also managed through use of road tankers, travelling over 100km on a round trip to a licensed Wastewater Treatment Plant (WWTP) for disposal. This is not considered to be a sustainable long-term option.

The installation of engineered capping and soil cover systems across the site will reduce infiltration of water and hence the potential for leachate generation and migration to groundwater, giving a reduction to the environmental risk profile of the site to a likely acceptable level.

Further information with respect to hydrogeological conditions at the site is presented in Chapter 12 Soils, Geology, Contaminated Land and Groundwater.

3.5.3 Landfill Gas and Odour Control

Odour emissions at the site are primarily linked with diffuse landfill gas emissions, while other potential secondary odour sources include the lined cell and gas flare emissions from the current landfill gas flares on site, one operational flare and one back-up flare. The lack of a capping system across the largest area of gas generating wastes (Zone 1) affects capture efficiencies and permits the continued release of methane to the atmosphere. Works to control odour release is reactive, based on monitoring and hence is not considered to be a sustainable long-term option.

Remediating the site will include the completion of the lined cell, installing a permanent engineered capping system across the site and installation of new landfill infrastructure to manage landfill gas generated at the site.

Further information with respect to air quality at the site is presented in Chapter 7 Air Quality, Odour and Climate.

3.5.4 Surface Water Control

The Morell River to the east of the site and the Canal Feeder Stream to the west are the key surface water receptors in the vicinity of the site and a potential environmental pathway exists via migration of leachate through shallow groundwater towards the surface waterbodies. Chemical analysis of the river water undertaken to date does not indicate any impacts caused by contamination from the site and there is no evidence to suggest deterioration in the ecological status of the Morell River in the vicinity of the site. However, in terms of contamination issues potentially affecting the Morell River two key risks remain:

- Direct contamination from the site in its unremediated state; and
- Management of surface water during and following future site remediation.

Currently, as rain falls on the site there is the potential that it may become contaminated due to contact with wastes at the surface which may either dissolve into the surface water runoff or the surface water runoff may carry suspended particles. These particles may be contaminated with, for example, metals or the silts themselves may cause a problem by settling out on the beds of rivers and smothering flora and fauna that grow on the river bed or block channels leading to an increased flood risk.

Remediating the site using capping systems will assist in separating surface waters from wastes, allowing the management of clean surface water and its discharge to the Morell River.

3.5.5 Landform Design

The landform created by future remedial works needs to be stable and safe, avoiding steep slopes, eliminating drops and sudden changes in gradient. The landform also needs to be able to accommodate potential future settlement caused by the continuing degradation of waste beneath the surface while at all times needing to facilitate drainage of surface waters efficiently to minimise infiltration and avoid the potential for surface ponding, waterlogging and flooding.

3.5.6 Site Use

The site is presently not in a condition that is beneficial to any end-use, and continues to pose a risk to the environment and human health. With the remediation works mitigating the risks to an acceptable level there is also an opportunity to develop the site to provide a positive amenity use for the local community, whilst protecting the site infrastructure and managing the site during the remainder of its lifecycle.

The proposed Project is outlined in Chapter 4 Description of the Proposed Project and the potential environmental impacts have been assessed in Chapters 7 to 17 inclusive and, where appropriate, mitigation has been proposed.

3.6 Area Surrounding the Proposed Project

The proposed Project is located in an area with a mix of land uses, including golf courses to the north and east and lands associated with Kerdiffstown House to the north-east and east. Properties to the south and east comprise a number of residential, commercial and agricultural properties and worked out quarries to the north-west. The L2005 Kerdiffstown Road from Sallins to Johnstown bounds the western site perimeter. The Morell River is the closest surface water body, located immediately to the east of the site.

Key residential and commercial receptors in proximity located within 1km of the proposed Project boundary are identified on Figure 3.4, listed with a receptor identification (ID) number as outlined in Table 3.4. Where Chapters 7 to 17 of this EIAR identify potential impacts of the proposed Project on the receptors the receptor ID is stated for reference and clarity.

Table 3.4: Receptors within 1km of the Proposed Project Boundary

Receptor ID	Full Receptor Name
Residential Receptors (or group of Receptors)	
REC001	Kerdiffstown House and lands – a recreational facility run by the Saint Vincent de Paul
REC002 to REC037	Residential Dwellings (or group of dwellings)
REC038	Larchfield Nursing Home
REC039 to REC041	Residential Dwellings (or group of dwellings)
Commercial Receptors	
COM001	Palmerstown House Estate (and Golf Club)
COM002	Johnstown Garden Centre
COM003	The Johnstown Inn
COM004	Centra (Johnstown)
COM005	Discount Designer Tiles and Bathrooms Showroom
COM006	Londis Logistical Distribution Centre
COM007	Mike Brown Caravans
COM008	Former Cement Factory / Proposed Applegreen Service Station (planning application status: withdrawn)
COM009	Naas Industrial Estate
COM010	The Globe Retail Park
COM011	Monread Commercial Park
COM012	Centra (Monread Rd, Naas)
COM013	FirstStop/Healy's Car Repair and Maintenance
COM014	Green Isle Foods
COM015	ESB Electricity Sub-station
COM016	Former/Inactive Quarry
COM017	Naas Golf Club
COM018	Naas Driving Range

3.7 Current Environmental Controls

3.7.1 Summary

As part of their commitment to manage the immediate environmental and health and safety risks the EPA and, latterly, KCC have implemented a range of interim measures to address the key environmental and health and safety concerns posed by the site, particularly addressing leachate and landfill gas production at the site. The principal interim measures put in place under Section 56 of the Waste Management Act 1996 (as amended) to prevent and limit environmental pollution are summarised below:

- Control of landfill gas through the use of gas well fields and gas flares. Currently only one flare is required (known as the 250 flare), and operates 24 hours a day seven days a week, fed from two independent gas fields: one within the lined cell (Zone 3) and one across Zone 1.
- Reduction of odours generated from the landfill through use of the gas management system. Gas and odour generation is, to a large degree, interlinked.
- Temporary capping of waste in the lined cell (Zone 3). Wastes generated from the post-fire clean-up operations were deposited to the lined cell (Zone 3). Further wastes, compliant with the acceptance criteria for a non-hazardous landfill, removed from within the buildings and structures demolished in 2016 have also been transferred to the lined cell. The temporary capping system limits landfill gas and odour release as well as reducing leachate generation.
- Non-compliant wastes removed from the site for re-use, recycling or disposal, including wooden poles, tyres and gas bottles.
- Provision of leachate extraction facilities in the lined cell located in Zone 3. Leachate collected in the base of the cell is extracted via pumps in inclined risers, for temporary storage in tanks. Road tankers then extract the leachate from the tanks on a daily basis for off-site disposal at Ringsend Wastewater Treatment Plant (WWTP).
- Demolition of unsafe buildings and structures on the site. Several supporting structural members had been previously removed from buildings and structures which were part of the former waste processing facility as a result of scavenging of metals at the site. The buildings were thus unsafe to access and represented a health and safety risk.
- Employment of a full time KCC Site Manager. The KCC Site Manager is involved in the daily management of the gas and leachate systems and oversees a number of other key environmental monitoring and surveillance activities at the site (e.g. monitoring of surface water, supervision of appointed contractors, security, health and safety inductions, and liaison with interested third parties).

The above measures are currently maintaining a stable condition in terms of environmental impacts. However, the measures are insufficient to fully mitigate the risks to public health and safety and the environment, and are not technically sustainable in the longer term.

3.7.2 Leachate

Wastes deposited in the lined cell in Zone 3 during the operation of the landfill, a portion of waste deposited during the post-fire clean-up operations and waste arising from the demolition of buildings have been covered using a temporary capping system to reduce water infiltration and hence leachate generation. Surface water runoff from the cap is directed away from the waste mass into a channel which flows towards a surface water soakaway located in Zone 4.

Leachate that collects in the lined cell in Zone 3 drains under gravity towards the south-west and north-west corners where pumps, located in inclined risers, remove leachate. Leachate is pumped to two temporary static leachate storage tanks at the top of the south slope of the cell. The leachate pumps are operated through a fully automated system with low and high level sensors located within the sumps and automatic cut-off float switches positioned within the storage tanks. When the level in the cell is high and the tank connected to the riser is empty the pump positioned in the riser turns on. The pump is switched off automatically when the storage tank is full (controlled by a float switch). The two tanks hold approximately 28m^3 in total when filled. The tanks are used to

store leachate prior to removal off site by road tanker for treatment/disposal to Ringsend Wastewater Treatment Plant. As the storage tanks are emptying, the float switches drop down and the leachate pump is switched back on allowing the tanks to fill again. This cycle continues until the leachate within the sump hits a low level mark and the pump is switched off automatically. The pump will then only switch back on when a high level has been reached within the sump.

Up to four tanker loads are removed from the site on a daily basis, each requiring a more than 100km round trip. This is not considered to be a sustainable long-term solution.

3.7.3 Landfill Gas

Currently landfill gas is controlled in Zones 1 and 3 through the use of gas well fields and a landfill gas flare. The positioning of gas wells in Zone 1 has been targeted to reduce effects where odours have been detected during routine monitoring. Currently there are 25 gas wells in Zone 1, covering an approximate area of 9,200m^2. As Zone 1 represents a total area of approximately 100,000m^2 the capture of landfill gas is currently achieved across only 9% of the zone.

In Zone 3 wastes have been covered with temporary capping comprising a heavy duty membrane to assist with odour management and to reduce air from being drawn in during gas extraction operations. There are currently 14 gas wells located in the cell to enable gas extraction.

There are two flares on site: one with 250m^3/hr capacity (known as the “250 flare”); the second with 500m^3/hr capacity (known as the “500 flare”). Valves are incorporated within the pipework systems to enable gas from both Zone 1 and Zone 3 fields to be directed to a single flare, or to separate flares, depending on gas yields and quality. Currently, all gas extracted is being burned at the 250 flare, with the 500 flare acting as standby flaring unit. This is due to poor gas extraction rates (a function of Zone 1 being uncapped) and limited gas quality due to waste types and degradation rates present at the site. Continuous flare stack monitoring has been set up on site with remote access from a portable device managed via a data logger supplied by the flare manufacturer.

3.7.4 Environmental Monitoring

Since 2011 groundwater and surface water monitoring has been routinely undertaken both on-site and off-site. In June 2014 a robust environmental monitoring programme was established, and includes:

- Groundwater;
- Surface water;
- Leachate;
- Landfill gas;
- Dust;
- Odour;
- Geotechnical assessments;
- Geophysical surveys;
- Volatile Organic Compounds (VOC) surveys;
- Meteorological data; and
- Noise.

A summary of current conditions observed from the monitoring data is outlined below.

Groundwater

Groundwater monitoring shows high hydraulic conductivity in sand and gravel deposits, particularly to the east and north-east of Zone 1. Clay deposits are reported to be more present to the west of Zone 3 and as a consequence the hydraulic conductivity is considerably lower. Estimated groundwater velocity is quite high and

the sand and gravel aquifer appears to have high permeability, with the hydraulic gradient inevitably steep as the topographic gradient steeply falls away from the site towards the Morell River. Therefore, there is a potential flow pattern from the site towards the Morell River. The mean flow in the Morell River has been measured at around 66,500m^3/day and based on the estimated groundwater flux to the river contaminant concentrations in groundwater discharging to the river would be diluted within the river.

The principal contaminants associated with leachate include ammonia (directly toxic to fish and other aquatic life), dissolved organic material (mainly organic acids) which give rise to high demands for oxygen chemical oxygen demand (COD), and biological oxygen demand (BOD) which can deoxygenate waters (leading to fish kills) and chloride (which increases salinity of water and changes ecological make-up).

Investigations and monitoring undertaken at the site have identified a number of potential contaminants of concern (e.g. ammoniacal nitrogen and chloride) and other physical indicators (e.g. reduced oxygen levels) within shallow groundwater beneath and adjacent to the site which are generally indicative of a plume of contamination which shares many of the characteristics of landfill leachate. The existing groundwater conditions are discussed in more detail in Chapter 12 Soils, Geology, Contaminated Land and Groundwater.

Groundwater levels in the overburden deposits show a general fall from south to north indicating a broadly northerly flow of groundwater. However, the data also shows a complex pattern of radial flow with an area of high groundwater levels across Zone 1. Available groundwater level data in the bedrock indicates a south to north flow direction. Information available on the Morell River indicates hydraulic continuity between water in the River and the surrounding groundwater. It is likely that groundwater to the east of the site is in hydraulic connection with the river.

Surface Water

Surface water sampling from the Morell River and Canal Feeder Stream is undertaken at key locations during monthly monitoring rounds to assess whether the landfill is having an adverse impact upon water quality within these water bodies.

Results from the surface water samples indicate that water quality in both the Morell River and the Canal Feeder Stream is good. Water quality in the downstream samples was very similar to water quality in the respective upstream samples. However, with respect to chloride, concentrations in the Morell River have been observed in past monitoring rounds to increase very slightly (generally by 1 to 2 mg/l) as the river flows past the site. These slight increases may be attributed to other sources unrelated to the site i.e. runoff from roads or sampling/ analytical error.

The most recent biological quality rating assessment took place in September 2016 in the Morell River and the Rathmore Stream. The Rathmore Stream is also known as the Hartwell River in some reports including the Water Quality Assessment of the Morell and Hartwell Rivers Adjacent to Kerdiffstown Facility in Co. Kildare, Aquens, 2016. It was found that there was a slight deterioration in Q-values both upstream and downstream of the site since the previous assessments (refer to Section 11.3.2 and Section 13.4.4 for further information. However, there was no indication that the site is currently causing any discernible impact on the Morell River as it passes the site.

Leachate Analysis

Monitoring of leachate from the lined cell in Zone 3 is undertaken via a sample recovered from the leachate storage tanks sampling leachate as pumped from the lined cell only. Sampling is carried out on a weekly basis.

In late 2016 wastes from buildings at the site were deposited into the lined cell in Zone 3, covering over the remaining open area of the basal aggregate drainage blanket. Prior to this rainfall would have affected the concentrations of leachate due to the capture on the drainage blanket, varying leachate production and quality. High or prolonged rainfall events had been seen to lead to increased amounts of leachate being produced in the lined cell, whilst diluting the leachate lowering concentrations of pollutants. Contaminant peaks generally corresponded with drier periods (e.g. July) while wetter periods (e.g. December) show decreases in pollutant concentrations.

Landfill Gas

The amount of landfill gas being produced from both the lined cell and the Zone 1 gas fields has been observed as falling since flaring began in 2011. Due to frequent flare shutdowns as a result of poor gas quality, wells in the lined cell have been closed off for periods of three to four days each week in order to allow the methane concentration to build up to a sufficient level to support the continued operation of the flare. Gas models which assess the gas potential from the site have demonstrated that approximately 600m^3/hr should be produced in 2017, whereas currently 100m^3/hr is captured through the flare. This is due to the gas field only covering a proportion of the site. Modelling suggests that gas potential will continue to decrease, with a level of 150m^3/hr indicated by 2040.

There are a limited number of perimeter gas monitoring boreholes at the site. Migration has not been detected in existing boreholes. Migration is unlikely due to the current uncapped condition of the site, where gas discharges to air. New boreholes were installed in 2016 and further perimeter gas monitoring boreholes are programmed to be installed during 2017 to assist in development of baseline information in advance of the Remediation Phase commencing.

Dust

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.

Odour

Odour monitoring has been conducted on a monthly basis since 2014. Odour monitoring has also been undertaken in the past in response to odour complaints to the EPA or KCC. Odours were not detected at any of the ten off-site monitoring locations in 2015. At the two on-site monitoring locations intermittent faint to strong odours were observed within the site around the '250 flare' and at the security cabin located on Zone 1. Odours are commonly detected in both these areas depending on prevailing winds. Odour occurrences are currently being minimised through best practice and regular monitoring. Five further gas wells were installed in 2016 targeting areas where odours had been detected. Monitoring will continue and where necessary, remedial works undertaken to control odour emissions.

Geotechnical Assessments

Geotechnical assessments have shown that existing waste slopes are undulating and, in places, at gradients of up to 1v:1.5h. This is considered over-steep for waste profiles and although no signs of slippage have been observed in the biannual surveys undertaken since 2014, insufficient information exists to demonstrate that slope failure will not occur. Due to the nature of the wastes (largely C&D wastes) it is considered unlikely that catastrophic slope failure will occur. However, the current gradients on the site are insufficient to permit installation of a capping system or to manage surface water runoff effectively.

Geophysical Surveys

Geophysical surveys have been undertaken annually since 2011 along the eastern boundary of the site. The purpose of conducting a geophysical survey is to highlight any potential contaminant plumes in the area of the Morell River.

Surveys have found elevated electrical conductivity levels indicative of groundwater contamination along the eastern boundary with these results matching well with groundwater monitoring results. Subsequent surveys have not confirmed elevated conductivities in the area suggesting that the results may have been anomalous due to interference. Monitoring has continued with conductivity readings suggesting a plume exists immediately adjacent to the site boundary though not discharging to the river.

VOC Surveys

VOC surface emissions surveys have been undertaken since 2011 to detect surface emissions of gas and make recommendations regarding potential improvements to the landfill gas infrastructure. Surveys were carried out at the site in 2011, 2012, 2014, 2015 and 2016. Surface emissions zones have been found at greater than or equal to 500ppm maximum VOC concentration around identified features e.g. landfill gas wells, and at greater than or equal to 100ppm VOC (instantaneous reading) on open surfaces.

Meteorological Data

Meteorological information is obtained on a monthly basis from the on-site weather station and from Casement Aerodrome available from Met Éireann. Information on rainfall, temperature, wind speed and direction is collated for inclusion in relevant reports including the monthly and annual environmental reports.

Noise

Various noise surveys have been carried out at the Kerdiffstown site in the past. A baseline noise survey was conducted in September 2016, comprising day and evening time surveying. Noise surveys have found that the main source of noise in the vicinity of the site is traffic noise from the N7 dual carriageway and M7 motorway, as well as occasional traffic on the L2005 Kerdiffstown Road adjacent to the site.

3.7.5 Investigations to Characterise Site Conditions

Since 2010 a series of intrusive and non-intrusive investigations have been carried out to provide detailed characterisation of the site and the surroundings. The primary objective of these investigations was:

- To evaluate the depth and extent of waste across the site;
- To assess the characteristics of the waste in terms of composition and leachate presence;
- To identify the nature of the natural ground underlying the wastes;
- Evaluation of groundwater conditions beneath and surrounding the site; and
- To install monitoring boreholes for ongoing sampling of landfill gas and groundwater samples.

These investigations have been used to inform the outline design of the remediation works. Further details on the ground investigations can be found in Chapter 12 Soils, Geology, Contaminated Land and Groundwater.

3.7.6 Demolition and Waste Removal Works

A number of substantial steel framed buildings and structures had been left in an unsafe state following the deterioration over time of structural members for scrap. This had meant that substantial areas of the site were inaccessible to project personnel. Wastes were also known to be contained within the buildings and thus could not be removed for storage within the lined cell.

Works were undertaken in 2016 to demolish these unsafe buildings and other disused infrastructure to allow unrestricted access to these areas of the site. Steel superstructures were demolished and materials removed from the site for recycling. Waste materials located within and around these structures were deposited in the lined cell (Zone 3) and were determined to be compliant with the acceptance criteria for a non-hazardous landfill. Wastes which were categorised as non-compliant, such as gas bottles, tyres, and timber (creosote coated) poles, were removed from the site for re-use or recycling. Contents of silo's and a tank were categorised and the liquid contained in the tank assessed as hazardous due to elevated total petroleum hydrocarbons (TPH) concentrations.

A significant number of tyres remain on the site, being utilised as a wind anchor to the temporary capping system in the lined cell (Zone 3).

3.8 Needs for the Proposed Project – Waste Policy Perspective

The development of the proposed Project is supported by waste policy set out at both national and regional levels.

3.8.1 A Resource Opportunity – Waste Management Policy in Ireland 2012

Current National Waste Management Policy – *'A Resource Opportunity – Waste Management Policy in Ireland, 2012',* notes the further investment required by the State to deal with landfill sites and illegal landfill sites. A 2005 European court of justice judgement, which found systematic failures in the waste management regulatory regime, dealt with such illegal landfill sites through an agreed programme of measures. While the proposed Project did not form part of the judgement, the commitment to the programme of measures demonstrates the States ongoing commitment to investing in the remediation of problem sites.

Furthermore, the policy commits to reviewing options in relation to the beneficial use of closed landfill facilities.

The development of the proposed Project will demonstrate remediation of the landfill site with a beneficial end-use in the operation of the multi-use public park.

3.8.2 Eastern–Midlands Region Waste Management Plan (EMRWMP) 2015 – 2021.

The Eastern-Midlands Region Waste Management Plan (EMRWMP) 2015–2021 advocates the protection of the environment and health of citizens in the region from potential adverse impacts resulting from waste management activities. The strategic objective agreed by the Local Authorities is to *'apply the relevant environmental and planning legislation to waste activities in order to protect the environment, in particular European Sites and human health against adverse impacts of waste generated'.*

The EMRWMP also recognises the need to address legacy, historic and closed landfills in the region within which the proposed Project is located.

The Plan identifies that risk to environmental receptors, such as groundwater and surface water, from waste buried at these sites needs to be tackled and minimised. The approach to the management of these environmental risks has been addressed in the EIAR, Industrial Emissions Activities Licence (subject to approval by the EPA) and other supporting environmental and engineering assessments for the proposed Project.

3.9 Local Policy Context

3.9.1 Kildare County Development Plan 2017 – 2023

The preferred development strategy of the Kildare County Development Plan 2017-2023 (KCDP) has been informed by the Regional Planning Guidelines and the environmental sensitivities of the county. It is based on building strong urban centres while protecting the rural hinterlands. The KCDP contains a specific policy in relation to the proposed Project. Policy WM16 states that the KCC will:

> *"Work in conjunction with Government departments and agencies and all other relevant stakeholders to remediate Kerdiffstown landfill in a socially, economically and environmentally sustainable manner that will both manage and reduce environmental risk and accommodate an appropriate end – use that is compatible with the established character of the area."*

The proposed Project is located in proximity to Naas which is classified as 'Large Growth Town 1' and within the multi-modal transport corridor. The proposal seeks to manage the environmental risk that exists on the site, while providing an appropriate end-use that will benefit the local and wider community and environment.

3.10 References

- Environmental Protection Agency (2010). Evaluation of Environmental Liabilities at Kerdiffstown Landfill, SKM Enviros, Final Report
- SKM Enviros (2013). Kerdiffstown Landfill Remediation Project Remedial Options.
- Aquens Ltd (2012). Water Quality Assessment of the Morell and Hartwell Rivers Adjacent to the Kerdiffstown Facility in Co. Kildare
- Aquens Ltd (2015). Water Quality Assessment of the Morell and Hartwell Rivers Adjacent to the Kerdiffstown Facility in Co. Kildare
- Aquens Ltd (2016). Water Quality Assessment of the Morell and Hartwell Rivers Adjacent to the Kerdiffstown Facility in Co. Kildare
- S.I. No. 9 of 2010. Environmental Objectives (Groundwater) Regulations (2010).

4. Description of the Proposed Project

4.1 Introduction

Kerdiffstown Landfill is located in County Kildare and comprises a former quarry, landfill and waste processing facility, occupying an area of approximately 30 hectares. The site has been progressively backfilled with wastes since around 1950 until 2010. Further details of the site history are outlined in Chapter 3 The Need for the Proposed Project. The proposed Project comprises the remediation of the site to reduce the risks posed by the site in its current condition to public health and safety and the environment, whilst developing the site to provide an amenity to the local community, comprising a multi-use public park (the Remediation Phase). Following the Remediation Phase, the site will continue to be managed by KCC, and regulated by the Environmental Protection Agency (EPA), as a remediated landfill, whilst operating as a multi-use public park (the Operational Phase).

The main features associated with the proposed Project comprise:

- Instigation of a remediation solution including the reduction of waste footprint at the site and installation of an engineered capping system (see Section 4.2.7);
- Installation of new environmental management and control systems including leachate and landfill gas. The leachate management system will include construction of a buried pipe to transfer leachate from the site, crossing under the Morell River and connecting to Johnstown Pumping Station and then onward to Osberstown Wastewater Treatment Plant (WWTP) (see Section 4.2.8);
- Development of a public park with multi-use sports pitches, car parking, changing room building, children's playground and a network of paths across the site including provision of services and foul drainage to the public sewer network (see Section 4.7); and
- Upgrading access to the site from the L2005 Kerdiffstown Road including the realignment of the L2005 Kerdiffstown Road and provision of footpath and cycleways adjacent to the realigned road to enable safe passage of passers-by during remediation works and for access to the multi-use public park during the Operational Phase (see Section 4.2.3).

This Chapter of the EIAR describes the main features of the proposed Project including maintenance and aftercare requirements for the proposed end-use. The details presented in this Chapter are the result of the outline design stage only and refinements in relation to the proposed Project will be further defined at the detailed design stage(s). However, sufficient design detail has been provided to ensure that comprehensive impact assessments have been completed and documented in this EIAR. Assessments of the 'worst case' scenario have been undertaken where detailed design may consider a number of options. Whilst the proposed Project is not a new landfill development the remediation proposals take cognisance of relevant guidance and good industry practice, most notably that from the Environmental Protection Agency, as referenced in Section 4.9.

Embedded within the design for the Kerdiffstown Landfill Remediation Project (KLRP) are the following broad objectives:

- The removal of risks to public health and safety;
- A reduction in the environmental risk profile of the site to an acceptable level;
- Delivery of a remediation solution which is acceptable to the local community;
- Completion of the remediation works within 8 years; and
- Integration of sustainability and sustainable design and development in both the remediation and post closure works (operation of the multi-use public park).

A description of the existing site is provided in Chapter 3 The Need for the Proposed Project with existing site layout shown on Figure 4.1. The main features of the proposed Project are outlined in Section 4.2, with descriptions of the key aspects detailed in the following Sections. The end-use proposals for the site are provided in Section 4.7.

Section 4.3.3 outlines the materials required to be imported to facilitate the remediation of the site and achieve the proposed end-use. The site will not be operated as a landfill for the deposition of new wastes except for the acceptance of inert soils to be imported to the site to facilitate remediation, end-use, environmental management and maintenance/ aftercare requirements as applicable. All materials imported to the site will be required to meet detailed specifications associated with the proposed engineering use. Section 4.6 provides a description of existing waste materials at the site that will be recovered or require to be disposed of as part of the proposed Project. Chapter 5 Consideration of Alternatives presents the alternatives considered for the site remediation and end-use proposals.

4.2 Main Features of the Proposed Project

4.2.1 Remediation Strategy

Optioneering to assess remediation strategies for the proposed Project (Kerdiffstown Landfill Remediation Project Remedial Options Report, SKM Enviros 2013) concluded that the most practical and sustainable remediation solution, with the lowest environmental impact, comprises capping of predominant areas of wastes in-situ, following a re-profiling exercise to achieve a suitable landform to improve slope stability, provide adequate surface water management and reduce the visual impact of the site. Alternatives considered are described in Chapter 5 Consideration of Alternatives.

A Detailed Quantitative Risk Assessment (DQRA) undertaken as part of the Environmental Impact Assessment (EIA) confirms the requirement to remediate the site and reduce risks associated with source-pathway-receptor linkages (refer to Chapter 12 Soils, Geology, Contaminated Land and Groundwater). Having assessed the need outlined in Chapter 3 The Need for the Proposed Project, the remediation solution presented herein involves the reduction of waste footprint at the site, minimisation of nuisance impacts (such as odour, dust, noise), provision of a stable landform and installation an engineered capping system to break the pathway associated with risks to human health by preventing direct contact with waste materials and to reduce the infiltration of rainwater.

The remediation solution comprises the main elements and supporting infrastructure outlined in Table 4.1.

Table 4.1: Overview of Main Features of the Proposed Project

Main Feature/ Infrastructure	Outline Description	Section	Figures
Site Access	New roundabout and realignment of the L2005 Kerdiffstown Road, including provision of footpaths and cycleways, to facilitate continued safe passage via L2005 Kerdiffstown Road during Remediation Phase and Operational Phase.	4.2.3	4.10 to 4.12
Demolition Works	Demolition of 3 houses and outbuildings and the removal of remaining concrete walls, to provide areas for storage/ stockpiling of imported and processed materials (short-term) and giving an opportunity to re-use crushed and screened materials in the remediation of the site.	4.2.4	4.1
Landfill Infrastructure Compound	Construction of new landfill gas and leachate management facilities in one location as well as a site office and storage area for the management and maintenance requirements of the site.	4.2.5	4.13 to 4.15
Site Re-profiling	Re-profiling the site to address current over-steep slopes to permit installation of an engineered capping and/or soil cover system, to allow for surface water drainage, and provide mitigation of long-term settlement of the waste mass.	4.2.6	4.2 to 4.7
Engineered capping and soil cover systems	Capping predominant areas of waste to prevent infiltration of rainwater, reducing leachate production, and to enable management of landfill gas and odour. Soil cover systems to provide suitable growing media for the landscaping of the site, providing stability to slopes and an opportunity for future enhancement in end-use proposals.	4.2.7	See detail in Section 4.2.7
Leachate and landfill gas management systems	Improved leachate management systems to remove and transfer leachate to a wastewater treatment plant via the public sewer network.	4.2.8	4.16 to 4.18
	Gas management to be improved across the site following capping works, with extraction being undertaken from predominant, gas generating wastes population		4.18

Main Feature/ Infrastructure	Outline Description	Section	Figures
Surface water drainage system	Surface water drainage to manage runoff post-capping completion, to treat and control discharges from the site.	4.2.9	4.19

Through all stages in the development of the remediation solution the principles of BAT (Best Available Techniques) have been considered. BAT is defined in Section 5 of the Environmental Protection Agency Acts, 1992 to 2007, and Section 5(2) of the Waste Management Acts 1996 (as amended) as:

> *the "most effective and advanced stage in the development of an activity and its methods of operation, which indicate the practical suitability of particular techniques for providing, in principle, the basis for emission limit values designed to prevent or eliminate or where that is not practicable, generally to reduce an emission and its impacts on the environment as a whole" where:*
>
> > *B 'best' in relation to techniques, means the most effective in achieving a high general level of protection of the environment as a whole;*
> >
> > *A 'available techniques' means those techniques developed on a scale which allows implementation in the relevant class of activity under economically and technically viable conditions, taking into consideration the costs and advantages, whether or not the techniques are used or produced within the State, as long as they are reasonably accessible to the person carrying on the activity.*
> >
> > *T 'techniques' includes both the technology used and the way in which the installation is designed, built, managed, maintained, operated and decommissioned.*

Where relevant, BAT compliance is reaffirmed in the following Sections.

4.2.2 Land Use Requirements

The current site condition, existing land uses and extent of land-take required for the proposed Project is shown on Figure 4.1. As outlined in Chapter 3 The Need for the Proposed Project, the site is sub-divided into a number of discrete zones characterised mainly by the types and arrangement of deposited material in each area, as outlined in Table 4.2.

Table 4.2: Zone Description and Current Condition

Zone	Estimated (plan) Area	Estimated Waste Volume		Basal & Side Lining	Cap Status	Other
1	100,000m^2	2,023,000m^3	(65.2%)	Unlined	None	-
2	83,000m^2	660,000m^3	(21.3%)	Unlined	25,000m^2 uncapped	58,000m^2 concrete hardstanding
3	24,000m^2	193,000m^3	(6.2%)	Lined	Temporary cap	-
4	45,000m^2	227,000m^3	(7.3%)	Unlined	33,000m^2 uncapped	12,000m^2 concrete hardstanding
Total	**252,000m^2**	**3,103,000m^3**				

The land requirements for the project are explained in detail in Table 4.3 and subsequent sections. In addition to the land that is underlain by waste at the site; there is a need to permanently acquire further lands, specifically lands:

- To the north and west of the landfill site, to facilitate drainage of clean surface water from sections of the remediated site that could not otherwise be managed;
- To the south to facilitate a safe entrance and access to the site for works vehicles and future park visitors. The new entrance, realignment of the L2005 Kerdiffstown Road and the addition of a footway and cycleway allows for the safe use of the road for current passing traffic and vulnerable road users during the

Remediation Phase and for access to the multi-use public park during the Operational Phase of the proposed Project;

- To the south, land is required to facilitate the construction of the Landfill Infrastructure Compound to house a new site office, landfill gas flares and leachate tanks which must be constructed on waste-free ground for stability reasons;
- To the east, land is required to ensure the viability of the park amenity, by maximising the space to be provided for sports and recreation. Following a request by Kildare Sports Partnership (part of the Kildare County Council and the County Development Board structure) recommending that options for more sports pitches be included in the project, to cope with local demand, additional land requirement was identified;
- Two wayleaves are required to facilitate pipelines from the site: one to convey surface water runoff to the Morell River; and a wayleave to accommodate two pipelines to convey leachate and foul water from the site to Johnstown Pumping Station; and
- Temporary land take is also required to give access to contractors to construct the project in a safe manner. Each of the areas where temporary land take has been identified as required is based upon the judgement of the Project Supervisor Design Process (PSDP) for the project.

Land use requirements for the Remediation and Operational Phases are summarised in Table 4.3, with detail provided in the following Sections.

Table 4.3: Land Use Requirements

Area (Indicative areas are showing in thumbnails)	Remediation Phase	Operational Phase
Site Entrance 	Demolition of existing residential properties. Construction of new site access. Realignment of a section of the L2005 Kerdiffstown Road, including provision of footpaths and cycleways. Construction of new Landfill Infrastructure Compound. Installation of the leachate transfer pipeline and foul sewer pipeline to Johnstown Pumping Station Realignment of private access road to Kerdiffstown House	Vehicle, pedestrian and cyclist access to multi-use public park. Car parking provision. Road tanker and site management access to Landfill Infrastructure Compound. Installation of third multi-use sports pitch.
Zone 1 	Re-profiling of existing over-steep slopes. Infilling with wastes to achieve suitable landform. Installation of capping system. Construction of new infiltration swale (north flank). Installation of landfill gas and leachate infrastructure.	Paths. Access for monitoring and maintenance of landfill gas, leachate and surface water infrastructure. Access for maintenance to swale and remediated slopes.
Zone 1A 	Reduction in waste footprint. Infilling to remediate existing over-steep slopes. Construction of new surface water pond. Installation of capping system.	Commissioning of new surface water soakaway. Access restricted due to location of pond and to encourage biodiversity.

Area (Indicative areas are showing in thumbnails)	Remediation Phase	Operational Phase
Zone 2A 	Demolition of existing concrete walls. Reduction in waste footprint. Temporary materials stockpile area. Remedial works to existing concrete hardstanding. Installation of capping system. Installation of surface water management scheme. Installation of landfill gas vent trenches.	Car parking provision. Multi-use sports pitch and paths. Changing room building. Children's playground.
Zone 2B 	Demolition of existing concrete walls, including retaining wall in east bund. Reduction in waste footprint. Re-profiling of existing over-steep slopes. Temporary materials processing and stockpile area. Remedial works to existing concrete hardstanding. Installation of capping system. Installation of surface water management scheme. Installation of landfill gas vent trenches.	Multi-use sports pitch and paths. Access for maintenance to surface water management scheme and remediated slopes.
Zone 3 	Infilling with wastes to achieve suitable landform. Installation of capping system. Installation of surface water management system. Installation of landfill gas and leachate infrastructure.	Paths. Access for monitoring and maintenance of landfill gas, leachate and surface water infrastructure.
Zone 4 	Demolition of existing concrete walls. Re-profiling of existing over-steep slopes and removal of stockpiles. Placement of low permeable soils. Construction of new surface water ponds.	Commissioning of discharge from surface water pond to Morell River. Paths and opportunity for ecological enhancements. Access restricted due to location of ponds and to encourage biodiversity.

4.2.3 Site Access

A new junction arrangement including realignment of the L2005 Kerdiffstown Road is required to facilitate safe access to the site by, primarily, heavy goods vehicles (HGVs) during the Remediation Phase. These works will also comprise provision of a new footpath and cycleway as shown on Figure 4.11. The path and cycleway will link to Johnstown via the footbridge over the N7 to the south-east of the site and offer linkage to Kill further to the east and Naas to the south-west. This improvement will provide safe passage to passers-by during remediation works and access by vehicles, cycles and pedestrians to the park during the Operational Phase. Design criteria is set out in the Road and New Site Access Design Technical Note (refer to Appendix A4.1).

The existing junction arrangement has restricted visibility splays and requires crossing of the L2005 Kerdiffstown Road (a secondary road) in order to access the entrance of the site (from the east). With the speed limit of 60kph

and carriageway width, currently a maximum of 5.6m, the existing access arrangements were considered inappropriate for frequent use by wider vehicles such as HGVs and the increased numbers that are likely during the Remediation Phase. The anticipated number of vehicles likely to use the site is discussed in Chapter 14 Traffic and Transport. It is also noted that HGVs will not be permitted to access the site from the west (from Sallins), instead HGVs will utilise the road network off the N7 (to the east of the site) as there is a posted 3 tonne weight limit on the railway bridge on the L2005 Kerdiffstown Road to the west of Sallins. The access arrangements will be designed to ensure that safety is maintained to all road users, following the outline design shown on Figure 4.10.

The proposed site access works comprise construction of a new roundabout, taking the existing road alignment off to the north, to satisfy road design guidelines, and providing one arm for access to the site. Temporary works will be required to facilitate tie-in of the east and west arms of the L2005 Kerdiffstown Road to the new road alignment. Site access design profiles are shown on Figure 4.12. A full description of the proposed access arrangements to the site is outlined in Chapter 14 Traffic and Transport.

As part of the first phase of works at the site a new perimeter fence will be erected around the site, comprising a 2.2m high palisade fence (or similar) with security gates at the site entrance. Pedestrian access points to the north-west and east of the site will also be provided for Project personnel to access key locations outwith the site boundary for monitoring and inspection purposes. During the Operational Phase the access point to the north-west will be available for use by the public to access the park. The Landfill Infrastructure Compound will also be secured within a fenced area, using 2.2m high chain-link security fencing (or similar) with security gates.

4.2.4 Demolition Works

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

Areas for temporary stockpiling and processing of materials are required to facilitate the site re-profiling and remediation works, hence these residual concrete structures will be demolished. Construction of the new site entrance and adjacent Landfill Infrastructure Compound will require the demolition of two existing residential dwellings located off Kerdiffstown Road to the south of the site (refer to Figure 3.4; REC010 and REC011).

During the consultation process it was recommended that an additional multi-use sports pitch be provided. As a result, it was identified that a residential property located to the south of Zone 1 and north of Zone 2A, off the L2005 Kerdiffstown Road, would provide a suitable area for a third pitch. This area is greenfield but also offers an area for temporary stockpiling of clean, imported fill materials. This area will form part of the new site and hence the dwelling will be demolished as part of the remediation works (refer to Figure 3.4; REC016).

On-site concrete structures are envisaged to be demolished by pneumatic breakers fitted to excavators. Where noise limits are likely to be exceeded noise barriers will be provided between the works and identified receptors in proximity to the working area. The assessment of noise and proposed mitigation measures are presented in Chapter 8 Noise and Vibration. 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. Dust suppression techniques will be employed, by spraying water from a site bowser or similar, in accordance with the Dust Management Plan developed as part of the Construction Environmental Management Plan (CEMP).

It is envisaged that fines (small particles) produced from the crushing and screening operations will be used as fill material in the proposed Project to make up levels (below cap). Reinforced steel extracted from the structures will be removed from site for recycling. Aggregate produced from the crushing and screening will be re-used in drainage infrastructure (subject to appropriate geotechnical and geo-environmental testing).

4.2.5 Landfill Infrastructure Compound

Currently landfill gas is managed via two flares on the site; one located adjacent to Zone 3 (lined cell) and another located in Zone 1. These flares will be maintained throughout the Remediation Phase and two new flares will be installed within the Landfill Infrastructure Compound to manage landfill gas during the Operational Phase.

Leachate is currently extracted from Zone 3 only, pumped to tanks and removed to Ringsend WWTP by road tanker.

As the site is to be utilised as an amenity space with a public park with multi-use sports pitches, changing rooms and a children's playground, etc. it was determined that siting landfill gas and leachate infrastructure in a single, secure compound on site would be preferred. Due to the nature of the site and risks to the environment should any such facilities fail, the new compound is proposed to be 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 to enable ready access by road tankers and maintenance contractors as necessary.

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.

The location of the new Landfill Infrastructure Compound is shown on Figure 4.13, while layout details are shown in Figure 4.14 and Figure 4.15.

Gas management infrastructure within the compound will comprise the installation of two landfill gas flares; one duty and one stand-by, which will be utilised to control off-site migration and reduce emissions to atmosphere in order to control odours. Leachate management will involve treatment of the leachate extracted from the waste mass via methane stripping plant to be located within the leachate management building as shown on Figure 4.14. Methane will be directed to the adjacent landfill gas flare. Leachate will be transferred to Johnstown Pumping Station for discharge to the local public sewer network and subsequent treatment at Osberstown WWTP.

A KCC Site Manager will also be in attendance at the site during week days and whenever emergency procedures are required where plant failures occur. A site office will be required with amenity facilities for such attendance. An indicative layout of the site office building is shown on Figure 4.15. In addition, maintenance equipment and plant, such as quad bikes or 4x4, to facilitate monitoring at the site may also be stored within the Landfill Infrastructure Compound.

4.2.6 Site Re-profiling

Re-profiling works are intended to minimise volumes associated with the excavation, movement and deposition of materials within the site. Design of the remediation profiles has achieved an approximate balance such that materials will not require to be removed from the site, reducing the impact of the works on the local community and environment.

The extent of waste was determined from ground investigation locations shown on Figure 12.2 in Chapter 12 Soils, Geology, Contaminated Land and Groundwater. An intention of the remediation works is to reduce the footprint of the waste mass where practicable. The main areas where waste deposit footprints are to be reduced are as follows:

- The southern boundary of Zone 2A where shallow deposits of waste will be excavated and deposited to Zone 1. This location also has a screening bund which appears to comprise waste deposits. This bund will be removed and replaced with clean material to maintain screening for the adjacent property.
- The boundary between Zone 4 and an adjacent residential property comprises wastes overtopping the quarry deep wall. These wastes will be excavated and deposited to Zone 3 (lined cell).
- East of Zone 2B, bordering on Zone 4, a large bund had been constructed around a concrete retaining wall. A new surface water discharge point is to be located from the surface water management pond in Zone 4 through this area, to connect to the Morell River (in the Operational Phase). Wastes will be removed to reduce this footprint of wastes, reduce the over-steep slopes in this location, enable partial demolition of the retaining wall (to a height below the re-profiled site contours) and create an opening for the new connection to the Morell River.

- Zone 1 north flank has shallow deposits of waste located adjacent to the pre-Norman era Church (ruins) in the Kerdiffstown House lands. Wastes will be removed from this area to facilitate construction of a new surface water swale to reduce potential flooding risk to the Church ruins.
- North-west extent of Zone 1 comprises largely inert type wastes, typically construction and demolition (C&D) wastes. This area will include a new surface water pond and soakaway hence wastes will be excavated to provide suitable ground conditions for the construction and operation of the soakaway.

Figure 4.2 shows the re-profiled site contours, representing the new 'top of waste'. The movement of material within the site is required in order to achieve a suitable landform to improve slope stability, provide adequate surface water management and reduce the visual impact of the site. A modelled assessment of current ground conditions at the site in comparison to the re-profiled site contours as shown on Figure 4.3 was undertaken to highlight areas of cut and fill. Existing boundary slopes are predominately steep, having been formed at gradients of maximum 1v:1.5h. The depth of soils associated with the proposed capping system was then added to the model to determine the remediation contours as shown on Figure 4.4. Assessment of predicted settlement (refer to Appendix A4.2) was undertaken to determine post-settlement contours as shown on Figure 4.5, to confirm that a suitable final landform for the site will be achieved, maintaining surface water management. Cross sections outlining the various stages of re-profiling, remediation and post-settlement are provided on Figures 4.6 and 4.7.

Excluding existing hardstanding areas in Zones 2A, 2B and 4 surface profiles across the site are typically undulating with a number of large voids and stockpiles present. Proposed re-profiling works in Zones 2A and 2B are limited given the end-use design and the positioning of multi-use sports pitches above these hardstanding areas. Earthworks will be required to enable placement of low permeable soils and for the end-use construction to facilitate drainage runoff.

A preliminary capping and waste slope stability assessment (refer to Appendix A4.3) has been completed adopting typical geotechnical parameters from published sources for waste materials. The assessment demonstrates that the permanent slopes to be formed in waste materials will need a maximum slope gradient of 1v:2.5h to provide acceptable long term stability. The minimum slope gradient (post-settlement) has been assessed to be 1v:30h, sufficient to maintain drainage runoff.

A preliminary assessment of the volumes to be cut and filled in each zone to achieve the required profiles is summarised in Table 4.4.

Table 4.4: Bulk Re-Profiling Material Volumes

Zone	Cut (m^3)	Fill (m^3)	Balance (m^3)
1 (& 1A)	47,000	111,500	-64,500
2A & 2B	26,300	19,900	6,400
3	0	85,500	-85,500
4	183,000	36,000	147,000
Totals	**256,300**	**252,900**	**3,400**

It is likely that volumes calculated for re-profiling works may be adjusted 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 C&D wastes, where rubble and concrete blocks may be anticipated. Encountering such materials for excavation may generate a greater volume of material to be moved around the site and subsequent materials required for backfill or adjustment (typically reduction) of site profiles or gradients. Similarly, there is an opportunity to re-use site won soils in the remediation works, subject to appropriate testing and classification.

4.2.7 Engineered Capping and Cover Systems

Capping System Principles

The primary role of any landfill capping system for non-hazardous landfill sites is to control leachate production by preventing or significantly limiting the infiltration of rainfall into the waste mass. The capping system is therefore required to include a barrier layer of very low permeability to intercept rainwater and an overlying drainage layer to convey the water away efficiently to the perimeter of the capped area. By eliminating this incoming water source from the waste body, the amount of leachate produced is limited to that from waste degradation alone and the rate at which that leachate pollutes the underlying groundwater is restricted to the degradation rate (of primarily MSW) rather than the flushing through according to rainfall events.

The capping system will also restrict vertical migration of landfill gas and will convey the gas to collection points for controlled burning via a landfill gas flare. Lateral migration of gas may be observed post-capping works, with the landfill gas management system designed to reduce this effect.

The proposed Project relates to the remediation of an existing body of waste that has been placed over a number of years, to mitigate impacts from the remediation works and effects on the local community as far as practicable whilst integrating sustainability into the design. These principles have been embedded in the design considerations and through assessment of the nature and extent of the wastes determined from the various ground investigation works that have been undertaken at the site, a zonal approach to capping system proposals has been adopted for the proposed Project. One stockpile of inert material, circa 10,000m^3, is available on site currently, with import of capping materials including cover soils required to facilitate remediation of the proposed Project. The adoption of these principles will reduce risks to human health and the environment by preventing rainwater and surface water infiltration and by controlling gas migration.

The EPA Landfill Manuals Landfill Site Design (EPA 2000) outlines the recommended components of a landfill capping system for non-hazardous and inert landfills. EPA guidance states that the need for each component should be assessed on a site by site basis and recognises that not all the components of the capping system will be necessary for every site. The EPA capping system recommendations are shown in Table 4.5 in comparison to the components being promoted for use in the proposed Project.

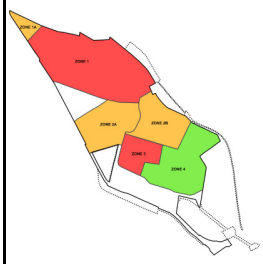
Table 4.5: Recommended Non-Hazardous and Inert Landfill Capping System Components (EPA; Landfill Manuals, Site Design, 2000; Figure 10.1) Compared to Proposals for each Zone

Non-Hazardous Landfill Capping System Components	Zones 1 & 3	Zones 1A, 2A & 2B
Topsoil (min. thickness 150mm)	✓	✓
Subsoil Layer	✓	
Drainage Layer $k > 1 \times 10^{-4}$ m/s	✓	
Barrier Layer $k \leq 1 \times 10^{-9}$ m/s or equivalent	✓	✓
Gas Drainage Layer (if required) $k > 1 \times 10^{-4}$ m/s		
Waste		

Inert Landfill Capping System Components	Zone 4
Topsoil	✓
Subsoil Layer	✓
Waste	

Based on the identified environmental risks outlined in Chapter 3 The Need for the Proposed Project and Table 3.2. The capping system design has been determined as outlined in Table 4.6 below.

Table 4.6: Capping Proposals by Zone

Capping Proposals		
	**Zones 1 & 3**	Zones 1 and 3 present the highest environmental risk in terms of waste, groundwater, landfill gas and odour generation potential due to the presence of MSW and C&D waste. An engineered capping system is proposed to mitigate those risks.
	Zones 1A, 2A & 2B	Zones 1A, 2A and 2B present a moderate environmental risk in terms of waste, groundwater, landfill gas and odour generation potential due to the lack of MSW, proposed reduction in waste footprint and retention of existing thick concrete hardstandings (Zones 2A and 2B). However, an engineered capping system is proposed to mitigate those remaining risks, taking cognisance of the topography.
	Zone 4	Zone 4 presents a low environmental risk considering proposals to reduce the existing volume of waste present, re-profiling over-steep slopes, retention of existing thick concrete hardstanding and application of a geomembrane to the ponds area. A soil cover system is proposed for this zone.

Further detail on the proposals for the engineered capping and cover systems for each zone are outlined below.

Zones 1 & 3 Capping System

Assessment of waste types in Zones 1 and 3 indicates that the body of waste would be classified as predominately non-hazardous with C&D and inert wastes mixed through.

Zone 1 represents the largest volumes of waste at the site, with the majority of waste in this zone reported to comprise Municipal Solid Wastes (MSW), although some logs do show C&D waste to also be present. The MSW wastes are found over most of the zone, although there appears to be more C&D waste in the north-west corner. This area has therefore been designated as Zone 1A to reflect this reduced risk profile (discussed further below). Throughout Zone 1, where waste is encountered, it is considered that there is sufficient putrescible material to classify this zone as comprising non-hazardous biodegradable wastes.

Zone 3 comprises a cell with engineered basal and side slopes lining system, and is referred to as the 'Lined Cell'. Full details of the waste contained in the cell are uncertain. However, the wastes 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.

The capping proposals for Zones 1 and 3 are based the assessment of the waste classification, the recommendations of the EPA Site Design Guidance, and take into consideration the absence of the requisite quantity of suitable materials on site, as outlined in Table 4.7.

Table 4.7: Zones 1 and 3: Proposed Multilayer Capping System – Components and Depths

Component	Zones 1 & 3 Proposals		Function & Justification
Topsoil	Top soil / soil forming material cover	min 150mm	Function: to provide suitable growing medium for restoration. Depth required to provide suitable growing medium for landscaping, primarily grasses in low maintenance use. Depth may be increased in local areas where scrub and shrub planting is proposed.
Subsoil	Subsoil	min 350mm	Function: to protect barrier layer and assist restoration. Reduced thickness from recommended 850mm due to absence of suitable materials on site and sustainability impacts of importation, whilst providing appropriate protection to the barrier layer. Depth to be increased in local areas where scrub and shrub planting is proposed.
Drainage layer	Geocomposite drainage layer	Negligible combined thickness (<15mm, incl. 2mm FML)	Function: to assist drainage off cap (barrier layer) and increase slope stability of the capping system. Use of a geocomposite liner, of minimum permeability $1x10^{-4}$m/s, provides the equivalent function of an aggregate drainage layer, whilst significantly reducing material import requirements including use of quarried material.
Barrier layer	Flexible membrane liner (FML)		Function: to provide protection and a separation between waste and clean restoration soils, reducing infiltration (hence leachate generation) and vertical gas migration. Use of a High Density Polyethylene (HDPE*) liner, of maximum hydraulic conductivity $1x10^{-9}$m/s, provides the equivalent function of a compacted mineral layer, e.g. clay, whilst significantly reducing material import requirements.
Gas drainage layer	Regulation layer	min 150mm	Function: to provide suitable formation for the installation of a FML. A gas drainage layer is not required as the landfill gas proposals include for gas wells at sufficient spacing to permit draw off to the flare. The regulation layer would comprise fine grained material, e.g. sand, with minimum equivalent permeability $1x10^{-4}$m/s., placed above prepared waste profile with any surface protrusions removed.

* HDPE to be selected for slopes >1v:3h. LLDPE may be adopted for other areas. To be confirmed during detailed design.

The proposed capping system for Zones 1 and 3 provides a 1.75m reduction in the total thickness of the capping system when compared to recommended depths as specified within the EPA Landfill Manuals Landfill Site Design (EPA 2000) including 600mm for a mineral barrier layer. As a result, an approximate 75% reduction in imported soil volumes with associated vehicle movements would be realised using this approach for Zones 1 and 3.

The proposed capping system components for Zones 1 and 3 are shown below in Diagram 4.1.

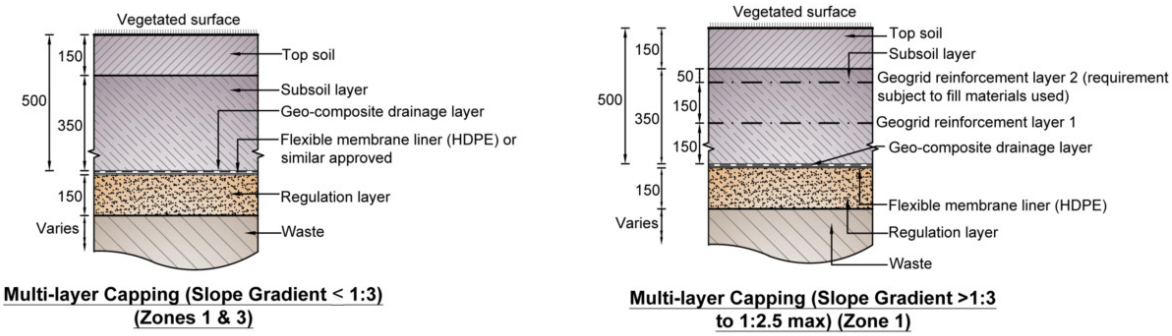


Diagram 4.1: Capping System: Zones 1 and 3

In order to prevent damage to the capping system only selected waste, to exclude large and bulky or sharp items such as concrete blocks and rebar, will be used to form the final lift of waste across Zones 1 and 3 immediately below the regulation layer. Selection and placement of the final layer of waste will be carried out under the supervision of a suitably trained and qualified person. Each waste layer placed will be covered at least by the end of the working day with the application of daily cover to assist with control of odours as well. This may comprise soils or geosynthetics, widely used for such purposes in the waste management industry as a temporary cover. The objective of the daily cover is to ensure windblown litter and debris are minimised, vermin is prevented from entering the waste mass and scavenging is prevented as far as practicable and the depth of cover is sufficient to avoid future problems of perched leachate. A stockpile of cover materials will be maintained, as necessary, in the vicinity of the operational area in order to ensure that exposed waste can be covered at the end of each working day. The use of alternative cover methods (e.g. proprietary geosynthetic sheeting) will be agreed with the EPA prior to use.

The regulation layer will comprise site processed materials or imported inert waste (fine grained soils, sands or similar) compacted to a minimum thickness of 150mm and will be placed above the daily cover layer previously applied. The regulation layer will be free of material likely to damage the capping barrier.

The barrier layer will consist of a FML comprising 2mm thick high-density polyethylene (HDPE) (on slopes >1v:3h) or 1mm thick Linear Low Density Polyethylene (LLDPE) (slopes <1v:3h). Panels of FML, typically 4m wide, will be welded together down slopes to then be overlain by a geocomposite drainage layer (GDL). For Zone 3, the FML can be anchored at the perimeter of the cell in intimate contact with the existing cell (basal/ side wall) liner system. Around the extents of Zone 1, a toe anchor detail will be applied, such as that indicated in Diagram 4.2.

The GDL is a geosynthetic composite of geotextiles supporting a drainage core, offering protection to the FML from the overlying soils whilst performing a drainage function. The subsoil layer shall be specified according to the grading that is acceptable for use in contact with the GDL, and method of placement subject to agreement with the GDL manufacturer. The final top layer of top soil or soil forming material will provide a suitable growing medium for the landscaping proposed across the site and will be increased locally where specific planting is proposed. On slope gradients up to 1v:3h an additional layer of geogrid will be required to reinforce the capping system and will be installed in the subsoil layer, as shown in Diagram 4.2.

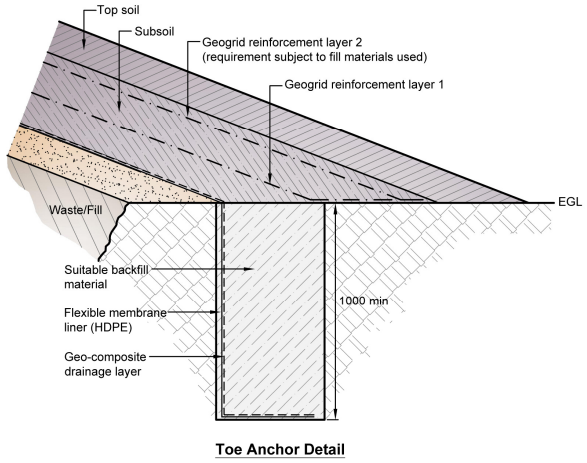


Diagram 4.2: Perimeter Toe Anchor Detail: Zone 1

Design, specification and installation of the capping system in Zones 1 and 3 will be subject to Construction Quality Assurance (CQA), discussed further in Section 4.3.5.

Zones 1A, 2A & 2B Capping System

Zone 1A comprises more C&D waste than the immediately adjacent Zone 1. The remediation works proposals include the reduction in the waste footprint in Zone 1A, with wastes excavated for emplacement in Zone 1.

Zone 2A & Zone 2B comprise largely flat areas with concrete hardstandings and remnants of buildings from the former waste processing facility. Review of ground investigations and subsequent monitoring data confirms that wastes in Zone 2A comprise more MSW than in Zone 2B and initial readings of gas shown on borehole logs show that relatively high concentrations of methane and carbon dioxide have been present in Zone 2A.

The majority of waste in Zone 2B is reported to comprise unprocessed non-hazardous mixed C&D waste but with MSW also present at varying depths mixed in within the C&D materials. The methane results within the borehole logs show lower concentrations of methane than in Zone 2A.

The proposed capping solution for Zones 1A, 2A and 2B reflects an assessed lower risk to groundwater from surface water infiltration in these areas resulting from a combination of reduced waste thicknesses and footprint and predominant C&D waste composition with a reduced proportion of MSW compared to Zones 1 and 3. The variation in capping solutions also reflects the maintenance of a barrier to waste materials by the retention of existing concrete hardstanding areas in Zones 2A and 2B. The capping proposals for Zones 1A, 2A and 2B are outlined in Table 4.8.

Table 4.8: Zones 1A, 2A and 2B: Proposed Capping System – Components and Depths

Component	Zones 1A, 2A & 2B Proposals		Function & Justification
Topsoil	Top soil / soil forming material cover	min 150mm	Function: to provide suitable growing medium for restoration. Depth required to provide suitable growing medium for landscaping, primarily grasses in low maintenance use. With park construction depth will be increased to facilitate tie-in to pitches and construction of paths.
Barrier layer	Low permeability compacted clay liner	min 350mm	Function: to provide protection and a separation between waste and clean restoration soils, reducing infiltration (hence leachate generation) and vertical gas migration. Due to relatively flat surface profile clay is selected for the barrier layer as it provides an advantage where maintenance may be required, e.g. due to settlement of the waste and creation of low spots, whilst providing adequate protection to the environment.

The proposed capping system for Zones 1A, 2A and 2B are shown below in Diagram 4.3.

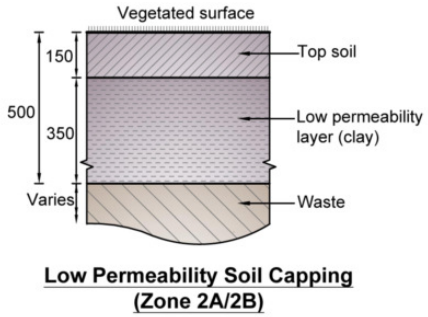


Diagram 4.3: Low Permeability Soil Capping (Zone 2A & Zone 2B)

Drainage across the capped areas of Zones 2A and 2B will be facilitated by tie-in to the multi-use sports pitch design. Gas is predicted to be at low levels insufficient for active abstraction hence perimeter venting trenches are proposed as outlined in Section 4.2.8.

In Zones 2A and 2B separation to waste materials will also be provided by retention of existing concrete hardstanding areas (circa 58,000m^2). Description of remedial works that are required to the concrete hardstandings is described further below. The low permeability capping system in Zones 2A and 2B will be tied-in to those hardstanding areas as shown in Diagram 4.4.

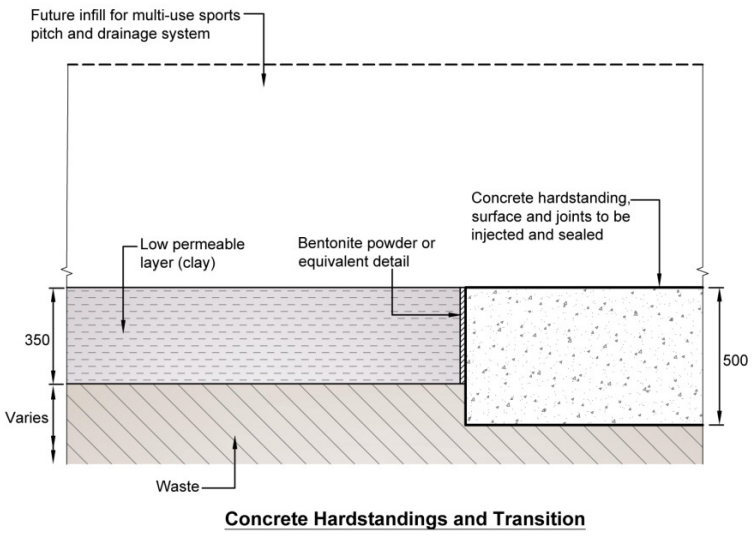


Diagram 4.4: Hardstanding Tie-in to Capping System: Zones 2A & 2B

The existing ground profile in Zone 1A is suited, with profiling using insert soils, to the formation of a geomembrane lined pond which will be installed to retain surface water prior to discharge (to ground via a soakaway). This use of geomembrane will further provide separation of clean surface water from the underlying materials.

Design, specification and installation of the capping system in Zones 1A, 2A and 2B will be subject to Construction Quality Assurance (CQA), discussed further in Section 4.3.5.

Zone 4 Cover System

The majority of waste in Zone 4 is reported in borehole and trial pit logs to comprise C&D waste with a high proportion of inert material (dominantly reported as gravelly clay). The logs do not generally report any MSW to be present as outlined in Chapter 3 The Need for the Proposed Project. Where gas readings have been taken and reported in the borehole logs, it is reported that methane and carbon dioxide concentrations are largely absent from the wastes or less than 1%v/v within this zone. Zone 4 also includes a large area covered with concrete hardstandings, approximately 12,000m^2.

Zone 4 poses a lower risk to groundwater from surface water infiltration due to a reduced waste thickness, and predominant C&D waste composition with minimal MSW. Re-profiling works in this area will further remove a significant proportion of the existing waste mass. The remediation profile will also reduce the risk in this zone due to the slope gradients and installation of (lined) surface water ponds. Gas management in Zone 4 is not required due to a lack of degradable wastes and due to the re-profiling works proposed. Taking cognisance of the above and for the purposes of design it is considered that the inert capping system is appropriate for this zone.

The 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 as identified during in the remediation of slopes, re-profiled slope gradients. A geosynthetic liner will also be used in the new surface water management ponds covering a large area of the zone.

The proposed cover system for Zone 4 is summarised in Table 4.9.

Table 4.9: Zone 4 Proposed Cover System – Components and Depths

Component	Zone 4 Proposals		Function & Justification
Topsoil	Top soil / soil forming material cover	min 150mm	Function: to provide suitable growing medium for restoration. Depth required to provide suitable growing medium for landscaping, primarily grasses in low maintenance use. Depth may be increased in local areas where scrub and shrub planting is proposed.
Subsoil	Subsoil	min 350mm	Function: to assist restoration. Depth to be increased in local areas where scrub and shrub planting is proposed.

The proposed cover system for Zone 4 is shown below in Diagram 4.5.

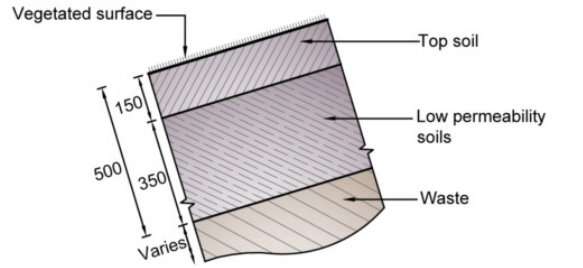


Diagram 4.5: Cover System: Zone 4

The retained concrete hardstanding area in Zone 4 will be buried below the new surface water ponds and remediated slope profiles.

Retained Concrete Hardstandings (Zones 2A, 2B & 4)

The existing hardstanding areas in Zones 2A, 2B and 4 currently provide a positive capping function over the deposits of wastes below. The removal of these hardstandings would increase the volume of materials to be processed and deposited on site, creating nuisance such as dust and noise, as well as requiring importation of fill material to backfill the void left by these hardstanding areas.

The utilisation of existing hardstanding areas in Zones 2A, 2B and 4, where these have been shown to be around 500mm thick providing 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, re-sealing of all construction joints, filling and capping over voids and grouting up of redundant drainage. There are a number of available techniques based on a variety of factors. The method to be adopted will be confirmed in detailed design and subject to Construction Quality Assurance (refer to Section 4.3.5). Design of the multi-use sports pitches will require installation of a drainage system which will transfer runoff away from the hardstanding areas.

4.2.8 Leachate and Landfill Gas Management Systems

Leachate Management

Following remediation, the site will continue to generate leachate (in smaller volumes but more concentrated). The need to manage this leachate remains a long term maintenance liability for the site. This requires the integration of the existing leachate collection infrastructure collecting leachate generated from Zone 3 (lined cell) to a new treatment and transfer system, discharged to Johnstown Pumping Station. The leachate will then be transferred in the public sewer network to Osberstown Wastewater Treatment Plant. Leachate generated following capping of the lined cell is expected to be typical of municipal waste landfill leachate.

From the EPA Landfill Manual on Landfill Monitoring (EPA 2003) it is stated that, for unlined landfills, three leachate monitoring points should be provided per five hectares of filled area. Therefore, given Zone 1 represents the largest volume of waste at the site five leachate monitoring wells are proposed be provided in Zone 1. The leachate management system, comprising extraction to the Landfill Infrastructure Compound for treatment and onward transfer to the public sewer network, will be extended to each of the monitoring points allowing extraction of leachate when monitoring confirms leachate to be present at levels sufficient to facilitate extraction. The leachate management system design, as outlined in the Leachate Management Plan (Appendix A4.4), will function as follows:

- Submerged pumps transfer leachate from the waste mass (where identified) along a rising main into an untreated leachate balancing tank housed in a building within the Landfill Infrastructure Compound;
- The leachate then gravitates from the balancing tank into a methane stripping plant within the building, where dissolved methane is removed. Leachate is transferred into a treated leachate balance tank;
- Treated leachate is then pumped from the treated leachate balancing tank to a buried rising main, discharging into the gravity main (as shown on Figure 4.17), subsequently crossing under the N7 and the Morell River connecting to Johnstown Pumping Station for onward transfer to Osberstown Wastewater Treatment Plant via the public sewer network;
- A treated leachate storage tank is included to store leachate in the event that Irish Water restrict discharge to the public sewer network (for example due to high flows in network or maintenance downtime in the network or treatment works) with capacity agreed with Irish Water on basis of likelihood of downtime and availability of other storage and disposal options (see below);
- Further storage will be provided with recirculation facilities in the lined cell (Zone 3) and
- Road tankers will be available via call-off contract to remove leachate from the site for transport to a treatment plant (to be agreed with Irish Water).

A piping and instrumentation drawing (P&ID) of the leachate management system is shown in the Leachate Management Plan in Appendix A4.4.

Security measures for the leachate management system are proposed in the Leachate Management Plan, to include provision for an underground storage tank which will be used in the event of spillage from the valves connecting to road tankers or the tankers. The operation of this system will be controlled and alarms set using a supervisory control and data acquisition (SCADA) system or similar, with proposals developed during detailed design.

During the Remediation Phase the generation of leachate will be managed through a number of on-site management operations, including:

- Working in discrete areas to minimise the area of exposed waste;
- Interception of any leachate outbreaks identified during waste excavation and re-profiling activities, by installing a drain point to direct leachate back in to the waste mass;
- Provision of daily cover to exposed wastes, occurring as part of the remediation works; and
- Progressively remediate the site with a landfill cap.

A Leachate Management Plan has been prepared and is provided in Appendix A4.4, which provides further detail on the leachate management system. Having an appropriate plan in place is a requirement of the Industrial Emissions Activities Licence (IEAL) licensing process and the Leachate Management Plan will be maintained and updated as required through the Remediation and Operational Phases.

Landfill Gas Management

At all stages the aim of the landfill gas management infrastructure is to:

- Prevent lateral gas migration off-site;
- Control emissions of gas to atmosphere to acceptable levels to reduce odour impact;

- Minimise global warming potential of gas emissions;
- Ensure safety of site operatives and appointed contractors working on site;
- Be sufficiently flexible to control gas occurrence throughout different phases of the remediation works;
- Integrate with leachate management and other environmental control systems; and
- Be compatible with final remediation and after-use of the site.

Due to the risks posed by landfill gas and the location of sensitive gas management receptors in proximity to the site (as shown on Figure 12.32), and the proposed amenity end-use a detailed assessment has been undertaken to determine the risks associated with the site. The migration potential for landfill gas from each zone is shown in the Landfill Gas Conceptual Site Models (Figures 12.28 to 12.31), which consider the potential for gas migration prior to and after remediation works. A framework will be put in place to ensure that the landfill gas is appropriately controlled and managed throughout the gassing life of the site.

Control measures have been developed on a zone specific basis for the site to take account of the differing gassing potential of each zone and their final end-use following remediation works. The landfill gas management system design comprises the following:

- In-waste vertical landfill gas extraction wells linked to active extraction;
- Gas wells in Zones 1 and 3 will be connected individually to manifolds, with the connecting pipework being designed to ensure that a high velocity is maintained to aid condensate management.
- Perimeter gas venting trenches (adaptable to active extraction system if required) will be installed in Zones 2A and 2B where low levels of gas generation have been identified);
- The design of the venting trenches will also allow the installation of vent stacks and cowls if the gassing potential is greater than models currently predict. This system can also be adapted to the extraction system as a further measure of control, though the quality of gas may affect the efficiency of the flare operation;
- Carrier mains will carry the landfill gas to the flare, which will be of an enclosed design providing high temperature flaring; and
- During remediation works the flare will be moved around the site to support key extraction areas, to reduce emissions and odour if observed during the works. Following remediation works gas flares will be sited within the Landfill Infrastructure Compound. The flares will be fitted with telemetry systems to inform of shutdowns and the flare stack height will be suitable to achieve the required air dispersion of the emissions products (refer to Chapter 7 Air Quality, Odour and Climate).

Due to the assessment of wastes and taking cognisance of the proposed remediation works in Zone 4 landfill gas management is not proposed for that part of the site.

A Landfill Gas Management Plan has been prepared and is provided in Appendix A4.5, which provides further detail on the proposals for landfill gas management. Having an appropriate plan in place is a requirement of the IEAL process and the Landfill Gas Management Plan will be maintained and updated as required through the Remediation and Operational Phases.

4.2.9 Surface Water Drainage System

At all stages the aim of the surface water management infrastructure is to:

- Not increase the future flood risk to land or properties outside the site boundary;
- Avoid adverse impacts and increased pollution risk to local streams and rivers;
- Prevent the escape of excessive sediment that may arise in the initial years following remediation works;
- Be sufficiently flexible to control surface water throughout different phases of the remediation works;
- Integrate with other environmental control systems to be employed as part of the remediation works; and
- Be compatible with final remediation and after-use of the site.

Surface water management measures for the Remediation and Operational Phases have been designed to mitigate the risk of environmental pollution and flooding generated from within the licensed extents the site. The proposed drainage system for the site, as shown on Figure 4.19, will include a network of open ditches, channels, swales and wetlands to intercept and control surface water runoff generated from with the licensed extents of the site and direct it towards three storage ponds. Topographical review has shown that runoff will not enter the site from outside the licensed boundary.

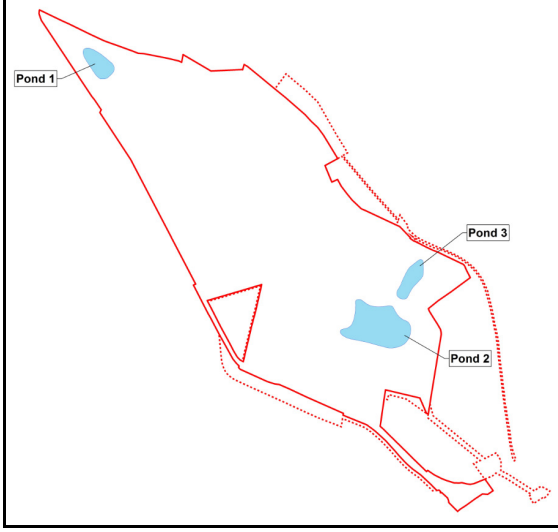
Review of the Flood Risk Assessment (refer to Chapter 13 Water - Hydrology) indicates that the site is located just outside the fluvial flood risk zone. However, an area located to the north extents of the site boundary aligning with the private access road to Kerdiffstown House is positioned within the 0.1% AEP (annual exceedance probability) and 1% AEP fluvial flood events which represents areas at risk of 1 in 1000 and 1 in 100 year flood events respectively.

A suitably competent contractor(s) will be appointed to undertake remedial works at the site, with surface water management a particular aspect to be closely monitored and controlled. The contractor will be required to construct temporary perimeter bunds and silt fences to enable separation of working areas from remediated areas. However, it is anticipated that until initial vegetation coverage, comprising grass, fully germinates silty runoff from capping soils may still be prevalent and require control. The appointed contractor(s) responsible for the remediation works will be required for ensuring a break between working (exposed waste) areas and remediated areas (restored) is maintained to prevent cross contamination. The appointed contractor(s) may also utilise temporary on site lagoons to retain surface water runoff, with silt buster tanks (or similar) used to limit the amount of silt being disposed to the ponds/ lagoons. Water collected in these lagoons will be used for dust suppression across the open working areas and, if not contaminated, over restored areas with any contaminated waters removed from the site by road tanker. The appointed contractor will be required to prepare a Construction Environmental Management Plan (CEMP) for agreement with KCC, for the contractor to then implement through the Remediation Phase, with water contamination testing requirements and limits to be agreed by the EPA.

Oil interceptors will be required during the Remediation Phase to serve temporary working areas (e.g. potential laydown area, fuelling station, temporary car park and wheel wash area). These interceptors will be removed on completion of the remediation works.

Surface water management ponds in Zone 1A and Zone 4 are to be developed as part of the remediation works, only discharging once remediation works have been completed. An impermeable cap will isolate the waste body from interacting with rainfall on the site and nearly all rainfall will result in runoff which will have to be managed to avoid flooding or ponding of water on the site. This rainwater/surface water will not have interacted with waste or leachate in any way and will be equivalent in quality to runoff from parkland or agricultural fields with a degree of suspended solids which will need to be reduced before discharge, with the pond in Zone 1A discharging to groundwater via a soakaway and the ponds in Zone 4 discharging to surface water. The location of these ponds is shown in Table 4.10 below.

Table 4.10: Surface Water Ponds Proposals

Surface Water Ponds Proposals		
	**Pond 1 (Zone 1A)**	The surface water management design incorporates a surface water pond and soakaway at the north western corner of the site. This soakaway may be used following settlement for discharge during the Remediation Phase with monitoring to confirm that there will be no impacts to groundwater.
	Ponds 2 & 3 (Zone 4)	Two further surface water ponds are to be located at the south eastern area of the site. Pond 2 will discharge to Pond 3, for discharge to the Morell River. Discharge from these ponds will be controlled via SCADA system and penstock, controlling discharge to the Morell River.

Further details can be found in the Surface Water Management Plan (Appendix A4.6).

Due to topographical constraints runoff from the north flank of Zone 1 cannot be returned into the site for discharge. An infiltration swale will be constructed in these locations to allow collected surface water to infiltrate to ground. As this area is adjacent to the flood plain the level of swale bund will be required to be above the maximum flood level.

Drainage design for internal site roads will incorporate road gullies, silt traps and oil interceptors, prior to passing forward flows to the surface water ponds in Zone 4. The offsite runoff from the proposed new roundabout, realigned road and footpath and cycleway will be connected to the existing drainage system near the existing roundabout on the L2005 Kerdiffstown Road.

Surface water from the new Landfill Infrastructure Compound will be collected by a system of road gullies and underground pipework which will be supplied with silt and oil interceptor(s). Flows from the Compound will be discharged to the main site road drainage. However due to the risk of runoff from the Compound containing contaminants due to leachate spillages the drainage system from the Compound will also be provided with an isolation point before discharge into the main site road drainage. An isolation penstock will be installed within a manhole and the surface water runoff will be retained within the storage manhole until mitigation works have been carried out. Contaminated surface water may need to be transported off-site for disposal during this period until the normal operation has been restored. Contingency plans to address leaks from valves and tankers used in the management of leachate in the Landfill Infrastructure Compound are outlined in the Leachate Management Plan (Appendix A4.4).

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 surface water outfall from Pond 3 will continue (as a minimum). The frequency of monitoring at all locations is to be monthly unless otherwise stipulated in the IEAL, with the real time monitoring and control system recording data via a supervisory control and data acquisition (SCADA) system more frequently. The frequency of the monitoring of the Morell River may be reduced following sufficient data to support ongoing assessment.

A Surface Water Management Plan has been prepared and is provided in Appendix A4.6. Having an appropriate plan in place is a requirement of the IEAL process and the Surface Water Management Plan will be maintained and updated as required through the Remediation and Operational Phases.

4.2.10 Environmental Management During the Remediation Phase

Prior to commencement of the Remediation Phase, the appointed contractor responsible for the remediation works shall prepare a Construction Environmental Management Plan (CEMP) for agreement with KCC. The CEMP shall contain the mitigation measures and plans identified (as a minimum), the wider EIAR and shall implement the conditions set out in the planning approval and the requirements of the site's Industrial Emissions Activities Licence (IEAL).

The CEMP shall set out all the intended methods to manage potential environmental impacts from remediation of the proposed Project, and shall include the following plans as a minimum:

- Groundwater Management Plan;
- Odour Management Plan (to be developed using the existing draft Odour Control Plan (SKM 2013);
- Dust Management Plan;
- Noise and Vibration Management Plan;
- Invasive Species Management Plan;
- Site Biodiversity Management Plan;
- Erosion and Sediment Control Plan;
- Contaminant Spill Emergency Plan;
- Construction Traffic Management Plan;
- Mobility Management Plan; and
- Waste and Materials Management Plan.

The CEMP shall also incorporate the requirements of the existing plans developed for the proposed Project, including but not limited to:

- Landfill Gas Management Plan;
- Leachate Management Plan;
- Surface Water Management Plan;
- Landscape Masterplan Statement;
- KLRP Management Plan Accident and Emergency Response; and
- Monitoring and Control Management Plan.

These Plans and the CEMP are live documents and will be reviewed on a regular basis and updated accordingly by the appointed contractor, in particular the document shall be reviewed on receipt of planning approval and grand of the IEAL.

The key elements of the CEMP shall include:

- Appointment of an Environmental Officer by the appointed contractor for the duration of the Remediation Phase;
- Incorporation of environmental commitments and requirements;
- Incorporation of procedures to record any environmental incidents on site and procedures for implementing appropriate corrective and preventative measures;
- Outlining the methods by which the remediation works will be managed to meet these commitments and requirements;

- Outlining the relevant guidance (with those outlined in the EIAR as a minimum) that have informed the Plan development;
- Incorporation of procedures for communicating with KCC, the public and stakeholders;
- Incorporation of procedures for staff environmental awareness training;
- Incorporation of environmental monitoring procedures; and
- Incorporation of a system of audit and review with regard to the effectiveness of the Plan.

4.3 Proposed Works and Methods

Further to the description of the main features given in Section 4.2, the following Sections set out details with respect to the proposed works and outline phasing programme, working methods and controls, and materials.

4.3.1 Outline Remediation Phasing

For the purposes of the EIAR, the remediation works are grouped into eight phases of works, assumed to take place over an approximate four year period. It is appreciated that the construction phases are of varying lengths but the overall duration of the intensive works is estimated to be 4 years, and for the purposes of the assessment we have assumed an average phase length of 6 months. It is acknowledged that there may be overlap between phases and activities based on identified constraints. The assumed 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, programme and ecological constraints. Depending on the outcome of these factors a lead-in time for the commencement of remediation works may also be required. The durations are also likely to be subject to weather conditions, which can restrict works where impacts and nuisance may be prevalent including inclement weather giving rise to surface water runoff, and dust and odour generation through waste excavation works. The outline phasing is broadly described below. Figure 4.8 shows the Outline Remediation Phasing for Phases 1 to 4 and Figure 4.9 shows similar for Phases 5 to 8.

Phase 1

- Demolition of existing residential properties (REC010, REC011 and REC016).
- Construction of new site entrance;
- Realignment of L2005 Kerdiffstown Road;
- Provision of new footpath and cycleway adjacent to realigned road extents;
- Installation of new perimeter fencing to site boundary;
- Installation of new foul and leachate pipeline connections to Johnstown Pumping Station;
- Construction of a new Landfill Infrastructure Compound;
- Demolition of concrete structures in Zone 2A, Zone 2B and Zone 4, including demolition of the retaining wall to form a future link to the Morell River;
- Removal of existing site connection to Canal Feeder Stream;
- Establishment of crushing and screening area in Zone 2B for processing of site generated concrete from demolition activities;
- Removal of stockpiles of materials in Zone 4;
- Re-profiling of current over-steep slopes in Zone 4, including removal of wastes where identified;
- Processing of materials from Zone 4 where identified as an opportunity for recovery of soils and re-use on site;
- Re-profiling of Zone 1/ 1A to accommodate surplus material derived from Zone 4;
- Stockpiling of imported fill material in Zone 2A; and

- Filling of Zone 3 with wastes from Zone 4.

Phase 2

- Continued re-profiling of slopes in Zone 4;
- Installation of a capping system in Zone 1A;
- Temporary stockpiling of Zone 4 material in Zone 2B for processing;
- Continued filling of Zone 3 with wastes from Zone 4;
- Continued re-profiling of waste in Zone 1 including filling with surplus material from Zone 4;
- Installation of a new or supplementary gas wells in Zone 1A; and
- Placement of imported low permeable soils to Zone 4.

Phase 3

- Removal of subsoil stockpile located adjacent to the new site entrance;
- Construction of temporary surface water retention pond in Zone 4;
- Installation of a capping system in Zone 1;
- Installation of a capping system in Zone 3;
- Installation of a new or supplementary gas wells in Zones 1 and 3; and
- Placement of imported low permeable soils to Zone 4.

Phase 4

- Construction of surface water retention pond in Zone 1A;
- Continued re-profiling and installation of a capping system in Zone 1;
- Continued progressive installation of new or supplementary gas wells in Zone 1; and
- Removal of the processed material stockpile from Zone 2B.

Phase 5

- Removal of the existing flare stack in Zone 1, commencing use of new flare stack in the new Landfill Infrastructure Compound;
- Continued re-profiling and installation of a capping system in Zone 1;
- Re-profiling and installation of a capping system in Zones 2A and 2B;
- Inspection and repair of concrete hardstandings in Zone 2B;
- Installation of gas venting measures in Zone 2B;
- Continued progressive installation of new or supplementary gas wells in Zone 1; and
- Removal of existing perimeter screening bund in Zone 1.

Phase 6

- Construction of surface water soakaway in Zone 1A;
- Continued progressive installation of new or supplementary gas wells in Zone 1;
- Continued re-profiling and installation of a capping system in Zone 1;
- Reduction in material stockpiled in Zone 2A;
- Re-profiling and installation of a capping system in Zones 2A and 2B;
- Inspection and repair of concrete hardstandings in Zone 2A; and

- Installation of gas venting measures in Zone 2A.

Phase 7

- Cleaning of surface water management pond in Zone 1A and commissioning of soakaway;
- Continued progressive installation of new or supplementary gas wells in Zone 1;
- Removal of stockpiled materials from Zone 2A;
- Removal of concrete stockpiles from Zone 2B;
- Cleaning of surface water management ponds in Zone 4, installation of ecological enhancements and final commissioning of the ponds; and
- Remediation works complete.

Phase 8

- Installation of multi-use sports pitches;
- Construction of building with changing rooms, public toilets and stores;
- Creation of a children's playground; and
- Construction of car parking, informal trails and defined viewpoints.

Design Mitigation

The Remediation Phase works will be subject to conditions identified with in the planning approval and IEAL licence issued by the EPA. The durations of construction phasing will also be subject to conditions, to restrict works where impacts and nuisance may be prevalent including inclement weather giving rise to surface water runoff, and dust and odour generation through waste excavation works. Prior to commencing any such works the appointed contractor(s) will prepare an Erosion and Sediment Control Plan (ESCP), setting out the procedures to minimise impacts, which could include use of temporary lagoons, silt busters and/or silt fences, as necessary.

A series of management plans will be required under the IEAL process which will also input and affect the approach to the phasing works.

4.3.2 Material Processing

Waste materials present at the site typically contain a high proportion of C&D wastes, including large blocks of concrete and demolition rubble. Re-profiling of the site will require the selected removal of oversize materials at the point of excavation. 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 will be undertaken in the Zone 2B site won materials processing and stockpiling area.

4.3.3 Material Import and Export

The application of key material and waste management principles, such as the waste management hierarchy (Diagram 4.6), will reduce the effects on natural resources. In particular, this will be achieved by re-using existing soils at the site, with appropriate processing, assessment and testing.

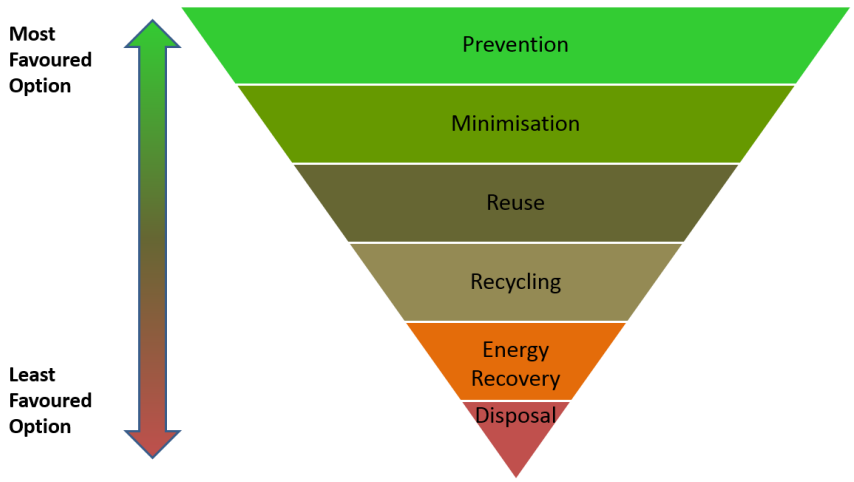


Diagram 4.6: Waste Management Hierarchy

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. It is these principles that apply to works at Kerdiffstown. No wastes other than inert wastes for use as engineering materials, such as aggregate, subsoil and top soil will be imported to the site. Further detail is provided in Section 4.5.

Proposals for material management will be set out in a CEMP, required as part of the EIAR and planning process. The CEMP will be prepared by the appointed contractor responsible for the remediation works. Material management is discussed further in Chapter 12 Soils, Geology, Contaminated Land and Groundwater, Chapter 15 Waste and Chapter 17 Material Assets.

Export volumes

Significant export of materials from the site is not expected to be required during the site remediation works. 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) 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 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 currently used on site for an engineering purpose being the restraint of the temporary cap on the lined cell (Zone 3); and
- hazardous waste, if encountered during the site re-profiling works, which requires disposal to a suitably licensed off-site facility as determined through the above process.

Other materials may be generated, for instance from off-cuts of geosynthetic liner or fencing. The removal of such materials does not represent export of existing waste materials, but as generated through the remediation works. Appropriate records of waste transfer will be maintained and held in the site file.

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 determination of capping options.

The total volume of soil materials required to construct the capping has been calculated by applying the construction thicknesses to the required capping areas. The approximate material import volumes are summarised in the Table 4.11.

Table 4.11: Approximate Volumes of Material to be Imported

Material		Approximate Import volumes (m^3)
Capping System	Top soil / Soil Forming Material	29,300
	Sub-soil	68,300
	Regulation layer (fine grained material, e.g. sand)	16,500
Engineered bunds (to support Surface Water Ponds 2 & 3)		13,300
Total volume		**127,400**

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 significant above that indicated in Table 4.11 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.

4.3.4 Temporary Stockpiling

Prior to commencing any phase of remediation works a suitable volume of soils will be required on site. 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 will be set out in a CEMP, required as part of the EIAR and planning process.

To prevent possible contamination of clean materials by site wastes separate stockpiling areas for imported materials and site won materials will be established. Stockpiling arrangements are summarised in the following table with stockpile locations shown indicatively on Figure 4.8 and Figure 4.9.

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

Table 4.12: Stockpiling Arrangements

Stockpile	Location	Identified Potential Uses
Existing sub-soil	Retained adjacent to existing site entrance.	Zones 1 and 4 capping
Imported 'clean' soils	Zone 2A Greenfield north of Zone 2A	Zone 3 toe bund Zone 4 ponds bunds Zones 1 to 4 capping (subject to testing and specification compliance)
Crushed / screened concrete (aggregate)	Zone 2B	Gas wells, access tracks, drainage aggregate. (subject to testing and specification compliance)
Site wastes (including fines from crushing of concrete)	Zone 2B	Infill to Zones 1 and 3 (where shown to be compliant with Industrial Emission Licence acceptance criteria)

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 of 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 though 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 ponds will be adopted as retention ponds during the remediation works, and the appointed contractor shall be required to utilise silt-buster traps as is typical on earthworks/ construction projects.

To further mitigate the risk of off-site contamination, 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 will be subject to regular road sweeping.

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.

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 will 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 runoff, including silt mitigation;
- The avoidance of un-necessary trafficking / handling of stockpiled materials; and
- Measures to prevent the spread of invasive plant species.

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.

With the exception of top soil (or soil forming materials), stockpile heights will 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.

4.3.5 Construction Quality Assurance (CQA)

To enable overall quality management, the remediation works will be governed by a comprehensive CQA Plan, prepared for submission to and review by the EPA. 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. The CQA Plan will set out:

- Construction Quality Control (CQC) procedures to ensure materials and workmanship meet design specifications;
- Procedures for implementing quality control;
- Technical specification and the conditions of contract drawn up by the designer; and
- Set out roles and responsibilities for the remediation works. The CEMP may also inform and be informed by the CQA Plan.

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

4.3.6 Park Construction

The final stage of works for the proposed Project will be the construction of a public park including multi-use sports pitches, a building with changing rooms, public toilets and stores, car parking, a children's playground, informal trails and defined viewpoints as shown on the indicative Landscape Masterplan (Figure 4.20). Refer to Section 4.7 for more detail.

4.3.7 Significant Effects

Assessments of significant effects are discussed in Chapters 7 to 17 of this EIAR.

4.3.8 Environmental Protection Measures

The remediation works proposals have been developed to include environmental protection measures to manage issues including odour, leachate, landfill gas, noise and dust. A series of management plans have been developed and will be supported as necessary by a CEMP. The CEMP will be prepared by the appointed contractor responsible for the remediation works for agreement with KCC, embracing all mitigation detailed in this EIAR, conditions set out in the planning approval and the requirements of the site's IEAL.

4.4 Commissioning

As part of the proposed Project there are a number of activities which will require to be commissioned prior to the Operational Phase. These are summarised below:

- The sewage pipeline from the leachate collection system and sewage pipeline from the changing rooms and site office will be connected to the sewerage system, subject to Irish Water approval;
- Once the gas flares are installed within the Landfill Infrastructure Compound, they will be connected to the gas pipework and once commissioned will emit in a controlled manner to atmosphere;

- Surface water ponds will be connected to the Morell River, following cleaning to remove sedimentation build up. The connection will be subject to EPA approval; and
- Northern surface water pond will be connected to soakaway, subject to EPA approval.

Commissioning of the leachate management system, specifically the leachate treatment plant and transfer pipeline to Johnstown Pumping Station, will be undertaken immediately following construction in the early phase of the remediation works, in agreement with the EPA and Irish Water.

Records of all commissioning work will be held on site file.

4.5 Raw Material Requirement and Sourcing

The remediation strategy is based on the optimisation of the capping guidance and end-use in order to minimise the requirement for import of materials from off-site sources. However, it is recognised that there will be a need to import materials to meet the requirements for provision of a suitably engineered site and to meet the proposed end-use condition.

The proposed Project will not operate as a landfill and will not accept waste for disposal but will require importation of inert wastes for use as engineering materials, such as aggregate, subsoil and top soil. In such instances, waste acceptance procedures shall be followed. The procedures will be supported by a summary note of Waste Acceptance Procedures (for issue to Contractors when seeking appropriate materials) and an extract from Part VIII of the Waste Management (Licensing) Regulations 2004, to confirm the wastes that are prohibited from the proposed Project. For all soils proposed for the remediation of the site a source specific determination of their suitability shall be required. Source materials which have the potential to be contaminated shall be tested to determine the suitability of the soils for use in the remediation works. The testing protocols and the frequency of testing shall be determined from an assessment of the source site. This methodology shall be carried out for both greenfield and brownfield sites. Once the source information is available then a site specific risk assessment shall be undertaken to identify the actual risks posed by the contaminants in their proposed use at the site and the suitability of the soils for remediation purposes confirmed. This suitability assessment will include Waste Acceptance Procedures comprising:

- Basic characterisation;
- Compliance testing; and
- On-site verification.

There is also an opportunity to process and re-use materials on site, subject to appropriate testing and specification compliance.

The primary requirement for raw materials will be in the provision of capping material. During site re-profiling, excavated material will be physically sorted to separate out suitable capping material. Where required, additional capping material will be specified and sourced from the local area where possible.

Table 4.11 sets out the assumptions with respect to materials volumes for importation. An Earthworks Summary Technical Note has been prepared to support the calculations of materials balance, importation and phasing (refer to Appendix A4.7).

4.6 Waste Recovery and Disposal

It is anticipated that only limited new sources of waste material will be introduced to the site during the remediation works. Where wastes are generated from, for example, the demolition of existing site infrastructure the majority of the material produced will be re-used as part of the site re-profiling and landscaping works. Any material that cannot be reused on site will be appropriately segregated and stored prior to collection for off-site recycling, recovery or disposal as appropriate at a suitably licensed facility.

During the Remediation and Operational Phases landfill gas and leachate will continue to be produced from the degradation of landfill wastes. The remediation works will enable the collection and appropriate disposal of these

materials. As the landfill wastes are assumed to be in a partially degraded state, the collection of landfill gas for the purposes of energy recovery is not considered feasible given the low quantities produced, however this will be reassessed once capping has been completed and further pumping trials have been conducted. The remediation proposals will also limit the production of leachate requiring treatment and disposal. Collected leachate will be pre-treated on site, prior to being pumped to Osberstown Wastewater Treatment Plant for further treatment.

It is estimated that there may be the potential to recycle rebar, to be recovered from the walls of former buildings and structures at the site as part of the remediation works. The level of recovery will depend on a number of factors including market value at the time of the proposed works and the grade of the rebar. Materials arising from the demolition of the existing residential properties will also be recovered as far as reasonably practicable.

It is not anticipated that other existing waste materials at Kerdiffstown will require off-site recovery or disposal. However, in the event that the construction works uncover a waste type which is non-compliant with a non-hazardous waste licence thus requiring off-site disposal, then measures to remove and dispose/recover such materials will be undertaken in accordance with the CEMP.

It is anticipated that soils that have been used for covering wastes may be reprocessed on site for the purposes of providing an engineering use, such as regulation layer (below cap) or as a subsoil (above cap) where appropriate testing and classification has been undertaken. The reuse of such materials will reduce the quantities of materials required to be imported and therefore the traffic impact on the surrounding community. The Traffic and Transport Assessment (refer to Chapter 14 Traffic and Transport) has assumed a 'worst case' scenario, which assesses the importation of all materials by road and no reuse of other site won materials in the remediation works.

4.7 End-Use, Aftercare and Maintenance

4.7.1 Industrial Emissions Activities Licence Compliance

Although the end-use proposal for the site is a multi-use public park the site will still be 'operated' under an IEAL granted by the EPA. However, unlike other landfill facilities in which waste licences set conditions for the operation of an active landfill for the acceptance and disposal of waste, it is anticipated that the IEAL for the site will set conditions and emission limits for the ongoing aftercare of the end-use at the site. KCC, as the licence holder, will be required to adhere to these specific conditions to minimise potential environmental impacts from the site, and provide data and reports to the EPA to confirm compliance. As a result, there will be an ongoing requirement for access to gas, leachate and groundwater monitoring wells on and off site and for the recovery of surface water samples from the within and outwith the site. The IEAL will also set out conditions in which the site may be determined as no longer requiring monitoring and aftercare, with the licence holder seeking EPA agreement with justification to satisfy that condition(s).

4.7.2 End-Use

Proposals

The end-use of the site, representing the Operational Phase of the proposed Project, will be a multi-use public park including multi-use sports pitches, a building with changing rooms, public toilets and stores, car parking, a children's playground, informal trails and defined viewpoints as shown on the indicative Landscape Masterplan (Figure 4.20). The proposals provide landscape improvements and present an opportunity for further ecological enhancements.

An overview of the main components of the park is outlined below:

- Vehicular and pedestrian/cycle main entrance, with double gates;
- Semi-ornamental planting to roundabout;
- North-west pedestrian entrance, with security gate;
- Vehicular 6m wide, tarmac access road within the park, with a minimum 2m wide footway;

- Public walkways and informal tracks within the site of varying widths (typically 1.2m-1.8m), constructed of unbound stone. These paths would vary in gradient, with some steps required in steeper sections, requiring confirmation on review of the final achieved site profiles;
- Maintenance tracks, 4m in width, constructed of unbound, imported stone, or combined with reinforced grass to reduce visual impact (north flank; Zone 1).
- 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 (4 No.) and public toilet facilities;
- Store room for materials required in use of sports pitches;
- Playground area adjacent to the main changing room building;
- Bicycle parking provision;
- Three synthetic (or similar approved surface) pitches, two sized 90m by 145m suitable for multiple codes including GAA, rugby and soccer, which can be sub-divided, each lit by 6 No. x 18m high, hinged masts; the third pitch offering flexibility as a training pitch or as 3 No. five-a-side pitches, lit by 6 No. x 8m high, hinged masts;
- 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;
- Enhancement of the three attenuation ponds, with use of marginal aquatic species planting and grouped trees;
- Surface water ditches and swales, enhanced by filling 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;
- Two 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 trigonometric plinth at the top of the site; and
- Outlet to the Morell River, with a stone clad headwall to integrate visually into the bank.

Further details of end-use proposals are included in the Landscape Masterplan Statement (refer to Appendix A4.8).

At the detailed design stage, the provision of trails would also be considered, which would mark out set trail lengths within the park of 1,000m and 2,000m 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.

Drainage of foul and grey waters from the changing rooms building will be directed to the sewer installed during the Remediation Phase. Further detail is provided in the Surface Water Management Plan (refer to Appendix A4.6).

Details of the changing room building and the sewage drainage arrangements from the building are shown on Figures 4.21 and 4.22. There will also be infrastructure required for the continued control of emissions from the landfill, namely the gas flare and a leachate management system discussed earlier.

Management of the Public Park

The park will be open to the public for use as an amenity area. The proposed hours of use of the multi-use public park are set out in Table 4.13 below.

Table 4.13: Proposed Public Park Opening Hours

Period	Sports Pitches	Park
Monday to Friday	08:00 – 21:00	09:00 – 20:00
Saturdays / Public Holidays	08:00 – 21:00	09:00 – 20:00
Sunday	09:00 – 18:00	10:00 – 17:00

Note: Park Opening will be subject to hours of daylight and dictated by park operations with the times specified above the latest closing time permitted to be used.

KCC will retain ownership of the park and will have overall responsibility for managing and maintaining the site. A KCC Site Manager will be based on site to maintain and oversee the monitoring and control mechanisms for the landfill infrastructure at the site, including gas wells and leachate. It is anticipated that park rangers and / or maintenance teams will also attend site when necessary.

Wastes generated during the operation of the park and the operation of the landfill infrastructure are likely to be litter (to be collected and removed from the site), some municipal and paper waste from the site office and foul waters from the changing room building and site office (to be disposed of to sewer).

Health & Safety of Visitors

The end-use for the site has considered the health and safety of visitors by incorporating the following elements into the outline design:

- Presence of council staff including the KCC Site Manager on site during normal working hours and park opening hours as outlined above.
- The public park facility, comprising paths across Zone 1, Zone 3 and around the ponds in Zone 4 will be open during daylight hours only. At all other times, these sections of the site will be closed off by locking gates.
- Areas around key plant and equipment, such as the Landfill Infrastructure Compound, will be designated as out of bounds, with no access to the public.
- A footpath and cycleway will be provided to allow pedestrians and cyclists to safely gain access to the site from the footbridge over the N7 from Johnstown, linking also to existing footpaths leading to Junction 8 over the N7 and to an underpass at Goff's, leading to Kill.
- Suitable signage will be placed around the site, warning visitors of the potential for deep water and the presence of key landfill infrastructure. A number of life buoys will be provided around the perimeter of the ponds, and the ponds will be fenced off to prevent access and to promote biodiversity in these areas.
- All monitoring wells at the site will be fitted with lockable covers.

During detailed design of the remediation and end-use, risks from landfill gas will be considered through the implementation of the requirements of Part 8 of the Safety Health and Welfare (General Application) Regulations 2007 (Statutory Instrument No. 299 of 2007) as amended. These Regulations require that where an explosive atmosphere is, or is likely to be, present at or may, from time to time, arise in a workplace the employer is required to make a suitable and appropriate assessment of the risk arising from such explosive atmosphere to the employees concerned having regard to all the circumstances. In this case users of the 'workplace' would be extended to public users of the parkland and recreational facilities. It cannot be ruled out that public users will not use ignition sources, therefore the site and infrastructure would need to be appropriately assessed, zoned and access restrictions put in place. The Regulations require the employer to prepare an explosion protection document to confirm the risk assessment undertaken and set out the applicable zoning of the site. This document

will be informed by the remediation works, most notably the findings of the landfill gas pumping trials and as-built details of the gas management system, for adoption in the management of the public park. Further information is provided in Section 12.3.20.

Health and Safety considerations and procedures will be regularly reviewed and developed, most notably during the detailed design phase and on completion of the remediation works.

Resource Requirements

Electricity will be required to power lighting in the Landfill Infrastructure Compound, car parking areas, multi-use sports pitches and changing room building. Water will be required for the changing room building and Landfill Infrastructure Compound.

Renewable technologies for lighting and re-use of grey waters will be explored at the detailed design stage, if feasible. Opportunities for energy efficiency will also be explored during detailed design, including the requirements for new buildings to be Nearly Zero Energy Buildings (NZEB). Existing utilities, such as electricity, water and telecommunications are discussed in detail in Chapter 17 Material Assets.

4.7.3 Post Remediation Settlement

Due to the nature of material deposited during the landfilling activities at the site, degradation of the waste over time will result in settlement – a process by which the volume of material decreases. As part of the remediation design a "post-settlement profile" of the planned final profile of the landfill after all settlement has taken place has been estimated for the Project using numerical predictive waste settlement modelling. This is shown on Figure 4.5.

Consideration of this potential settlement has been taken into account to ensure that the 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.

To confirm acceptable post-settlement profiles will be maintained, a preliminary settlement assessment was undertaken for the site. Post remediation settlement predictions were made by the application of Jacobs' numerical predictive waste settlement model[1] which is related to the anticipated composition and age of the waste materials present at the site. 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 (refer to Appendix A4.2). Through an iterative process, the proposed remediation profiles were adjusted until no post-settlement low spots occurred and a minimum gradient of 1v:30h was achieved for all areas of capping, providing suitable profiles for surface water management and complying with relevant EPA guidance. This excluded the retained hardstanding areas which are assumed to be drained separately as part of end-use proposals.

Emplacement of wastes from other areas on the site will 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.

Following the remediation works regular inspections of the site will be required to check for signs of settlement, such that maintenance can be undertaken without delay.

[1] In 2002 Enviros, a predecessor company of Jacobs, developed a reliable in-house, numerical method to accurately predict post-capping waste settlement, based on the modelling of waste degradation processes which act on the actual waste types and tonnages deposited over time at a subject landfill. This settlement prediction method utilises the mathematical representations of waste processes developed by Dr Alan Young in association with Enviros – Young (1992). The numerical, predictive waste settlement model considers waste processes and determines postcapping settlement with time, based on the mathematical prediction of mass loss due to waste degradation over time, from the commencement of the placement of waste. Post-capping waste settlement is directly related to mass loss due to waste degradation. The model is described in detail in Thomas and Cooke (2007), which includes illustrative data taken from previous practical applications of the model.

4.7.4 Aftercare

Aftercare arrangements include the collection, monitoring and flaring (as required) of landfill gas, the collection, monitoring and disposal of leachate and ongoing monitoring of groundwater and surface water. The Landfill Infrastructure Compound will also be maintained during the aftercare period.

The period of aftercare is likely to be detailed in the site's IEAL, together with criteria to be assessed in order to affect cessation of the aftercare period.

4.7.5 Maintenance

The following maintenance activities will be required to continue on a regular basis during aftercare, albeit mostly for short periods and for most activities on an infrequent basis:

- inspections and servicing of pumps, treatment plant, flare unit, collection pipes, etc.;
- measurement of leachate and gas concentrations in on-site and perimeter boreholes to check for off-site migration (more infrastructure will be required within the scope of remedial works);
- observation and assessment of settlement, slope stability and any ground movements;
- surveys of odour and other nuisances, e.g. noise;
- safety and security inspections;
- inspections of drainage and investigation and rectification of any ponding, flooding or pollution; and
- investigation and rectification of any operational damage from the selected end-use.

A series of management plans will be prepared to account for the continued operations at the site including maintenance requirements, to be regulated by the EPA under the sites' IEAL.

4.8 Vulnerability of the Project to Risks of Major Accidents and/or Disasters

Article 2 of Directive 2014/52/EU provides that Member States shall bring into force the laws, regulations and administrative provisions necessary to comply with the Directive by 16 May 2017. Therefore, in line with this Directive Table 4.14 considers the expected effects deriving from vulnerability of the project to risks of major accidents and/or disasters, where relevant to the project.

The below key outlines the approach to assessing the risk.

Key

Likelihood x Severity =	Risk

Likelihood	Severity: Negligible	Severity: Moderate	Severity: Severe
Likely	Medium	High	High
Unlikely	Low	Medium	High
Highly Unlikely	Low	Low	Medium

Table 4.14: Consideration of Vulnerability to Major Accidents or Disasters

Scenario	Hazard	Degree of Risk (uncontrolled)			Control Measures	Residual Risk			Reference in the EIAR
		Likelihood	Severity	Risk		Likelihood	Severity	Risk	
Flooding	• Increased risk of siltation within runoff • Risk of damage to site management infrastructure and amenity infrastructure. • Inaccessibility of areas of the park. • Health and safety risks	🟠	🟠	🟠	The landform design of the proposed Project has been designed to avoid the potential for surface ponding, waterlogging and flooding. At all stages the aim of the surface water management infrastructure for the proposed Project is to not increase the future flood risk to land or properties outside the site boundary. Surface water management measures for the Remediation and Operational Phases have been designed to mitigate the risk of environmental pollution and flooding from the site. The proposed drainage system for the site will include a network of open ditches, channels, swales and wetlands to intercept and control surface water runoff generated within the licensed extents of the site and direct it towards storage ponds. A Flood Risk Assessment (FRA) has been carried out. This indicates that the site is located just outside the fluvial flood risk zone. The FRA has initially concluded that all across the study area, comparison of the existing and the proposed Project demonstrates that the proposed works do not increase the flood risk.	🟢	🟠	🟢	Surface Water Drainage System – Section 4.2.9 Flood Risk Assessment – Appendix A13.1 Chapter 12 Soils, Geology, Contaminated Land and Groundwater Chapter 13 Water Quality – Hydrology
Fire	• Damage to site infrastructure and buildings. • Smoke impact on air quality and health of local residents. • Release of pollutants to air including particulate matter. • Odours associated with the fire. • Risk of contamination to groundwater and surface waters due to firefighting activities. • Health and safety risks. • Waste generated from firefighting activities and clean-up operations.	🟠	🔴	🔴	Capping of wastes and installation of landfill gas management system to control and burn off gases generated by the waste, preventing gas build-up.	🟢	🔴	🟠	Chapter 4 Description of the Proposed Project Section 4.2.8 Leachate and Landfill Gas Management Systems Appendix A4.5 – Landfill Gas Management Plan
Slope failure	• Risk to any underground infrastructure (piping, gas wells, groundwater wells, etc.). • Exposure of waste. • Damage to trees and other habitats. • Safety risk to people on or below slopes. • Impact to watercourses and groundwater.	🟠	🔴	🔴	The proposed Project includes re-profiling the site to address current over-steep slopes to permit installation of an engineered capping and/or soil cover system, to allow for surface water drainage, and provide mitigation of long-term settlement of the waste mass. Observation and assessment of settlement, slope stability and any ground movements have been identified as key maintenance activities required to continue on a regular basis during the Operational Phase.	🟢	🔴	🟠	Chapter 4 Description of the Proposed Project Slope stability assessment Requirement for the appointed contractor to provide a CEMP:
Explosion of gases, migration of gas off-site, lateral flow of gas once capping is in place	• Damage to landfill gas management infrastructure. • Damage to leachate management infrastructure. • Damage to sewer lines. • Risk of causing a fire. • Health and safety risks.	🟠	🔴	🔴	Installation of landfill gas management system to control and burn off gases in a controlled manner. Installation of methane stripping plant to remove methane from leachate prior to discharge into the sewer. An Accident Prevention and Emergency Response Plan has been developed which includes measures to minimise the risk of fires. The Plan is a live document and will be reviewed on a regular basis and upgraded accordingly.	🟢	🔴	🟠	Chapter 4 Description of the Proposed Project Section 4.2.8 Leachate and Landfill Gas Management Systems Appendix A4.5 – Landfill Gas Management Plan Chapter 12 Soils, Geology, Contaminated Land and Groundwater
Uneven settlement	• Localised dips in the surface • Possible damage to infrastructure such as the landfill gas management system, the leachate management system and surface water management system, the multi-use sports pitches, underground pipelines, pathways, etc.	🟠	🟠	🟠	Due to the nature of the site and risks to the environment should any such facilities fail, the new Landfill Infrastructure Compound is proposed to be positioned off-waste such that ground conditions are not liable to settlement due to waste degradation or loading. Observation and assessment of settlement, slope stability and any ground movements have been identified as key maintenance activities required to continue on a regular basis during the Operational Phase. To confirm acceptable post-settlement profiles will be maintained, a preliminary settlement assessment was undertaken for the site.	🟢	🟠	🟢	Chapter 4 Description of the Proposed Project Section 4.7.3 Post Remediation Settlement Section 4.7.5 Maintenance
Failure of Leachate Management System- Leachate release	• Contamination of surface water drainage system • Odours • Contamination of groundwater	🟠	🟠	🟠	Security measures for the leachate management system are proposed in the Leachate Management Plan, to include provision for an underground storage tank which will be used in the event of spillage from the valves connecting to road tankers or the tankers. The operation of this system will be controlled and alarms set using a supervisory control and data acquisition (SCADA) system or similar, with proposals developed during detailed design. A Leachate Management Plan has been prepared, which provides further detail on the leachate management system. Leachate management system and management plan in place, regular maintenance of tanks to be carried out, emergency response plan in place.	🟢	🟠	🟢	Chapter 4 Description of the Proposed Project Section 4.2.8 Leachate and Landfill Gas Management Systems Appendix A4.4 – Leachate Management Plan

Scenario	Hazard	Degree of Risk (uncontrolled)			Control Measures	Residual Risk			Reference in the EIAR
		Likelihood	Severity	Risk		Likelihood	Severity	Risk	
Spillage	• Variable depending on substance spilled, the scale of the spill and the location of the spill. • Contamination of surface water drainage system • Odours • Contamination of groundwater				An Accident Prevention and Emergency Response Plan has been developed which includes measures to minimise the risk of spillages. The Plan is a live document and will be reviewed on a regular basis and updated accordingly. The proposed Project includes for water quality monitoring to be undertaken as indicated in the Industrial Emissions Activities Licence (IEAL) as agreed by the EPA supported by a Monitoring and Control Management Plan. In the event of an exceedance of the agreed emission level values, the discharge from the pond will be automatically shut off.				Appendix A4.4 Leachate Management Plan Chapter 13 Water Quality – Hydrology
Failure of gas management system	• Odours due to lack of flaring of gases				A back up flare will be available during both the Remediation and Operational Phases in the event of the main flare going offline. Regular maintenance to be carried out on the system. Measurements of gas concentrations in on-site and perimeter boreholes has been identified as a key maintenance activity required to continue on a regular basis during the Operational Phase. An Accident Prevention and Emergency Response Plan has been developed which includes measures to minimise the risk of migration of landfill gas and explosions. The Plan is a live document and will be reviewed on a regular basis and updated accordingly.				Chapter 4 Description of the Proposed Project
Penstock failure	• Loss of control on surface water release in the event of contamination to the site drainage				An Accident Prevention and Emergency Response Plan has been developed which includes measures to minimise the risk of spillages and leakages. The Plan is a live document and will be reviewed on a regular basis and updated accordingly. Regular maintenance to be carried out on the penstock. Surface water ponds act to attenuate surface waters being discharged to the Morell River surface water outfall.				Chapter4 Description of the Proposed Project Appendix A4.6 Surface Water Management Plan
Extreme weather (high winds and/or rainfall)	• Increase in pressure on the surface water drainage network. • Damage to buildings and infrastructure from high winds. • Impact on gas flaring. • Damage to trees and fencing • Health and safety risk from windblown debris. • Scour of capping system.				Surface water system design takes cognisance of climate change. Construction works to be undertaken by competent contractor. Specification for the works to embrace all relevant building regulations, standards and approvals. A Maintenance Management Plan will be required as part of the IEAL. Site will be regulated under conditions of IEAL by EPA.				Appendix A4.6 Surface Water Management Plan Surface Water drawings
Contamination being found in imported fill material	• Contamination of surface waters and groundwater • Cross contamination of materials				The proposed Project includes measures for the management of imported material, including strict environmental and geotechnical specifications and acceptance criteria. 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 of imported material will 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 runoff, including silt mitigation; • The avoidance of un-necessary trafficking / handling of stockpiled materials; • Measures to prevent the spread of invasive plant species; • 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.				Chapter 4 Description of the Proposed Project Section 4.3 Proposed Works and Methods Requirement for the appointed contractor to provide a CEMP:

Scenario	Hazard	Degree of Risk (uncontrolled)			Control Measures	Residual Risk			Reference in the EIAR
		Likelihood	Severity	Risk		Likelihood	Severity	Risk	
Non-compliant material being found in imported fill material	• Contamination of surface waters and groundwater • Cross contamination of materials				The proposed Project includes measures for the management of imported material, including strict environmental and geotechnical specifications and acceptance criteria. 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 of imported material will 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 runoff, including silt mitigation; • The avoidance of un-necessary trafficking / handling of stockpiled materials; • Measures to prevent the spread of invasive plant species; • 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.				Chapter 4 Description of the Proposed Project Requirement for the appointed contractor to provide a CEMP:
Discovery of non-compliant materials within the existing waste mass during earthworks	• Release of contaminants to air, water, ground. • Human health				It is not anticipated that other existing waste materials at Kerdiffstown will require off-site recovery or disposal. However, in the event that the construction works uncover a waste type which is non-compliant with a non-hazardous waste licence thus requiring off-site disposal, then measures to remove and dispose/recover such materials will be undertaken in accordance with the Construction Environmental Management Plan.				Requirement for the appointed contractor to provide a CEMP:
Earthquake	• Risk to any underground infrastructure (piping, gas wells, groundwater wells, etc.). • Risk to any over ground infrastructure (Landfill Infrastructure Compound buildings, changing rooms, lighting, etc.) • Exposure of waste. • Damage to trees and other habitats. • Health and safety risks.				In the event of an earthquake impacting the proposed Project, the project would require an assessment of damage cause by the earthquake, the implementation of interim control measures where appropriate and development of a strategy to address any damage. Observation and assessment of settlement, slope stability and any ground movements have been identified as key maintenance activities required to continue on a regular basis during the Operational Phase.				
Power failure	• Failure of power supply to the landfill infrastructure • Failure of power supply to the park infrastructure, floodlighting, changing rooms, etc. • Health and safety risks.				The appointed contractor(s) responsible for the remediation works will be responsible for ensuring a suitable power supply and possible back-up generators to continue the remediation works. In the event of a power failure during the Operational Phase, KCC will be responsible for reviewing the opening hours to ensure the public's safety. KCC will also review the situation to determine if a back-up power generator is required to continue the operation of the landfill infrastructure. Detailed design of leachate, surface water and landfill gas management systems will be subject to a Hazard and Operability Study (HAZOP) to determine appropriate security provisions for these systems in order to prevent accidents.				Leachate Management Plan
Irish Water unable to accept leachate at Johnstown Pumping Station for a prolonged period of time	• The proposed leachate management system would be unable to pump leachate to Johnstown Pumping Station				The utilisation of various storage capacities within the site allow for a period for tankers to be mobilised to site to remove leachate directly from the leachate system. This use of capacities is necessary as a fail-safe as the prevention of discharge to sewer network via sewer may also apply for direct disposal to a treatment plant, which requires the assignation and agreement of Irish Water. Allowing for the tankering of leachate for removal to a suitably licenced treatment facility.				Chapter 4 Description of the Proposed Project Section 4.2.8 Leachate and Landfill Gas Management Systems Appendix A4.4 – Leachate Management Plan

4.9 Guidance

Below is a non-exhaustive list of guidance used in the determination of design for the purposes of this Chapter of the EIAR.

- Abacus. 2017. Gaelic Sports Lighting. [ONLINE] Available at: http://www.abacuslighting.com/gaelic-sports-lighting.asp. [Accessed 14 June 2017].
- CIRIA (2007). The SuDS Manual (C753).
- CIRIA (2010). Environmental Good Practice on site (third edition).
- Cumann Luthchleas Gael (2005). Club Manual. Chapter Eight – Providing Facilities.
- Department of Transport, Tourism and Sport (2013). Design Manual for Urban Roads and Streets.
- Directive 94/9/EC of the European Parliament and the Council of 23 March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres.
- Directive 1999/92/EC of the European Parliament and of the Council of 16 December 1999 on minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres (15th individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC)
- Environmental Protection Agency (1995). Landfill Manuals. Investigations for Landfills.
- Environmental Protection Agency (1997). Landfill Manuals. Landfill Operational Practices.
- Environmental Protection Agency (1999). Landfill Manuals. Landfill Restoration and Aftercare.
- Environmental Protection Agency (2000). Landfill Manuals. Landfill Site Design.
- Environmental Protection Agency (2003). Landfill Manuals. Landfill Monitoring (2nd Edition).
- Environmental Protection Agency (2011). Final Draft BAT Guidance Note on Best Available Techniques for the Waste Sector: Landfill Activities.
- HR Wallingford. 2017. Online Tools for Sustainable Drainage Systems (SuDS). [ONLINE] Available at: http://www.uksuds.com/. [Accessed 14 June 2017].
- Irish Water (2016). Code of Practice for Wastewater Infrastructure. A design and construction guide for developers.
- National Transport Authority (2011). National Cycle Manual.
- National Standards Authority of Ireland (2000) IS EN 12056-2 Gravity drainage systems inside buildings.
- National Standards Authority of Ireland (2008) IS EN 752:2008 Drain and sewer systems outside buildings.
- S.I. 10 of 2005. Safety, Health and Welfare at Work Act (2005)
- S.I. 291 of 2013. Safety, Health and Welfare at Work (Construction) Regulations (2013).
- Scottish Water (2015). Sewers for Scotland (3rd Edition).
- Transport Infrastructure Ireland (2011). Design Manual for Roads and Bridges.
- UK Department for Environment Food and Rural Affairs (DEFRA) (2009). Construction Code of Practice for the Sustainable Use of Soils on Construction Sites.
- UK Environment Agency (2014). Technical Guidance Note (Monitoring) M18. Monitoring of discharges to water and sewer.
- UK Water Industry Research Limited (2011). Civil Engineering Specification for the Water Industry (7th edition).
- WRc (2013). Sewers for Adoption. A Design and Construction Guide for Developers. 7th Edition.

5. Consideration of Alternatives

5.1 Introduction

This Chapter of the EIAR describes the reasonable alternatives which were considered for remediation and end-use of Kerdiffstown Landfill site. This Chapter also provides an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects. In developing design options a key aspiration was to embrace a balance between the avoidance of adverse environmental effects and achievement of the project objectives. As outlined in Chapter 1 Introduction, the objectives of the proposed Project are:

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

Kerdiffstown Landfill comprises a former quarry, landfill and waste processing facility, occupying an area of approximately 30 hectares. The site has been progressively backfilled with wastes since around 1950 until 2010, with an estimated waste volume of around 3.1Mm^3. Further details of the site history are outlined in Chapter 3 The Need for the Proposed Project. The proposed Project comprises the remediation of the site to reduce the risks posed by the site in its current condition to public health and safety and the environment whilst developing the site to provide an amenity to the local community, comprising a public park with multi-use sports pitches, changing rooms, car parking and a children's playground.

From the "*Revised Guidelines on the Information to be contained in Environmental Impact Statements (Draft)*" Environmental Protection Agency (2015) it is recognised that there are aspects for which alternatives may not be applicable to a particular project. When considering the nature of this proposed Project there are a number of alternatives that are therefore not relevant. Therefore, no consideration has been given to options that would potentially leave the site in breach of relevant environmental legislation. Typical alternatives considered for this proposed Project are outlined below, referencing to the appropriate Section in this Chapter where these are discussed further.

- Alternative Locations refer to Section 5.2;
- Alternative Layouts refer to Section 5.3;
- Alternative Designs refer to Section 5.4; and
- Alternative Processes refer to Section 5.5.

5.2 Alternative Locations

5.2.1 Remediation

A remediation options assessment carried out for the site (Kerdiffstown Landfill Remediation Project Remedial Options Report, SKM Enviros 2013) examined the potential technical options for addressing the risks posed by the site and used a qualitative scoring mechanism to assess each viable option against a number of performance criteria.

The option to excavate and remove all of the wastes for off-site disposal was dismissed early in the options assessment process. If considering groundwater protection only the option of "dig and dump" would be appealing; however, the environmental consequences of excavating 3.1Mm^3 of waste would be significant, involving the uncontrolled release of landfill gas resulting in very significant odour impacts over a period of years, as well as thousands of tonnes of Greenhouse Gases (GHGs). The implications for traffic would also be enormous with over 300,000 traffic movements; at least 7,000,000 kilometres travelled (based on known, existing landfill location) and greater than 10,000 tonnes of GHGs released.

It is also recognised that there is a significant pressure on landfill capacities for operational sites at a national level, with set annual limits regularly being reached within a period of less than 12 months. The additional disposal of waste from Kerdiffstown Landfill would therefore require planning and regulatory approvals to be in place at a national level. It is considered unlikely that a single and or local disposal site would be available for the entire volume requiring excavation from Kerdiffstown Landfill.

The 'void' that would then be created at the site, by the excavation of waste, would require importation of inert material to at least partially restore the site to an acceptable profile. This poses risks of sourcing suitable material (clean, local source) and traffic impacts to import the material to site.

As a result, complete removal of wastes to another location was not considered to be a sustainable option and was not considered further.

Assessment of remedial options is further discussed in Section 5.3.1, which includes reference to the transfer of waste from this site to another location.

5.2.2 End-Use

The key aspect of the proposed Project is the remediation of the former landfill site and to then offer an amenity use to the local community who have been negatively affected by works at the site for a number of years. In this regard, the exploration of an alternative location for the end-use proposals is not considered relevant for this proposed Project.

5.3 Alternative Layouts

5.3.1 Remediation

As outlined in Chapter 4 Description of the Proposed Project waste deposits have been observed to the extents of the site. Alternative layouts of the remediation design were considered as part of the remediation strategy review, discussed further in Section 5.4.1.

5.3.2 End-Use

Technical Constraints

Options for the end-use for the proposed Project are limited due to the technical constraints posed by the long term management requirements associated with the legacy landfill site, many of which will be addressed through the installation of infrastructure at the site. These constraints are outlined in Table 5.1:

Table 5.1: Technical Constraints on End-Use Alternatives

Constraint	Description	Effect
Settlement of wastes	The volume of the waste mass will reduce as the biodegradable components in waste degrade and decompose over time.	This reduction in the volume of waste will result in the lowering of the waste profile. Access to waste areas will be required to facilitate inspection and maintenance.
Protection of the Surrounding Environment and Identified Receptors	The remediation design will include measures to provide protection to the surrounding environment, for example capping to reduce generation of leachate and limit gas and odour emissions.	A capping system will be required above wastes which limits the nature of the development which can be undertaken on such areas. Special design features may be necessary, with supporting risk assessments.

Constraint	Description	Effect
Leachate Management	The site will continue to generate leachate from the waste mass for a significant period of time. Within the lined cell leachate will be collected for extraction, representing a long-term site management requirement.	Infrastructure is required at the site to enable monitoring, extraction and transfer of leachate from the site. Access will be required to facilitate inspection, monitoring and maintenance.
Surface Water Drainage	A network of ditches, swales or drains will be required to convey the rainwater collected over the site area to a suitable low point for settlement to remove suspended solids and for discharge to an off-site watercourse/ body.	The presence of drainage features should not constrain the end-use. Drainage for any areas on which traffic movements or parking occur, would be diverted through a silt trap and oil interceptor, before discharge. Access will be required to facilitate inspection, monitoring and maintenance.
Landfill Gas Management	The site will continue to generate landfill gas from the waste mass for a significant period of time. The need to manage landfill gas remains a long-term site management requirement.	Monitoring of gas wells, manifolds and boreholes will be required on a regular basis, as determined by the site's Industrial Emissions Activities Licence (IEAL). Flare operation and maintenance will be required over the remaining gassing lifespan of the site. Access will be required to facilitate inspection, monitoring and maintenance.
Landform	A number of walls remain from former buildings and structures which would require removal as they pose a risk to site users. Over-steep slopes require to be re-profiled to provide a stable landform. The profile of the remediated areas of the site requires to be such that surface water runoff is facilitated and ponding does not occur. Above wastes, where settlement is predicted, the pre-settlement landform has to be sufficient to accommodate the predicted settlement.	Re-profiling of slopes and removal of stockpiles present on site will generate a significant volume of material to be accommodated within the extents of the site, without the need for exporting from the site, thus restricting areas for development on the site. Access will be required to facilitate inspection, monitoring and maintenance.
Capping Integrity	The capping of predominant areas of waste with a fully engineered low permeability capping system is a fundamental element of the remediation solution. It will provide a barrier to prevent the infiltration of rainfall into the waste and the uncontrolled escape of gas from the waste mass.	The integrity of the capping system(s) must be maintained and cannot be impacted by any end-use or development overlying the capped surface.

Constraint	Description	Effect
Monitoring and Maintenance	The operation of the end-use option will require the following activities on a regular basis: • Inspections and servicing of pumps, treatment plant, flare unit, collection pipes, etc.; • Monitoring of groundwater quality and gas concentrations in on-site and perimeter boreholes to check for offsite migration; • Observation and assessment of settlement, slope stability and any ground movements; • Surveys of odour and other nuisances, e.g. air quality; • Safety and security inspections; • Inspections of drainage and investigation and rectification of any ponding, flooding or pollution; and • Investigation and repair of any operational damage from the selected end-use.	Access to the various infrastructure (monitoring boreholes, wells, pipes, drains) and surface will be required for a significant period of time, until the period when cessation of activities can be agreed by the Environmental Protection Agency.

In the determination of end-use design options the above constraints were considered in order to select the option(s) with least environmental impact, balanced against technical imperative for the long-term management of the site.

End-Use Options

There is precedent for closed landfills to be remediated to allow various end-uses that are compatible with the constraints imposed by the need to continue to 'manage' the performance of the landfill. These range from relatively passive uses for capped landfills, generally pasture, parkland or wildlife reserves, through to more active uses such as sports facilities and suitably engineered structures. Ultimately it is possible to conceive of a large range of end-uses for the Kerdiffstown site, but as a general rule the costs of implementation will increase with complexity.

A Remedial Options Report (Kerdiffstown Landfill Remediation Project Remedial Options Report, SKM Enviros 2013) presented an outline of three potential end-use options, namely:

1. Site completion in accordance with previous planning approval – domed cap (i.e. layering of waste and/or cover material above original ground contours) with final remediation level of 108mOD (Poolbeg), providing an agricultural end-use.
2. Medium to high density mixed-use redevelopment – utilising existing concrete slab areas for industrial/ commercial end-use, possible educational centres and activity parks. Employment and cultural projects could be included.
3. Passive amenity function, i.e. informal recreation – landscape entire site with retention of raised area in north-west area of site (Zone 1), retention of hardstand in central portion and provision of a landscaped area in south-east (Zone 4). Other sub-options were considered with respect to providing wider access to the site following completion of the remediation works.

The Remedial Options Report concluded that Option 3 was the preferred option for a number of reasons including improved landscape and visual impacts and provision of an amenity site for the local community.

In 2016 Jacobs undertook a further End Use Assessment on behalf of Kildare County Council (Kerdiffstown Landfill End Use Assessment, Jacobs 2016), taking cognisance of the following design objectives:

- Environmental Protection;
- Public Health Protection;
- Bringing the Land Back into Productive Use; and

- Sustainability.

This report considered a range of constraints including technical, economic and local community opinion. This report detailed a number of potential end-uses for Kerdiffstown Landfill, all of which have precedence elsewhere in Ireland and the UK. A summary of alternative end-use options is presented in Table 5.2.

Table 5.2: Alternative End-Use Options

Selected Option	Description		Main reason for selecting chosen option
Public open space, parkland Sports and recreation	Series of pathways, a car park, cafe and children's play area. Potential for dog park, visitor centre and an outdoor events venue. Sports pitches and changing rooms. Possibility to extend to include outdoor gym equipment, cycling paths, or BMX track.		Provides an amenity to local community. Improved landscape and visual impact.
Alternatives	**Description**	**Environmental and Planning Considerations/Constraints**	**Main reason for rejecting alternative**
Pasture/grazing	Pasture for grazing animals	Human perception (assumption that there would be contamination of the food chain) may have precluded livestock production for food – reducing farmer's potential income.	Infrastructure required for drainage and gas management can be buried at shallow depth possibly at risk from animals. 80% of the land available for agricultural leases for grazing, leaving 20% of site to be otherwise managed.
Arable	Arable farmland for crops	Slope gradients limit access for machinery. The depth and quality of the soil cover would need to be greater to protect integrity of capping layer. Human perception (assumption that there would be contamination of the food chain) may have precluded crop production for food – reducing farmer's potential income.	Infrastructure required for drainage and gas management can be buried at shallow depth possibly at risk from farming activities. 70% of the land available for agricultural leases for crop growing, leaving 30% of site to be otherwise managed. Improved landscape and visual impact offered by multi-use park.
Renewable energy	Landfill gas transformed to electricity. Heat energy potential from the ground for use in district heating. Solar farm or wind turbines.	Limited volumes of landfill gas being generated. Heat energy - provision of heat beyond on-site uses, unlikely to be a viable option. (Exploration of Heat Recovery Potential from Landfill Waste [Reilly 2016]) Solar - site would need to be extensively re-profiled to render it suitable for this type of development (south-facing). Wind turbines require complex foundations. Landscape and visual impacts from solar farm or wind turbines.	Gas may provide only limited energy source, unlikely to produce sufficient energy to warrant export to the grid or to power nearby property. The nature of the waste may affect the ability to predict how the heat source may vary over time and therefore the viability. Provision of infrastructure would require long-term investment return period, and incentives are politically motivated and hence subject to market turbulence.

5.3.3 Consultation on Alternative End-Use

As part of the 2016 end-use assessment (Kerdiffstown Landfill End Use Assessment, Jacobs 2016) three options were selected by KCC for further consideration and external consultation, being:

1. Agriculture (pasture for grazing);
2. Country Park; and
3. Multi-use Recreational.

A simple screening matrix was developed to assess the identified technical constraints against the potential end-uses. For completeness the option of developing the site for industrial or commercial purposes was also included in the assessment as there is precedent for such developments elsewhere on closed landfill sites.

Table 5.3: End-Use Screening Matrix

End Uses:	Technical Constraints								
	Waste settlement	Site profile and topography	Leachate Management	Surface Water Drains	Gas management	Capping integrity	Boundary issues	Environmental Monitoring Boreholes	Traffic / site Location
Pasture/grazing									
Arable									
Parkland – basic public open space									
Parkland – country park									
Sports									
Renewable Energy									
Commercial / Industrial									

Key

	Green – end-use has minimal impact on remediation design.
	Yellow – end-use requires remediation design to be modified to some extent.
	Red – end-use cannot be accommodated without fundamental change to remediation design.

Consideration was also given to potential environmental benefits associated with each of the selected end-use options, as set out in Table 5.4.

Table 5.4: Potential Environmental Benefits of End-Use Options

Benefit	Option 1 Agricultural end-use	Option 2 Country Park	Option 3 Multi-Use Recreational
Food production	Minimal	×	×
Non-food production	Possible	×	×
Recreation	×	Limited – could be expanded through design	✓
Potential to provide local economic gains	×	Limited – could be expanded through design	✓
Biodiversity value	×	✓ Values could be maximised through targeted design and management	Limited
Education	×	×	✓
Visual amenity	×	✓	✓
Potential to provide climate resilience benefits	×	✓ Values could be maximised through targeted design and management	✓
Renewable energy possibilities	Considered to be technically not feasible		

KCC undertook a period of consultation, discussed further in Chapter 6 The Consultation Process. This consultation process and the feedback supported the selection of a multi-use public park as the end-use. Further input and feedback from individuals, community groups and sports partnerships have informed the design of the park, shown on Figure 4.20.

5.4 Alternative Designs

5.4.1 Remedial Options Studies

In 2010 SKM Enviros (now Jacobs) were commissioned by the Environmental Protection Agency (EPA) to conduct an evaluation of potential environmental liabilities associated with various closure scenarios for Kerdiffstown Landfill. In 2013 SKM Enviros carried out a high level independent review of the environmental baseline at the site, including identifying potential outline remediation and end-use options. As part of this work, the scenarios as proposed in the Evaluation of Environmental Liabilities (SKM Enviros 2010) report were further explored and refined in the Kerdiffstown Landfill Remediation Project Remedial Options Report (SKM Enviros 2013). The outline details of remediation options considered along with the main environmental and technical advantages and disadvantages were assessed to determine the most appropriate solution for the proposed Project, as presented in Table 5.5.

Table 5.5: Remedial Options Assessment

Item	Option	Broad Description	Environmental Advantages	Environmental Disadvantages	Comment
1	**Do Nothing**	Leave site in its current state and discontinue ongoing environmental monitoring.	None	Risks to human health via direct and indirect pathways remains. Would leave the site in breach of environmental legislation.	Does not meet the project objectives. **Not considered further.**
2	**Do Minimum**	Environmental monitoring regime continues, with reactionary action undertaken in the event of an environmental hazard occurring.	None	Risks to human health via direct and indirect pathways remains. Would leave the site in breach of environmental legislation.	Does not meet the project objectives. **Not considered further.**
3A	**Do Something** Minimal reconfiguration and capping	Minimal movements of wastes to provide a safe landform. Installation of cap; collection and management of landfill gas, leachate and surface water.	Limited excavation minimising potential environmental impacts during works (noise, traffic, odour etc.). Post remediation gas and odour control. Post remediation surface water control.	Ongoing groundwater impact post remediation but leachate generation should be restricted by capping of wastes to reduce infiltration. Potential off site leachate migration from Zone 1 posing risk to Morell River.	Meets project objectives. Potentially viable option.
3B	**Do Something** High quality cap across whole site, groundwater interception and treatment	Minimal movements of wastes to provide a safe landform. Installation of cap; collection and management of landfill gas, leachate, surface water and groundwater.	Limited excavation minimising potential for environmental impacts (noise, traffic, odour etc.). Post remediation gas and odour control. Post remediation surface water control. Off-site leachate migration controlled by barrier system to prevent groundwater / surface water impact, mitigating risk to Morell River.	Ongoing groundwater impact post remediation but leachate generation should be limited by capping of wastes to reduce infiltration.	Meets project objectives. Potentially viable option.
3C	**Do Something** Development of fully lined containment site for all wastes	Construction of new lined cells to form a new lined landfill. Installation of cap; collection and management of landfill gas, leachate and surface water.	Groundwater and surface water impacts controlled by total containment solution. Post remediation gas and odour control. Post remediation surface water control.	Extended construction period, longer duration of temporary construction related impacts. Extensive excavation works required increasing potential for environmental impacts and nuisance.	Meets project objectives. Not viable from a financial perspective.
3D	**Off-Site Disposal** Excavation and off-site disposal of all wastes	Remove all processing plant, waste and other materials from the site and transfer all wastes off-site for deposition into another appropriately licensed landfill site.	Removes predominant risks from the site.	Lack of suitable alternative licensed disposal sites in vicinity. Significant volumes of haulage traffic associated with this option. Significant odour, dust and noise impacts. Potential requirement to import significant quantities of materials to fill in void, post-waste excavation. Health and safety risks for workers. Transference of risk to another site.	Not viable both from a sustainability and financial perspective. **Not considered further.**

5.4.2 Short-listed Remedial Options

From the assessment in Table 5.5 three options were considered to be potentially viable, being 3A, 3B and 3C. These scenarios were further refined (as Scenarios A, B and C) using a high level optioneering process (Kerdiffstown Landfill Remediation Project Remedial Options Report, SKM Enviros 2013), as shown on Diagram 5.1.

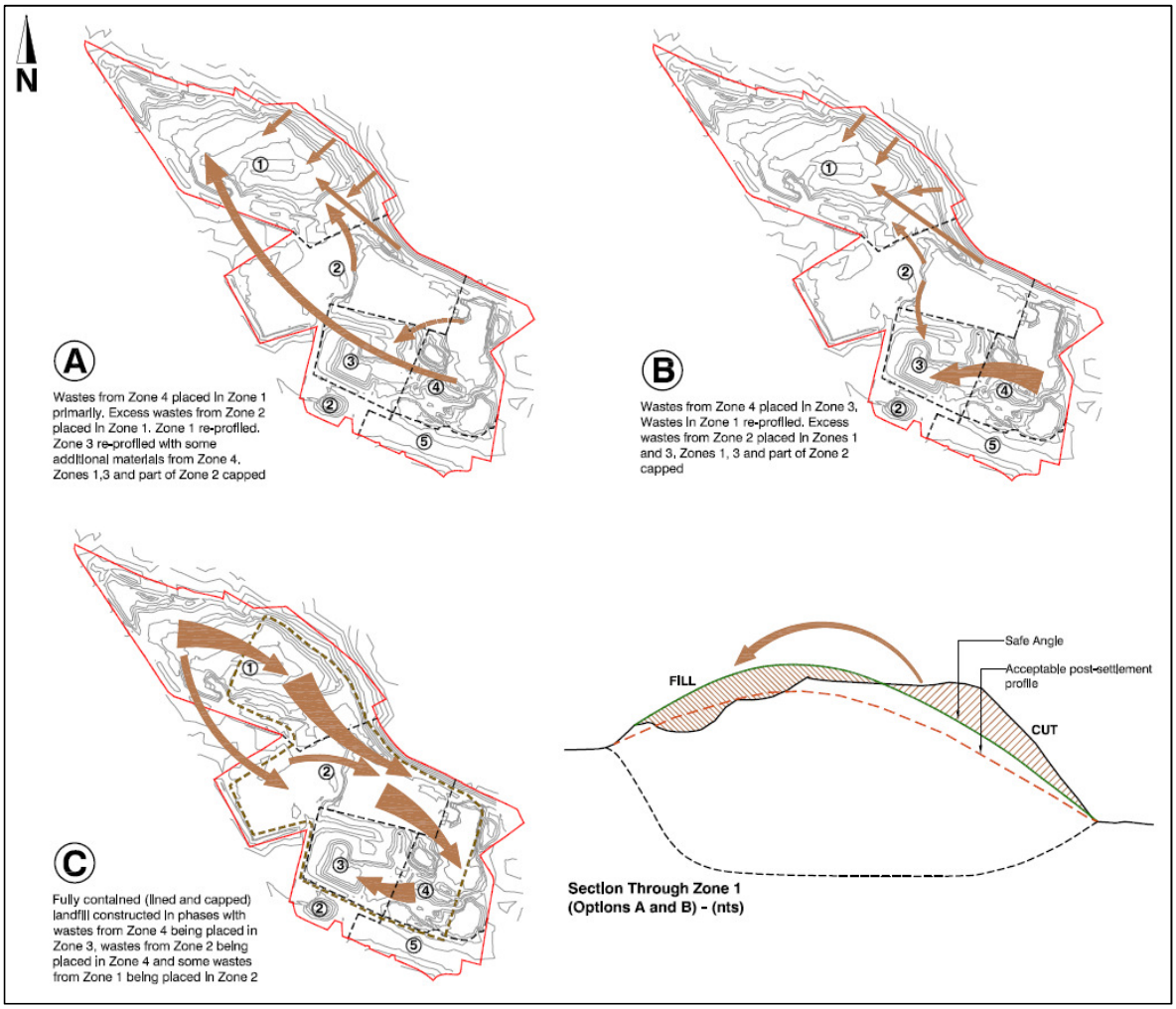
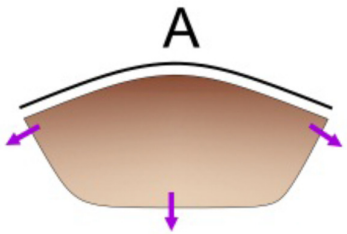
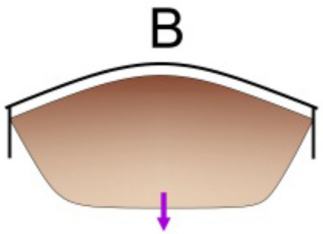
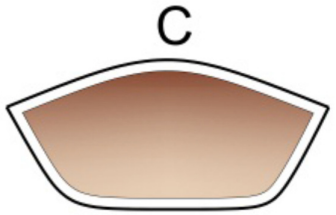


Diagram 5.1: High Level Remediation Scenario Schematics (SKM Enviros 2013)

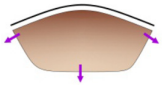
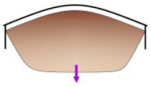
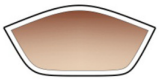
Each of the options were broadly similar, all representing a practical way of capping wastes in-situ. Scenario A achieved this objective as a 'do minimum' approach; rationalising all wastes with the minimum of excavation by creating both a lined and unlined capped landfill with provision for perimeter collection and treatment of any significant leachate migration formed Scenario B; and, the creation of a new lined landfill in the south-eastern area of the site was the basis of Scenario C. A summary of each scenario is presented below and are illustrated in simple conceptual terms by schematics.

Table 5.6: Remediation Scenario Summary

Scenario A	Scenario B	Scenario C
		
Majority of wastes left in-situ; Peripheral wastes to the north-western area of Zone 1 moved within Zone 1; Waste from Zone 2 not covered by concrete to Zone 1; Existing liner in Zone 3 to be repaired; Waste from Zone 4 moved into the lined cell in Zone 3 (any excess to be moved to Zone 1); Re-profile the waste in Zone 1 and completion of lined cell in Zone 3 to an acceptable, safe landform; Install a capping layer over Zones 1 along with completion/capping of the lined cell in Zone 3; Installation of a gas management system in conjunction with capping; Acceptance of reduced leakage through the base of unlined zones (and to a lesser extent Zone 3) into the underlying groundwater system; Allow potential lateral leachate migration from Zones 1 and 2 (on the basis of much reduce leachate generation potential as a result of the cap); Collection and management of surface water runoff; Continue to collect and manage leachate from Zone 3.	As with Scenario A, leave the majority of the waste in-situ with limited movement of waste in Zone 1; Repair and expand the lined cell in Zone 3 to allow receipt of all waste from Zone 4 along with uncovered waste from Zone 2; Re-profile the waste in Zone 1 and completion of lined cell in Zone 3 to an acceptable, safe landform; Install a capping layer over Zones 1 along with completion/ capping of the lined cell in Zone 3; Installation of a gas management system in conjunction with capping; Acceptance of reduced leakage through the base of unlined zones (and to a lesser extent Zone 3) into the underlying groundwater system but in addition to Scenario A, installation of a hydraulic control/cut-off along the north eastern area of the site between the wastes and the Morell River; Provide for treatment of collected contaminated groundwater via perimeter cut-off wall/ barrier system; Collection and management of surface water runoff; Continue to collect and manage leachate from Zone 3.	Completion of the existing lined cell in Zone 3; Construction of new lined cells to form a new lined landfill in areas currently occupied by redundant waste processing plant; Cells filled/ completed sequentially; Placement of remaining wastes, including all wastes currently deposited in north-western area into lined cells; Installation of leachate and gas collection infrastructure; Restoration with a low permeability capping layer and creating a safe landform after the existing wastes have been excavated. Collection and management of surface water runoff; Collect and manage leachate from all cells.

A series of key criteria were determined in order to qualitatively consider the relative merits of each of the three scenarios in terms of order of preference. The findings of this assessment are summarised in Table 5.7.

Table 5.7: Qualitative Assessment of Technical Merits for Remediation Scenarios

Issue	Scenario A	Scenario B	Scenario C
	A 	B 	C 
Groundwater protection	🔴	🟡	🟢
Surface water protection	🔴	🟡	🟢
Landfill gas control	🟢	🟢	🟢
Odour and nuisance impacts	🟡	🟢	🔴
Traffic, noise and vibration impacts	🟢	🟢	🔴
Visual impact / intrusion during works	🟢	🟢	🔴
Timescale to remediate the site	🟢	🟢	🔴
Sustainability / greenhouse gas emissions	🟡	🟢	🔴
Cost	🟢	🟡	🔴

Key:

🟢 Most preferred option 🟡 Intermediate option 🔴 Least preferred option

Scenario C was determined to be the least preferred option for odour and noise impacts, traffic, noise and vibration impacts, visual impact during works, timescale of works and greenhouse gas emissions.

Scenario B was therefore selected as the preferred option, on the basis of landfill gas control, odour and nuisance impacts, traffic, noise and vibration impacts, visual impacts/ intrusion during works, timescale and greenhouse gas emissions.

5.4.3 Developed Remedial Option

Subsequent to the optioneering assessments, during 2016 and the development of the engineering design for the remediation of the site it was observed that previously predicted plumes of contamination migrating from the site had not been realised. Monitoring data, recorded on at least a monthly basis, had shown no impact on the Morell River. This is further discussed in Chapter 12 Soils, Geology, Contaminated Land and Groundwater.

Options for limiting migration of leachate in groundwater from the site are varied, and can include the construction of a cut-off wall, installation of a series of abstraction boreholes or a combination of both. The impacts of such a system were therefore assessed as an early design consideration, with findings outlined below:

- Water quality monitoring and ecological assessments have not shown any direct impacts from leachate on the Morell River;
- Geophysical surveys undertaken annually along the eastern boundary of the site have not identified a contaminant plume emanating from the site and discharging to the river;

- The adoption of engineered capping systems across the site will reduce infiltration and therefore the potential for leachate generation, thereby reducing the environmental risk profile to a likely acceptable level;
- There is a risk of destabilising the current groundwater system through the installation of a cut-off wall;
- There is the potential to impact on river flow rates as water is prevented from discharging to the river. This could have potential knock-on effects on river ecology. Pumping could similarly impact river flows as the pumping may also draw in water from the river;
- There would be increased impacts during works and a need for additional resources such as cement and water;
- The requirement for dewatering to install the cut-off wall would likely impact the river, ecology and the public sewer;
- Installation of the cut-off wall would not be a sustainable solution with associated environmental impacts (carbon footprint, dust, noise emissions, etc.), which would not be in alignment with the project objectives; and
- Should future monitoring highlight the need for such remediation measures the system could be installed relatively quickly and is not reliant on other remediation works.

Many of the above observations align with the broader project objectives, set out in Section 5.1. The remediation design was therefore progressed without a cut-off wall, on the basis that monitoring works would continue at the site with regular reviews and reporting to verify data and to assess the effect (if any) of the site on groundwater and the Morell River. It is also envisaged that with the Industrial Emissions Activities Licence (IEAL) application, trigger levels will require to be set for groundwater monitoring locations, which will allow ongoing review and assessment of data to determine any future requirement for remediation measures between the site boundary and the Morell River.

Similarly, the IEAL will require a Groundwater Management Plan to be prepared for the site to include monitoring and actions to be undertaken where assessment of data suggests effects on the river are being realised. This management plan will be submitted as part of the licence application and used to regulate the site in the future by the EPA.

5.4.4 Consultation on Alternatives for Remediation Design

In parallel with the planning application a waste licence will be required for the operations to be undertaken in the remediation of the site, comprising movement of wastes and management of landfill gas, leachate and nuisance impacts. An application for an IEAL will therefore be undertaken where the technical merits of the remediation solution will require to be justified to the EPA.

5.5 Alternative Processes

This Section reviews the alternative options that were considered for the main design elements, processes or activities of the proposed Project. The design of the proposed Project is outlined in Chapter 4 Description of the Proposed Project.

5.5.1 Site Access

The site access will be reconfigured with a new roundabout being constructed along with realignment of a section of the existing road (L2005 Kerdiffstown Road) and provision of a new footpath and cycleway. Refer to Chapter 4 Description of the Proposed Project for a full description. Other options considered for the design of the site access are shown in Table 5.8. Mitigation of impacts to the site access was also considered through the reduction in soil importation volumes, as described in Section 5.5.5.

Table 5.8: Alternative Considerations for Site Access Arrangements

Selected Option Description		Main reason for selecting chosen option
New roundabout to facilitate continued safe usage of Kerdiffstown Road during Remediation Phase (& Operational Phase). Improvement works to include provision of new a footpath and cycleways on Kerdiffstown Road.		Significant number of HGVs will require access to the site during the Remediation Phase, with current road layout compromising safe access.
Description of Alternatives	**Environmental and Planning Considerations/Constraints**	**Main reason for rejecting alternative**
Do nothing	Traffic numbers. Carriageway width and design speed. Visibility. Congestion.	Health and safety concerns. Increasing congestion. Crossing of road by HGVs affecting road users from west (Sallins) coming off bend with restricted visibility.
Do minimal – increase visibility	Impact on landowners to improve sightlines.	Health and safety concerns. Increasing congestion. Crossing of road by HGVs affecting road users from west (Sallins). Impact on landowners.
Revised T junction arrangement	Traffic numbers. Carriageway width and design speed. Visibility. Impact on landowners to improve sightlines. Congestion.	Health and safety concerns. Increasing congestion. Crossing of road by HGVs affecting road users from west (Sallins). Impact on landowners.

The design of the site access and roundabout was further reviewed and mitigation embedded following completion of a Stage 1 Road Safety Audit.

5.5.2 Demolition Works

There are a series of concrete walls and drainage features remaining following the demolition of buildings and structures in 2011 and during 2016-2017. To enable the remediation and end-use development at the site these walls will be required to be removed. There will also an opportunity to re-use the materials in the remediation works, subject to appropriate screening and testing. There are also three residential properties (REC010, REC011 and REC016) which will be required to be demolished in order to remediate the site, provide safe access to the site, allow construction of key landfill infrastructure off-waste and construct the end-use option of a multi-use public park. Alternatives considered are outlined in Table 5.9.

Table 5.9: Alternative Considerations for Demolition Works

Selected Option Description	Main reason for selecting chosen option
Removal of remaining concrete walls and three residential properties.	Provides areas for storage/ stockpiling of imported and processed materials. Provides an opportunity to re-use crushed and screened materials in remediation. Provides areas supporting end-use development.

Description of Alternatives	Environmental and Planning Considerations/Constraints	Main reason for rejecting alternative
Do nothing (retention of properties)	Removes three properties from local housing market. Drainage infrastructure would require upgrading to remove linkage to the site.	Prevents safe access to site and provision of footpath and cycleway. Severely restricts siting options for key landfill infrastructure.
Do nothing (Retention of walls)	Potentially unsafe in longer term.	No amenity value. Impacts end-use options.
Demolition and removal from site	Traffic impacts. Noise and nuisance.	Not sustainable option in terms of vehicles movements, air, dust and noise impacts. Option to re-use materials reduces volumes and impacts of imported / quarried aggregate.

5.5.3 Landfill Infrastructure Compound

A new Landfill Infrastructure Compound is required to maintain requisite landfill management plant and equipment in a single, secure location. Due to the nature of the site and risks to the environment should any such facilities fail, the new compound is proposed to be positioned off-waste such that ground conditions are not liable to settlement due to waste degradation or loading. A description of the option for the Landfill Infrastructure Compound is included in Chapter 4 Description of the Proposed Project. Alternatives considered for the position of the Landfill Infrastructure Compound are outlined in Table 5.10.

Table 5.10: Alternative Considerations for Landfill Infrastructure Compound

Selected Option Description	Main reason for selecting chosen option
Construction of new landfill gas and leachate management facilities in a single, secure location off-waste.	Allows construction and operation in parallel with site remediation works. Improved security of key infrastructure. Minimised risk of settlement. Control of site at entrance. Optimises areas on site for end-use development.

Description of Alternatives	Environmental and Planning Considerations/Constraints	Main reason for rejecting alternative
On top of the waste	Settlement. Pollution incidents. Restriction on end-use development opportunities.	Failure of infrastructure poses environmental risks hence settlement of ground should be avoided. Earthworks required to improve ground conditions would be extensive and not representative of a sustainable option. Buildings and service intrusions would require to be protected from underlying wastes.
On existing hardstanding	Potential settlement. Restriction on end-use development opportunities.	Failure of infrastructure poses environmental risks hence settlement of ground should be avoided. Buildings and service intrusions would require to be protected from underlying wastes. Restriction for maintenance access. Restriction on end-use development. Increase vehicle (including tanker) movements on site / park roads.
Other, non-waste area	Potential settlement. Pollution incidents. Restriction on end-use development opportunities.	Limited non-waste areas on site. Restriction on end-use development. Increase vehicle (including tanker) movements on site / park roads.

5.5.4 Site Re-profiling

Site re-profiling options were broadly considered as part of the remedial options assessment undertaken in 2013 (refer to Section 5.4.1). The EPA Landfill Manuals regarding Site Design and Restoration and Aftercare have stipulations with respect to landforms on landfill sites, to include:

- minimum slope of 1 in 30 to prevent surface water ponding and to promote surface water runoff; and
- slopes to be no greater than 1 in 3.

Zone 1 comprises the largest volume of waste at the site and is largely domed. However, this zone has a number of voids in places and several flat lying areas. Without intervention these slopes would encourage ponding of surface water and could cause leakage into the landfill due to failure of the landfill cap generating leachate, as well as releasing landfill gas to the atmosphere. Similarly, there are a number of waste stockpiles around the site and over-steep slopes that pose a significant risk of failure without intervention.

The re-profiling of other areas would alleviate these issues on Zone 1 using site won material as opposed to imported materials, in parallel to addressing slope stability risks in the other zones, providing profiles that will permit installation of an engineered capping system where required.

For this EIAR further design work was undertaken to determine suitable re-profiled contours to comply with the EPA guidance whilst maintaining a balance in the volumes of materials required to be retained within the footprint of the site. The profile was also identified as being able to support the potential end-use options.

Alternatives considered in the design review are outlined in Table 5.11.

Table 5.11: Alternative Considerations for Site Re-profiling

Selected Option Description	Main reason for selecting chosen option
Re-profiling the site to address current over-steep slopes to permit installation of an engineered capping and/or soil cover system, to allow for surface water drainage, and provide mitigation of long-term settlement of the waste mass.	Minimises volumes associated with the excavation, movement and deposition of materials within the site. Material export from the site is not required, reducing the impact of the works on the local community and environment. Gradients required to manage surface water and maintain capping integrity following settlement.

Description of Alternatives	Environmental and Planning Considerations/Constraints	Main reason for rejecting alternative
Do nothing	Over steep slopes present potential stability risk. Profile does not accord with EPA Landfill Manuals for restoration profiles. Would not permit placement of wastes and reduction of risk/ footprint from other zones.	Current profiles would require additional soils to provide abutment to create suitable final profile. Retention of existing profile would present long term issues for surface water ponding. Capping system installation would require re-profiling to ensure long-term stability and integrity. Does not comply with environmental guidance and legislation. Poses risks to receptors. Does not align with risk profile and objectives of the project.
Reduce height of site / reduce slope gradients.	Excavation volumes. Nuisance: odour, dust. Environmental controls: leachate, landfill gas. Industrial Emissions Activities Licence compliance. Incompatible with EPA guidance on landfill restoration.	To reduce profile to previously permitted height (ref KCC: 03/2355; ABP: PL.09.206726); maximum height 110.7mOD Malin Head) would require excavation of c.19,000m^3 of highly odorous wastes, causing significant environmental impacts. Significant increase in volumes from slopes, requiring increased height on site or removal from site. Material likely to be removed from site, or other areas identified for deposition on site. Vehicle movements to / from site and associated impacts. Limits end-use options.

As a result of the likely environmental impacts that would be realised by reducing the elevation of the waste mass, primarily in Zone 1, to accord with the previous planning permission, Kildare County Council exercised its powers under Section 56 of the Waste Management Act 1996 (as amended) and took the measure of issuing a Chief Executives Order CE10770 instructing that:

> "*All practicable measures… to be taken in the design and implementation of the Kerdiffstown Landfill Remediation Project to minimise the movement of odorous materials to prevent and limit environmental pollution in accordance with the aims of remedial Option B for the site.*"
>
> *"…the maximum elevation at the Kerdiffstown Landfill of 113.5mOD Malin is not required to be reduced as part of the remediation, given the significant environmental pollution that could result from any such action to reduce the height significantly below this level."*

5.5.5 Engineered Capping and Soil Cover Systems

The primary role of the landfill capping system for the site is to control leachate production by preventing or significantly limiting the infiltration of rainfall into the waste mass. The capping system is therefore required to include a barrier layer of very low permeability to intercept rainwater and an overlying drainage layer to convey the water away efficiently. This system reduces the amount of leachate produced, restricts vertical migration of landfill gas and reduces risks to human health and the environment. Proposals for the engineered capping and

cover systems to be installed for the proposed Project are discussed in Chapter 4 Description of the Proposed Project.

The proposed capping and soil cover systems vary according to the waste quantities, types and associated risks that are present in each zone at the site, taking cognisance of EPA Landfill Manuals Landfill Site Design (EPA 2000). Alternatives for each zone are considered below.

Zone 1 and Zone 3

The capping design for Zones 1 and 3 compared to alternatives is discussed in Table 5.12 below:

Table 5.12: Alternative Capping System and Materials (Zones 1 and 3)

Selected Option Description		**Main reason for selecting chosen option**
Top soil / soil forming material cover (150mm depth); Subsoil (350mm depth); Geocomposite drainage layer (GDL); Flexible membrane liner; Regulation layer (fine grained material, e.g. sand).		Reduced volume of imported fill. Reduced traffic and associated impacts. Provides requisite stability of capping system. Low maintenance requirements. Complies with project objectives.
Description of Alternatives	**Environmental and Planning Considerations/Constraints**	**Main reason for rejecting alternative**
Topsoil (strict specification, e.g. to BS 3882:2015)	Traffic impacts. Available sources. Market conditions.	No site-won material available for works. Precludes use of other, suitable growing media materials. Use of recycled soils seen as preferable over external borrow pit arrangement (subject to appropriate testing and specification compliance).
Subsoil (up to 850mm depth)		
Drainage Layer		
Sand or granular drainage layer (up to 500mm depth)	Traffic impacts. Available sources. Market conditions. Material resources.	GDL reduces vehicles movements to site. GDL provides adequate transmissivity of water above the barrier layer. Not sustainable in terms of use of virgin, quarried materials, vehicles movements. Impact on roads and traffic.
Barrier Layer		
Clay (up to 600mm depth)	Traffic impacts. Available sources. Market conditions. Material resources.	The Flexible Membrane Liner (FML) complies with Landfill Directive. Cost effectiveness. Reduces importation of clay. Removes use of natural resources. Ease of construction compared to clay. Onerous CQA for clay. Long-term settlement. Not sustainable in terms of use of virgin, quarried materials, vehicles movements. .
Geosynthetic Clay Layer	Settlement and cap integrity.	Reduced stability for side slopes. Use of single product for ease of capping integration across zone.

Selected Option Description		Main reason for selecting chosen option
Top soil / soil forming material cover (150mm depth); Subsoil (350mm depth); Geocomposite drainage layer (GDL); Flexible membrane liner; Regulation layer (fine grained material, e.g. sand).		Reduced volume of imported fill. Reduced traffic and associated impacts. Provides requisite stability of capping system. Low maintenance requirements. Complies with project objectives.
Description of Alternatives	**Environmental and Planning Considerations/Constraints**	**Main reason for rejecting alternative**
Bentonite Enriched Soils (up to 600mm depth)	Traffic impacts. Available sources. Market conditions. Material resources.	Reduces importation of bentonite and host material. Use of natural resources (water). Consistency of material batching. Potential future issues due to settlement of the waste mass. Not sustainable.
Gas Drainage Layer		
Geosynthetic drainage layer	Traffic impacts. Capping integrity.	Ease of construction. Requirement to protect FML from underlying wastes. Gas extraction wells installed across zones will allow management of landfill gas. Gas wells will be sufficiently spaced based on pump tests to ensure zones of influence capture gas appropriately.

The EPA Landfill Manuals Landfill Site Design confirms that design of a capping system should be determined on a site by site basis. Depths of layers were considered taking cognisance of the absence of site-won material, impacts on traffic and sustainable options for the remediation of the site. The end-use proposals were also based around these key areas, such that Zones 1 and 3 will only have paths and tracks for public use. Six options were considered as shown in Table 5.13.

Table 5.13: Capping Options for Zone 1 & 3 (Approximate Import Volumes)

Option	Topsoil (m)	Sub-soil (m)	Drainage Blanket (m)	Clay Barrier (m)	Granular Gas Blanket (m)	Regulation Layer (m)	Drainage Geocomposite	GCL or FML Barrier	Gas Geocomposite	Total Cap Thickness (m)	Required Capping Material Import Volume (m^3)	Reduction Compared to Option 1	
												(m^3)	(%)
1	0.15	0.85	0.5	0.6	0.3	0.15				2.55	274,000	n/a	n/a
2	0.15	0.35	0.5	0.6	0.3	0.15				2.05	256,000	18,000	7%
3	0.15	0.85	0.5		0.3	0.15		✓		1.95	245,000	29,000	11%
4	0.15	0.35	0.5		0.3	0.15		✓		1.45	190,000	84,000	31%
5	0.15	0.85				0.15	✓	✓	✓	1.15	120,500	153,500	56%
6	0.15	0.35				0.15	✓	✓	✓	0.65	**66,000**	**208,000**	76%

As shown in Table 5.13 the proposed capping system for Zones 1 and 3 provides a 1.75m reduction in the total thickness of the capping system (excluding the regulation layer) and, as a result, a 76% reduction in required imported soil volumes and associated vehicle movements when considered with a typical 0.6m depth of a clay barrier layer. This reduced capping system thickness still complies with environmental guidance and legislation as demonstrated in Chapter 4 Description of the Proposed Project, whilst satisfying project objectives.

Zones 1A, 2A & 2B

In Zones 2A and 2B the majority of the capping is being provided by the existing concrete hardstanding pads which overlie waste deposits, with remedial works to seal joints and cracks. In areas where separation to waste will not be provided by the hardstanding areas a low permeability capping solution is proposed consisting of a 350mm thick layer of compacted clay under a layer of topsoil. This system, described further in Chapter 4 Description of the Proposed Project, poses a lower risk to groundwater from surface water infiltration due to a combination of reduced waste thicknesses and predominant construction and demolition (C&D) waste composition with a reduced proportion of Municipal Solid Wastes (MSW) compared to Zones 1 and 3. Alternatives are shown in Table 5.14.

Table 5.14: Alternative Capping System and Materials (Zones 1A, 2A and 2B)

Selected Option Description		**Main reason for selecting chosen option**
Top soil / soil forming material cover (min 150mm depth); Low permeability clay (min. 350mm depth).		Low maintenance requirements. Complies with project objectives.
Description of Alternatives	**Environmental and Planning Considerations/Constraints**	**Main reason for rejecting alternative**
Topsoil (according to strict specification e.g. BS 3882:2015)	Traffic impacts. Available sources. Market conditions.	No site-won material available for works. Precludes use of other, suitable growing media materials. Use of recycled soils seen as preferable over external borrow pit(s) arrangement (subject to appropriate testing and specification compliance).
Subsoils to greater depth (e.g. 850mm)		
Mineral Layer		
Flexible Membrane Liner	Settlement and cap integrity.	Would require earthworks to create suitable profile to facilitate collection of runoff.
Geosynthetic Clay Layer	Settlement and cap integrity.	Would require earthworks to create suitable profile to facilitate collection of runoff.
Bentonite Enriched Soils (up to 600mm depth)	Traffic impacts. Available sources. Market conditions. Material resources.	Reduces importation of bentonite and host material. Use of natural resources (water). Consistency of material batching. Potential future issues due to settlement of the waste mass. Not sustainable.

Zone 4

Zone 4 poses a lower risk to groundwater from surface water infiltration due to a reduced waste thickness, predominant C&D waste composition with minimal MSW and re-profiling works removing a significant proportion of the existing waste mass. The remediation profile will also reduce the risk in this zone due to the slope gradients and installation of (lined) surface water ponds. This system, described further in Chapter 4 Description of the Proposed Project, poses a lower risk to groundwater from surface water infiltration due to a combination of reduced waste thicknesses and footprint. Alternatives are shown in Table 5.15.

Table 5.15: Alternative Soil Cover System (Zone 4)

Selected Option Description		**Main reason for selecting chosen option**
Top soil / soil forming material cover (min 0.15m depth); Soil cover (min. 0.35m depth). Predominantly regraded 1:3 side slope gradients to enable surface water runoff, with grassed surface.		Low maintenance requirements. Complies with project objectives.
Description of Alternatives	**Environmental and Planning Considerations/Constraints**	**Main reason for rejecting alternative**
Topsoil (according to strict specification e.g. BS 3882:2015)	Traffic impacts Available sources Market conditions	No site-won material available for works. Precludes use of other, suitable growing media materials. Use of recycled soils seen as preferable over external borrow pit(s) arrangement (subject to appropriate testing and specification compliance).
Subsoils to greater depth (e.g. 850mm)		

The soil cover system proposed is reflective of the reduced risk, comprising placement of 350mm depth of low permeable subsoils overlain by 150mm of top soil / soil forming material.

This zone also has two large surface water ponds located at the toe of the slopes, with the ponds lined with a geomembrane liner, to separate the clean surface water runoff from the underlying wastes.

5.5.6 Leachate and Landfill Gas Management Systems

Leachate Management System

The need to manage leachate remains a long-term maintenance liability for the site. Further details on the selected option are provided in Chapter 4 Description of the Proposed Project. Alternatives considered for leachate management are outlined in Table 5.16.

Table 5.16: Alternative Considerations for Leachate Management

Selected Option Description		**Main reason for selecting chosen option**
Improved leachate management systems to remove and transfer leachate to a wastewater treatment plant via the public sewer network.		Significantly reduces traffic impacts from road tankers (tankering only to be used as a back-up), and potential for pollution events through accidents. Reduces risks of pollution events on site. Subject to agreement with Irish Water.
Description of Alternatives	**Environmental and Planning Considerations/Constraints**	**Main reason for rejecting alternative**
Do nothing	Leachate from Zone 3 (lined cell) will overtop lining system polluting the environment. Odour emissions. Impacts on end-use.	Does not comply with environmental guidance and legislation. Poses risks to receptors. Does not align with risk profile and objectives of the project.
Continuation of existing arrangements through collection of raw leachate by road tanker for haulage to off-site treatment works.	Traffic. Environmental pollution. Ability to manage leachate volumes. Sustainability (road use). Acceptance limits at treatment works.	Not considered as a sustainable option. Impacts on the local community through vehicle movements (due to high volumes of traffic). Environmental risks with carriage of leachate on public roads should an accident occur. Not sustainable when considering transportation and disposal activities. Disposal to Ringsend WWTP requires 100km round-trip.
Pumping raw leachate through a dedicated rising main pipeline directly to an off-site treatment works.	Onerous discharge conditions. Landowner's agreements for dedicated main.	Treatment of raw leachate subject to commercial agreement between KCC and Irish Water. Price likely to fluctuate according to variations in leachate concentrations and flow rates. Not sustainable. When considering impacts for installation of dedicated main to a treatment works would be significant. Sustainability choices with respect to sizing of pumps.
Partial on-site treatment/ discharge to foul sewer for final treatment at an off-site treatment works.	Land area required to install treatment system. Environmental impacts due to pollution event. Onerous discharge conditions.	On-site treatment not in KCC interest for risk exposure should failure scenarios be realised. On-site treatment likely to affect siting of plant and hence influence use and perception of end-use.
On-site treatment in a bespoke treatment plant/ tertiary treatment in a wetland/ discharge to a nearby watercourse.	Land area required to install treatment system. Environmental impacts due to pollution event. Potential impacts to local watercourses.	On-site treatment not in KCC interest for risk exposure should failure scenarios be realised. On-site treatment likely to affect siting of plant and hence influence use and perception of end-use.

A Leachate Management Plan has been prepared and is provided in Appendix A4.4, which provides further detail on the leachate management system. Having an appropriate plan in place is a requirement of the Industrial Emissions Activities Licensing process and the Leachate Management Plan will be maintained and updated as required through the Remediation and Operational Phases.

Any discharge to the public sewer network or disposal to a treatment works requires agreement with Irish Water. Discussions in this regard are ongoing with agreement in principle having been reached with respect to the selected option and discharge to Johnstown Pumping Station.

Landfill Gas Management System

The primary function of the proposed landfill gas management system at the site is to break the pathway to surrounding environmental receptors by prevention of uncontrolled release of gas and odours from the site. Due to the risks posed by landfill gas and the location of sensitive receptors in proximity to the site the need to manage landfill gas remains a long-term maintenance liability for the site.

The design of the site's landfill gas system comprises extraction from Zones 1 and 3 for combustion in a high temperature flare and venting in Zones 2A and 2B where the gas quality is considered too low for flaring. Gas management in Zone 4 is not required due to a lack of degradable wastes and due to the re-profiling works proposed. The effectiveness of the gas management system is directly linked with the capping system design. Further details on the selected option for the landfill gas management system are provided in Chapter 4 Description of the Proposed Project. Alternatives considered for landfill gas management are outlined in Table 5.17.

Table 5.17: Alternative Considerations for Landfill Gas Management

Selected Option Description		**Main reason for selecting chosen option**
Gas management to be improved across the site following capping works, with extraction being undertaken from predominant, gas generating wastes and venting in other areas where landfill gas has been detected.		Reduces the risk of gas migration from the site. Reduces Greenhouse Gas (GHG) emissions from the site. Addresses potential odour issues (with capping design). Complies with appropriate environmental guidance and legislation.
Description of Alternatives	**Environmental and Planning Considerations/Constraints**	**Main reason for rejecting alternative**
Do nothing	Risk of landfill gas migration. GHG emissions. Odour emissions. Impacts on local receptors. Impacts on end-use.	Does not comply with environmental guidance and legislation. Poses risks to receptors. Does not align with risk profile and objectives of the project.
Continuation of existing arrangements through collection of gas in discrete fields for flaring.	Risk of landfill gas migration. GHG emissions. Odour emissions. Impacts on local receptors. Impacts on end-use.	Reactionary. Does not comply with environmental guidance and legislation. Poses risks to receptors. Does not align with risk profile and objectives of the project.
Physical gas barrier	Land requirements (beyond waste). Sustainability, requiring importation of low permeable materials.	Not sustainable given reducing life-span of gas potential at the site. Technically not feasible.
Utilisation of landfill gas	Proximity to energy grid. Landowner's agreements for connections. Visual impacts of plant.	Gas quality and yield too low for utilisation. Not sustainable option. Would require flaring back-up system.

A Landfill Gas Management Plan has been prepared and is provided in Appendix A4.5, which provides further detail on the proposals for landfill gas management. Having an appropriate plan in place is a requirement of the Industrial Emissions Activities Licensing process.

5.5.7 Surface Water Management

Remediation of the site will require installation of a surface water management system. The system must collect and transport runoff from the site to drains. Design proposals include a network of open ditches, channels, swales and wetlands to intercept and control surface water runoff and direct it towards storage ponds. Further details on the selected option for surface water management at the site are provided in Chapter 4 Description of the Proposed Project. Alternatives considered for surface water management are outlined in Table 5.18.

Table 5.18: Alternative Considerations for Surface Water Management

Selected Option Description		**Main reason for selecting chosen option**
Surface water drainage to manage runoff post-remediation works, to treat and control discharges from the site.		Sustainable option, capturing clean water for retention in surface water catchment.
Description of Alternatives	**Environmental and Planning Considerations/Constraints**	**Main reason for rejecting alternative**
Do nothing	Uncontrolled runoff would affect local properties/ receptors.	Does not comply with environmental guidance and legislation. Poses risks to receptors. Does not align with risk profile and objectives of the project.
Discharge all runoff from the site to the Morell River	Volume to be discharged to the Morell River. Effects on river. Flood risks. Land requirements to achieve capture.	Topography limits ability to achieve gravity drainage from the north flank (Zone 1) and north-west corner (Zone 1A). Maintenance challenges for piped systems. Pumping from these locations is not a sustainable option.
Utilise existing discharge to the Canal Feeder Stream.	Quality of receiving water. Integrity of existing pipeline and connection.	Topography prevents capture from all of site discharging by gravity. Pumping is not a sustainable option. Would require additional emission and hence monitoring and compliance location. Would require new, larger diameter pipe to facilitate discharge.
Discharge to sewer.	Effect on removal of site catchment from surface water resources.	Removes ‘clean water’ from catchment. Not considered as a sustainable option.
Remove waters via road tanker.	Traffic. Ability to manage volumes. Sustainability (road use).	Removes ‘clean water’ from catchment. Not considered as a sustainable option.

5.6 References

- Environmental Protection Agency (2002). Guidelines on the Information to be contained in Environmental Impact Statements.
- Environmental Protection Agency (2015). Revised Guidelines on the Information to be contained in Environmental Impact Statements (Draft)
- Environmental Protection Agency (2003). Advice notes on current practice in the preparation of Environmental Impact Statements
- Environmental Protection Agency (2015). Advice notes for preparing Environmental Impact Statements (Draft)
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- Environmental Protection Agency (2000). Landfill Manuals. Landfill Site Design.
- Environmental Protection Agency (2011). Final Draft BAT Guidance Note on Best Available Techniques for the Waste Sector: Landfill Activities.
- Jacobs (2016) (on behalf of Kildare County Council). Kerdiffstown Landfill End Use Assessment.
- Jacobs (2016) (on behalf of Kildare County Council). Technical Note to assess the requirement for a Groundwater Barrier as part of the Remediation Design at Kerdiffstown Landfill.
- Reilly, A (2016) Exploration of Heat Recovery Potential from Landfill Waste, Postgraduate Diploma, Athlone Institute of Technology.
- SKM Enviros (2010) (on behalf of the Environmental Protection Agency). Evaluation of Environmental Liabilities at Kerdiffstown Landfill.
- SKM Enviros (2013) (on behalf of the Environmental Protection Agency). Kerdiffstown Landfill Remediation Project – Remedial Options Report.
- SKM Enviros (2014) (on behalf of the Environmental Protection Agency). Kerdiffstown Landfill Remediation Project – Groundwater DQRA Report for the Environmental Protection Agency).

6. The Consultation Process

6.1 Introduction

This Chapter describes the consultation process of the Kerdiffstown Landfill Remediation Project (hereafter referred to as "the proposed Project").

Kerdiffstown Landfill is located in County Kildare and comprises a former quarry, landfill and waste processing facility. The site has been progressively backfilled with wastes since the 1950's until 2010. The site poses a number of risks due to large areas of uncapped waste, remnants of buildings and structures, over-steep slopes and absence of appropriate capping to the lined cell. The proposed Project comprises the remediation of the site to reduce the risks posed by the site in its current condition to public health and safety and the environment, whilst developing the site to provide an amenity to the local community, comprising a multi-use public park (the Remediation Phase). Following the Remediation Phase, the site will continue to be managed by KCC, and regulated by the EPA, as a remediated landfill whilst operating as a multi-use public park (the Operational Phase).

Details on the project background and site history can be found in Chapter 3 The Need for the Proposed Project and descriptions of the remediation and operation can be found in Chapter 4 Description of the Proposed Project.

The Kerdiffstown Project Team has engaged with local residents, interested groups and other local commercial interests since 2011. In 2011, a Community Liaison Group (CLG) was set up and meetings held on a quarterly basis. Updates on the latest developments at the site were provided and feedback welcomed from the group participants.

Early involvement of the public and other stakeholders ensured that the views of groups and individuals were taken into consideration throughout the preparation of the Environmental Impact Assessment Report (EIAR) and during the development of the proposed Project design. It was recognised at an early stage of the project that public and stakeholder engagement is a critical component to the process of developing a sustainable, long-term end-use for the Kerdiffstown Landfill Site.

6.1.1 Consultation Process

The objective of the stakeholder and public consultation process undertaken for the proposed Project was to:

- Meet the regulatory requirements for consultation under the EIA Regulations;
- Raise public and stakeholder awareness, and develop their knowledge of the project;
- Promote and provide active engagement with the public and all stakeholders on the Kerdiffstown Landfill Remediation Project;
- Seek input from the public and from relevant stakeholders with respect to the proposed end-use for Kerdiffstown Landfill and the measures to reduce impacts during the Remediation Phase;
- Give opportunities for the public and stakeholders to provide baseline and other information with respect to the potential impacts that could arise as a result of implementing the proposed Project; and
- Keep the public informed of the proposed Project as it progresses.

The consultation process to date has involved two key consultation phases;

- Public and stakeholder consultation on the proposed end-use, which included letters, consultation events and a defined consultation period; and
- EIA Scoping consultation.

These two key elements of consultation are discussed in detail in Section 6.2 and Section 6.3 respectively.

6.1.2 Communication Channels

There were a number of communication channels for each of the consultation phases, as outlined in Section 6.2 and Section 6.3. However, to support the ongoing consultation and engagement, a standalone webpage was set up, www.kerdiffstowncleanup.ie. This website enables the public to access (at any time) up-to-date information on the consultation process, the proposed Project and the overall project programme. An extract showing the home page of the website is provided in Diagram 6.1 below.

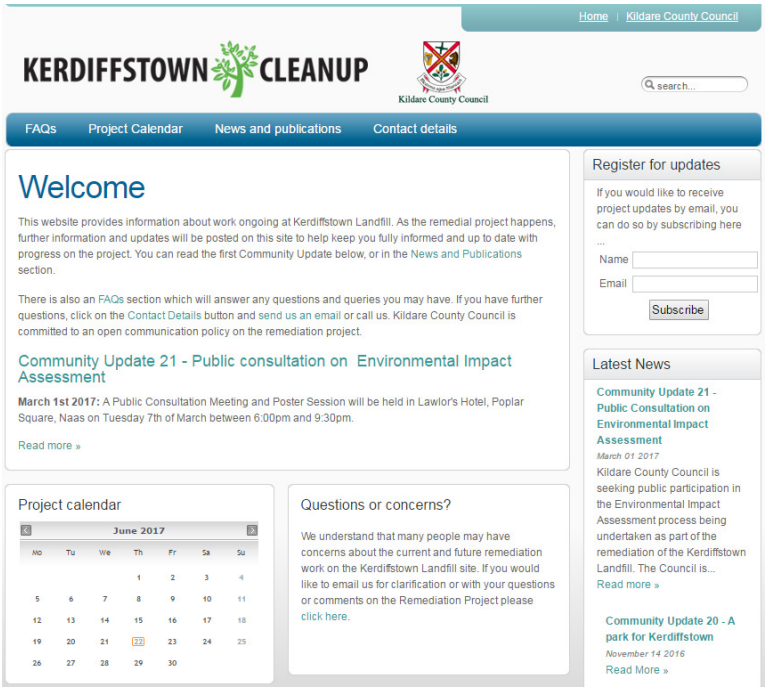


Diagram 6.1: Extract from www.kerdiffstowncleanup.ie

Additionally, a dedicated email address kerdiffstown@kildarecoco.ie, postal address (Environment Section, Áras Chill Dara, Devoy Park, Naas, Co. Kildare), phone line (045 980240) and text line (0879607899) were established, to allow any interested parties the opportunity to provide feedback or ask questions through a variety of means.

6.2 Public and Stakeholder Consultation on Proposed End-Use

6.2.1 Stakeholder Mapping

In order to establish a stakeholder list, key members of the public and organisations (both statutory and non-statutory) with a potential interest in the Kerdiffstown Landfill Remediation Project were identified. These included:

- People living and working in the area;
- Local community groups;
- Local business groups;
- Local environmental groups;
- Local public representatives;

- Locals who expressed an interest in the project previously (e.g. CLG, Kerdiffstown Residents Association, Clean Air Naas, North Kildare Chamber of Commerce, Saint Vincent de Paul (SVP) Kerdiffstown House); and
- Statutory Stakeholders (i.e. prescribed bodies under EIA Regulations).

6.2.2 Consultation Initiatives

In addition to the established communication channels outlined in Section 6.1.2 a number of initiatives were also undertaken for this consultation phase, such as follows:

- **Social media** Kildare County Council's Twitter and Facebook accounts posted tweets and updates about the Project;
- **Press Release** in local media and online;
- **Advertisement Posters** on the public consultation day posters were put up in local shops, council office, public houses and library;
- **Community Briefings** were organised for key organisations with an interest in Kerdiffstown Landfill; and
- **Council Briefings** were organised for Kildare County Council members to provide project updates and information.

In February 2016 a consultation letter was distributed to the following stakeholders;

- An Taisce
- BirdWatch Ireland
- Department of Agriculture, Food and Marine
- Department of Arts Heritage and the Gaeltacht (National Parks and Wildlife Services (NPWS))
- Department of Communications Energy and Natural Resources
- Electric Supply Board
- Fáilte Ireland
- Geological Survey of Ireland (GSI)
- Health and Safety Authority
- Heritage Council
- Inland Fisheries Ireland
- Inland Waterways Association – Kildare
- Kildare County Council Heritage Department
- Teagasc
- Transport Infrastructure Ireland (TII)
- Tourism Ireland
- Waterways Ireland

The letter outlined the project, provided information on upcoming consultation events and provided details on how to keep up-to-date with project progress.

6.2.3 Proposed end-use consultation events

A public consultation day was held to launch the public consultation period regarding the future use of the Kerdiffstown Landfill on Wednesday 13 April 2016. The main aim of this event was to update the public on the project and to elicit feedback on the potential end-use for the Kerdiffstown Landfill. This event provided an open and transparent process for members of the public and stakeholders to participate and discuss the key issues they deemed relevant to their community, property or organisation.

Prior to the launch of the consultation on the proposed end-use (13 April 2016) Kildare County Council met with the CLG, to brief them on project progress and about the potential end-use options, and they were encouraged to make a formal submission on the project.

The public consultation day was held by the Kerdiffstown Project Team in the Kildare County Council Offices, Áras Chill Dara, Devoy Park, Naas, on 13 April 2016 from 14:00 to 19:00. A number of presentations, posters and display material was presented on the day and included the following:

- The Site History;
- The Site Now – detailing the interim measures taken to stabilise the site;
- Site Remediation – detailing the outline programme of works and the aims and objectives of the remediation;
- The two potential end-use options of the Landfill Site (Agricultural or Public Park); and
- Have your say – a poster encouraging feedback and providing contact details.

All attendees were provided with a summary leaflet before being taken through the display material by a member of the team. Consultation forms were also provided to obtain feedback. See Photo 6.1, for pictures from the consultation event.

Photo 6.1: Kerdiffstown Landfill Remediation Project, Public Consultation Day, 13 April 2016

6.2.4 Results of the Public Consultation

The public consultation day was attended by 17 individuals. Attendees included representatives of community groups, sporting organisations, interested individuals and Kildare County Council members. The main submission and comments identified the preferred end-use for Kerdiffstown Landfill as a multi-use public park and submissions were made regarding the elements to be included in the multi-use public park.

In addition, the subsequent consultation period from 13 April to 25 May 2016 resulted in the public and stakeholders showing a strong preference for a multi-use public park design over the agriculture option. There were 39 submissions in total made during the consultation period, summarised as follows:

- 36 of the submissions received were in favour of a multi-use public park option and the remaining three submissions expressed no preference.
- Suggested the following shall be considered for inclusion within the remediated site:
  - Good quality children's playground;
  - Picnic seating area close to the playground;
  - Buggy friendly walkway;
  - Adult fitness equipment;
  - Wildflower / wildlife area;
  - Car park that includes bike racks;
  - Play pitches (Gaelic football / Rugby / Soccer);
  - Park run facility / running track;
  - Running track;

  - Dog friendly park;
  - Camping facilities;
  - Café / indoor play area;
  - Toilet facility;
  - 'Fairy Woodland' area;
  - Car park for visitors;
  - Bicycle trail around the site;
  - An area (up to 5 acres) for a Men's Shed group; and
  - 4 acres to be used to extend local sporting facility.
- A number of submissions highlighted the need for additional playing pitches as County Kildare has seen a high population increase in recent years, and is projected to continue to grow, particularly in the areas surrounding Kerdiffstown. This has resulted in increased pressure on the amenities in Kildare and Kerdiffstown is seen as an ideal opportunity to help alleviate this problem;
- Suggestion for a combination of agricultural land and public park, with allotments;
- Vermin and ragwort control to be considered during remediation activities;
- 24-hour security and litter control during and post remediation shall be implemented; and
- Design stage shall incorporate suitable sustainable drainage system (SUDS) design and take account for the need for wastewater treatment.

6.3 EIA Scoping Consultation

As part of the EIA Scoping process a number of stakeholders were consulted through written correspondence or discussions. The stakeholders included prescribed bodies for the purposes of the Planning and Development Act 2000-2010, the Waste Management Act 1996 (as amended) and other key organisations that would have an interest in the proposed Project.

A consultation letter, inviting comment on the Kerdiffstown Landfill Remediation Project Environmental Impact Statement Scoping Report (Jacobs, September 2016), was issued in October 2016 to the following stakeholders:

- An Taisce;
- Birdwatch Ireland;
- Commission for Electricity Regulation;
- Córas Iompair Éireann;
- Department of Agriculture, Food and the Marine;
- Department of Communications, Climate Action & Environment;
- Department of Housing, Planning, Community & Local Government;
- Department of Jobs, Enterprise, and Innovation;
- Department of Justice and Equality;
- Development Applications Unit - The Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs;
- Environmental Protection Agency;
- Electric Supply Board (ESB);
- Fáilte Ireland;
- Geological Survey of Ireland (GSI);
- Health and Safety Authority (HSA);
- Health Service Executive (HSE);
- Inland Fisheries Ireland (IFI);
- Inland Waterways Association – Kildare;
- Kildare County Council;
- National Transport Authority (NTA);
- Office of Public Works (OPW);
- South Dublin County Council;
- Teagasc;
- The Heritage Council;
- Tourism Ireland;
- Transport Infrastructure Ireland (TII):
- Waterways Ireland; and
- Wicklow County Council

The aim of the EIS Scoping Report was to inform the Stakeholders of the progressing planning stage of the proposed Project. In addition, to invite submissions on the project proposal in relation to potential environmental issues which Stakeholders foresee may result from Remediation Phase and/or Operational Phase and that should be considered when developing the EIAR. The letter template issued is included in Appendix A6.1: EIA Scoping Letter Template.

6.4 Result of EIAR Scoping Consultation

Details of the feedback received through this approach is summarised in Table 6.1.

Table 6.1: Key Issues Raised Through EIAR Scoping Process

Stakeholder name	Acknowledgement from Stakeholder	Summary of Stakeholder Submission	Relevant Chapter/Section of this EIAR
An Taisce	Yes – see next column	Concerns raised over the landfill gas, the hydrology of the site and biodiversity. An Taisce are in favour of the option to use the site in a passive amenity function. *	A description of the proposed Landfill Gas Management System is provided in Section 4.2.8. A Landfill Gas Management Plan has been prepared and is provided in Appendix A4.5, which provides further detail on the proposals for landfill gas management. An assessment of potential hydrology impacts is provided in Chapter 13 Water – Hydrology. An assessment of potential impacts on biodiversity is provided in Chapter 11 Biodiversity. The proposed Project will remediate the site and includes the development of a multi-use public park.
CIE	Yes – see next column	CIE stated the proposed Project should not have any impact on the operations of Irish Rail.	Not applicable.
Commission for Energy Regulation (CER)	EIS Scoping Report received and acknowledged by the CER.	None	Not applicable.
Department of Communications, Climate Action & Environment	EIS Scoping Report received and acknowledged on behalf of Minster Denis Naughten.	None	Not applicable.
Department of Housing, Planning, Community and Local Government	EIS Scoping Report received and acknowledged on behalf of Minister Simon Coveney. It was then agreed that this matter is more appropriate for the Department of Communications, Climate Action and Environment.	None	Not applicable.
Department of Jobs, Enterprise and Innovation	EIS Scoping Report received and acknowledged on behalf of Ms. Mary Mitchell O'Connor.	None	Not applicable.

Stakeholder name	Acknowledgement from Stakeholder	Summary of Stakeholder Submission	Relevant Chapter/Section of this EIAR
Development Applications Unit	EIS Scoping Report was received and acknowledged by the DAU, Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs.	None	Not applicable.
Environmental Health Service (EHS)	EIS Scoping Report was received and acknowledged by EHS.	The Environmental Health Officer is satisfied that the EIS Scoping Report outlines and identifies environmental issues to be examined which are of concern to this department.	Not applicable.
Environmental Protection Agency (EPA)	Yes – see next column	The following comments were submitted regarding the remediation option for Kerdiffstown: - Clearly demonstrate why the remediation methods where selected and why alternatives were dismissed;	Chapter 3 The Need for the Proposed Development and Chapter 4 Description of the Proposed Development provides the background, history and need for the Kerdiffstown Landfill Remediation Project, which is under consideration for this EIAR. Chapter 5 Consideration of Alternatives describes the reasonable alternatives which were considered for the remediation and end-use of the Kerdiffstown Landfill site.
		- Planning history should be clearly mapped including current planning status;	The planning history is described separately in the Planning Report to be submitted to An Bord Pleanála. This EIAR will support that planning application.
		- Full history of site investigations should be presented;	A summary of the historical site investigations is provided in Chapter 12 Soils, Geology, Contaminated Land and Groundwater (specifically Section 12.3.1).
		- Description of current emissions using models / refine models clearly showing pathway and receptors; - Describe how and why particular parameters were selected and what they show in terms of emissions from landfill; - Forecasting methods used to assess effects on the environment need to be clearly described;	Descriptions of the baseline conditions, the assessment methodology and predicted impacts are provided in Chapters 7 to 17.
		- Odour prevention and management presented clearly;	Odour mitigation measures are discussed Section 7.5. The draft Odour Control Plan (OCP) for the proposed Project will be finalised as part of the overall Construction Environmental Management Plan (CEMP) and formed into an Odour Management Plan as part of the CEMP. A Draft OCP was formulated to inform the design process for this proposed Project and is attached in Appendix A7.7.
		- Noise / vibration sensitive locations and why selected;	The identification of Noise Sensitive Receptor (NSR) locations is described in Section 8.3 and NSRs were chosen as being representative of all receptors in the vicinity of the proposed Project that may be impacts by noise emissions arising from the proposed Project.
		- Construction of pipeline to carry leachate to main sewer shall be included and environmental aspect of the pipeline considered;	The construction of the pipelines to carry leachate and foul water to Johnstown Pumping Station have been included within this EIAR and where potential impacts associated with this construction have been identified they are discussed within Chapters 7 to 17.

Stakeholder name	Acknowledgement from Stakeholder	Summary of Stakeholder Submission	Relevant Chapter/Section of this EIAR
		- Invasive species locations identified and methods of eradication discussed; - Risk of importing soil to the site, and potential for invasive species spread; and - Invasive species management plan shall be considered.	Invasive species are discussed within Chapter 11 Biodiversity. The requirement to prepare an Invasive Species Management Plan is identified as part of the mitigation measures to control and prevent the spread of invasive species.
		Cumulative impacts of emissions from the facility and proposed works and the inter-relationship of all considered*.	Chapter 18 Environmental Interactions.
Fáilte Ireland	Yes – see next column	Recommend Fáilte Ireland's Guidelines for the treatment of tourism in an EIAR is taken into account in preparing the EIAR. *	Guidelines were considered within the assessment.
Geological Survey Ireland	EIS Scoping Report received and acknowledged by GSI, however, due to lack of resources GSI were unable to comment.	None	Not applicable.
Health Services Executive (HSE)	Yes – see next column	HSE are satisfied that the EIS Scoping report identifies and outlines the environmental issues to be examined which are of concern to the HSE. *	Not applicable.
Inland Fisheries Ireland (IFI)	Yes – see next column	Concerned regarding leachate and surface water management measures. IFI have suggested using their recent guidelines: "Guidelines on protection of fisheries during construction works in and adjacent to waters" (2016). *	A description of the proposed Leachate Management System is provided in Section 4.2.8. A Leachate Management Plan has been prepared and is provided in Appendix A4.4, which provides further detail on the proposals for leachate management. An assessment of potential hydrology impacts is provided in Chapter 13 Water – Hydrology. The IFI guidelines were considered within the assessment.
Inland Waterways Association of Ireland (IWAI) Kildare	Yes – see next column	Concerned about leachate management, Air Quality Impacts during construction phase, contingency planning should Air Quality risk increase during Operational Phase, Noise and Vibration. However, content is substantial and that risk mitigation has been detailed comprehensively. *	A description of the proposed Leachate Management System is provided in Section 4.2.8. A Leachate Management Plan has been prepared and is provided in Appendix A4.4, which provides further detail on the proposals for leachate management. An assessment of potential air quality impacts in both the Remediation Phase and the Operational Phase is provided in Chapter 7 Air Quality, Odour and Climate. An assessment of potential noise and vibration impacts in both the Remediation Phase and the Operational Phase is provided in Chapter 8 Noise and Vibration.
National Transport Authority (NTA)	EIS Scoping Report was received and acknowledged by the NTA.	None	Not applicable.
Office of Public Works (OPW)	EIS Scoping Report was received and acknowledged by the OPW.	None	Not applicable.

Stakeholder name	Acknowledgement from Stakeholder	Summary of Stakeholder Submission	Relevant Chapter/Section of this EIAR
The Heritage Council	EIS Scoping Report received and acknowledged by The Heritage Council, however, due to lack of funding were unable to comment.	None	Not applicable.
Transport Infrastructure Ireland	Yes – see next column	The Authority advised they are not in a position to engage directly with the process but uphold official policy and guidelines in the Spatial Planning and national roads Guidelines for Planning Authorities and to the relevant TII guidance available. *	

* The full submission from these stakeholders can be found in Appendix A6.2.

6.5 Consultation Feedback

In addition to the above EIA Scoping stakeholder consultation letter, there was an Environmental Impact Assessment public consultation day held on Tuesday 7 March 2017 from 18:00 to 21:30 in Lawlor's Hotel, Poplar Square, Naas, Co. Kildare. A formal presentation was given between 18:30 and 19:30 covering all aspects of the Environmental Impact Assessment process, with informal interaction and Questions and Answers before and after the presentation. The event was advertised on the Kerdiffstown website and local residents and individuals were issued with invites. The aim of this event was to elicit views from the public and local residents and/or groups on the environmental Impact Assessment process being undertaken as part of the Kerdiffstown Landfill and how it fits into the preparation of a planning application.

The event was well attended by local residents and elected officials, with over 20 individuals attending the presentation and/or the evening. The general feedback was positive and there were discussions with the Project Team regarding capping, permeability and impact on local roads.

Consultation in its various forms has been undertaken throughout the EIA process as outlined in this Chapter. Feedback, information and queries arising in the course of these consultations were regularly disseminated to the project team. This has ensured that the concerns of the public, stakeholders and prescribed bodies have continually fed into the project development. Where possible and appropriate, the preliminary outline design and proposed mitigation measures have been refined with public and stakeholder concerns taken into consideration. The early engagement with the public and key stakeholders has allowed sufficient time for concerns to be addressed in the EIA process.

6.6 Ongoing Consultation

The Kerdiffstown Project Team will continue to engagement with key stakeholders and the public. In addition, the project website (http://www.kerdiffstowncleanup.ie/) will be kept up to date with project news, community updates and Press Releases.

Outside of formal consultation events, the Kerdiffstown Project Team has met with key stakeholders, to inform them of project progress. These meeting were as follows:

- Kerdiffstown Landfill CLG, 19 October 2016; and
- Elected members of the Naas Municipal District Council, 15 November 2016.

The feedback from these events has generally been very positive in relation to the progress of the project and the development of the outline design for the remediation of the site and development of the multi-use public park.

Press Releases are posted on the website to further encourage stakeholders and the public to engage with the Kerdiffstown Project Team. Examples of the Press Releases are as follows:

- 30 May 2016 – Future use public consultation ends
- 21 October 2016 – Kerdiffstown clean-up project progressing
- 15 November 2016 – Community update 20 – A park for Kerdiffstown
- 1 March 2017 – Community Update 21 – Public Consultation on Environmental Impact Assessment

This ongoing engagement has encouraged further submissions from stakeholders. Submissions received as part of this ongoing and continued consultation process have reaffirmed support for the multi-use public park and associated amenity, in particular for the playing pitches and a submission acknowledging that Kildare County Council have taken suggestions on board while refining the outline design of the multi-use public park.

Kildare County Council are committed to continuing engagement with key stakeholders and the public after the planning application for the proposed Project has been submitted, and will continue to address any issues or concerns raised by the public through to the proposed Remediation Phase for the project. The project website will continue to be kept updated and function as an information point through the various stages of the statutory approvals process (e.g. statutory consultation and oral hearing).

During the Remediation Phase Kildare County Council will appoint a KCC Site Manager. The KCC Site Manager will be the first point of contact for public enquiries and be responsible for monitoring complaints, providing project up-dates and addressing any issues or queries as they arise.

In addition, the key stakeholder's groups will continue to be updated on the project progress and the Kerdiffstown Project Team will offer site visits to interested individuals.

7. Air Quality, Odour and Climate

This Chapter assesses the potential air quality, odour and climate impacts which may be generated during the Remediation and Operational Phases of the proposed Project. The principal Remediation Phase air quality and odour impacts will be primarily associated with dust emissions due to re-profiling and demolition works, landfill gases and odour emissions associated with re-profiling and earth moving activities and transport emissions. Transport associated with the import of material will also contribute to air emissions through the generation of dust and vehicle emissions and there will also be emissions associated with operation of landfill gas flares. The potential air quality impacts associated with the Operational Phase of the proposed Project arise primarily as a result of the landfill gas management system that will manage the landfill gas from the former landfill.

An air dispersion modelling assessment was carried out to determine the potential for impacts on air quality as a result of the proposed Project, particularly from the flare and the back-up flare which will be present on site. The impact assessment found that the highest potential for impact to air quality and odour was related to the disturbance of waste during demolition and site re-profiling works during remediation. However, all impacts were assessed as being short-term. With the implementation of appropriate dust and odour control measures and the appropriate phasing of the remediation works, the Remediation Phase of the proposed Project is not predicted to cause any significant impacts.

The air dispersion modelling carried out to predict the Operational Phase impacts of the proposed Project concluded that there would be no exceedances of the air quality standards caused by the operation of the on-site flare. During the Operational Phase of the proposed Project odour will be reduced by the extensive network of landfill gas extraction and venting systems and the proposed new landfill gas flare (and back-up flare if required) which will convert landfill gas into harmless substances. The results of the modelling undertaken for this impact assessment have shown that no odours shall be detectable as a result of emissions from the flare during the Operational Phase.

The completion of the proposed Project will result in considerable environmental improvements arising from the improved control of landfill gases and odours generated from the waste.

7.1 Introduction

This Chapter considers and assesses the effects of the Kerdiffstown Landfill Remediation Project (hereafter referred to as “the proposed Project”) on air quality, odour and climate which are anticipated to occur during the Remediation and Operational Phases.

Kerdiffstown Landfill is located in County Kildare and comprises a former quarry, landfill and waste processing facility. The site has been progressively backfilled with wastes since the 1950’s until 2010. The site poses a number of risks due to large areas of uncapped waste, remnants of buildings and structures, over-steep slopes and absence of appropriate capping to the lined cell. The proposed Project comprises the remediation of the site to reduce the risks posed by the site in its current condition to public health and safety and the environment, whilst developing the site to provide an amenity to the local community, comprising a multi-use public park (the Remediation Phase). Following the Remediation Phase, the site will continue to be managed by KCC, and regulated by the EPA, as a remediated landfill whilst operating as a multi-use public park (the Operational Phase).

The remediation of the proposed Project and development of the multi-use public park is anticipated to take approximately five to seven years, with approximately four years of intensive construction works to remediate the site. The Operational Phase will be the operation of a public park with multi-use sports pitches, changing rooms, a children’s playground, etc. and management of the site as a remediated landfill. Table 7.1 below summarises the key activities anticipated to be carried out in each of the phases of the proposed Project. Further detail on the scope of the proposed Project is provided in Chapter 4 Description of the Proposed

Project, and details on the outline phasing of the works are provided in Section 4.3.1 and outlined in Figure 4.8 and Figure 4.9.

Table 7.1: Summary of Key Activities during the Remediation and Operational Phases

Indicative Phase		Summary of Key Activities
Remediation Phase Phase 1 – Phase 8	Works to re-profile the site and construction of landfill infrastructure	• Construction of new site entrance and realignment of the L2005 Kerdiffstown Road • Demolition of 3 properties (REC010, REC011 and REC016) and concrete structures in Zone 2A, Zone 2B and Zone 4 • Installation of new foul and leachate pipeline connections to Johnstown Pumping Station • Construction of a new Landfill Infrastructure Compound • Removal of stockpiles of materials • Temporary stockpiling • Re-profiling and filling • Installation of capping systems • Installation of new or supplementary gas wells and gas venting measures • Construction, cleaning and commissioning of surface water management infrastructure • Removal of the existing flare stack in Zone 1 and the second back-up flare, commencing use of new flare stack in the new Landfill Infrastructure Compound • Inspection and repair of concrete hardstandings in Zone 2A and Zone 2B • Removal of existing perimeter screening bund in Zone 1
	Construction of Multi-Use Public Park	• Construction of park infrastructure, including multi-use sports pitches, a building with changing rooms, public toilets and stores, car parking, a children's playground, informal trails and defined viewpoints. • Planting and landscaping • Ecological enhancement and mitigation features such as hibernacula, nesting boxes and log piles
Operational Phase	Operation of Multi-Use Public Park	• Operation of the multi-use public park • Operation and maintenance of the landfill gas management infrastructure • Operation and maintenance of the leachate management infrastructure • Operation and maintenance of the surface water management infrastructure • Environmental control and monitoring as agreed by the Environmental Protection Agency

Details on the project background and site history can be found in Chapter 3 The Need for the Proposed Project and descriptions of the remediation can be found in Chapter 4 Description of the Proposed Project.

The assessment focuses on the key pollutants emitted to air from the landfill site as these are the emissions of concern in relation to the proposed Project. The pollutants potentially emitted from the proposed Project include methane, carbon dioxide, nitrogen oxides and trace gases; the trace gases are typically linked with the odours that are characteristic of landfill gas emissions.

7.1.1 Fundamentals of Air Quality and Odour

Good air quality is essential in order to protect human health, vegetation and ecosystems. In general air quality in Ireland is of a high standard across the country and is among the best in Europe. This is largely due to the prevailing clean Atlantic air and a lack of large cities and heavy industry. Air quality is usually judged in terms of the levels of various pollutants present in the air. The EPA manages the Irish national ambient air quality monitoring network, measuring the levels of a number of atmospheric pollutants including:

- Ozone – A natural component of the atmosphere. Exposure to high concentrations of ozone in the troposphere (the layer of atmosphere next to the earth) can cause detrimental health impacts;
- Carbon monoxide – The principal source of carbon monoxide in Ireland is from traffic sources and if absorbed into the bloodstream carbon monoxide can have harmful effects;
- Nitrogen dioxide and nitrogen oxides – The main source of nitrogen oxides in Ireland is emissions from traffic along with industry and electricity generating stations. Nitrogen dioxide can cause cellular damage.
- Sulfur dioxide – The main source of sulfur dioxide in Ireland is from fuel burning including oil and coal and it can cause damage to the throat and lungs.

- Particulate matter – these are small particles including dust from sources including combustion both in vehicles and industry as well as emissions from soil and road surfaces and these particles can be inhaled causing damage.

The results of the monitoring programme demonstrate that air quality in Ireland is generally excellent throughout the country.

Odour is another indicator of air quality that is of interest in terms of the proposed Project. Odour is the property of a substance that activates the human sense of smell. The human olfactory system is highly sensitive and as such is capable of detecting extremely low concentrations (fractions of a part per billion) of a wide range of odorous chemicals.

Offensive odours can have impacts on the health and well-being of humans, especially if one is subjected to the odour for extended periods of time. At sufficiently high concentrations odorous compounds may have a direct effect on human health. Also, an individual's health may suffer indirectly due to stress associated with odour impact. The gases that are typically linked with the odours that are characteristic of landfill gas emissions and include VOCs, hydrogen sulfide and sulfur dioxide.

As a result of natural biodegradation of waste which was deposited in the landfill during operation, gases are formed which have the potential to impact on air quality, odour and climate. The current control measures currently in place to manage the gases and odours are described in Section 3.7 of this EIAR where it is noted that the control measures are maintaining a stable environmental condition but are insufficient to fully mitigate the risks posed by Kerdiffstown Landfill to the environment, as well as public health and safety into the future. There is therefore a need to remediate the site and the impact of the proposed remediation project on air quality and climate is assessed in this Section of the EIAR.

The substances that are potentially emitted from the landfill arise as a result of the decomposition of waste and the management of the gases that are produced by the decomposition. The principal sources of gases and their potential release mechanisms are summarised as follows:

- Fugitive emissions of gases and odours from the surface of the landfill, mainly the uncapped areas; and
- Emissions of gases from the landfill gas flares and management infrastructure.

The management of landfill gas at the site is discussed in Chapter 12 Soils, Geology, Contaminated Land and Groundwater. Landfill gas is currently managed by an active gas extraction system through a network of extraction wells in two areas of the site, the lined cell (Zone 3) which cover the majority of the waste in this zone, and the north-western section (Zone 1) where only approximately a quarter of the waste has gas well coverage. The extracted gas is burned in a high temperature gas flare. There are two flares currently on site, one with capacity 250m^3/hr and the second with capacity 500m^3/hr. Currently all extracted gas is being directed to the "250 flare" located in Zone 1, with the "500 flare" acting as standby. Landfill gas is directed to the flare for combustion of the flammable constituents, particularly methane and to control odour nuisance and adverse environmental impacts.

Due to the risks posed by landfill gas and the location of sensitive receptors in proximity to the site (as shown on Figure 12.32) a Landfill Gas Management Plan (Appendix A4.5) has been developed to ensure that the landfill gas is appropriately controlled and managed according to the specific features and risks associated with each Zone. The Landfill Gas Management Plan as summarised in Figure 4.18 describes a system of in-waste gas extraction wells which are actively extracted with the gas burned in a new flare and perimeter gas venting trenches (adaptable to active extraction system if required) in areas where low levels of gas generation have been identified. The existing 250 flare and the back-up 500 flare will continue to operate throughout much of the Remediation Phase and the flares will be moved around the site to reduce emissions and odour if observed during the works. A new 600m^3/hr ("600 flare") will be installed in the Landfill Infrastructure Compound during the Remediation Phase as shown in Figure 4.13.and is anticipated to commence operation in Phase 5 with a 250m^3/hr backup flare.

7.2 Methodology

7.2.1 Study Area

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 as shown on Figure 3.1. The land uses in the immediate vicinity of the proposed Project are land associated with Kerdiffstown House to the north-east, golf courses to the north and north-east, and a mixture of land uses including residential, agricultural and worked out quarries to the south-east, south-west and west. Potential air quality impacts associated with the proposed Project are predicted to be at their most significant close to the site, but some impacts could be experienced up to 2 – 3km from the proposed Project. The study area is dependent on the nature of the site, the proposed Project and the potential air quality impacts which could arise and is determined by dispersion modelling. Air quality and climate impacts of the proposed Project on receptors which could potentially be affected by the proposed Project are considered in this Section of the report. The receptors located closest to the site and potentially impacted by the emissions are shown in Figure 7.1.

7.2.2 Air Quality and Odour Impact Assessment Methodology

General Impact Assessment Approach

The general approach to the impact assessment involves the identification and characterisation of the air quality and odour impacts that may be associated with the proposed Project, characterisation of the receiving environment to benchmark the existing situation, quantitative prediction of air quality impacts and assessment of the impacts against recognised Air Quality Standards and Guidelines. From this assessment comes a definition of the Management Plans and mitigation measures that are required to ensure that all aspects of the impacts of the proposed Project through the Remediation and Operational Phases are managed and controlled to protect human health, the environment and amenity.

The approach to the assessment of air quality impacts is described in the following Sections:

(i) The receiving environment is characterised in terms of baseline air quality and meteorological conditions which have the potential to influence the dispersion of pollutants and therefore the air quality impact of the proposed Project. The baseline air quality has been established by means of up-to-date surveys of existing air quality at the proposed Project and considers all of the available baseline data in describing the baseline air quality. Meteorological conditions at the proposed Project are described by reference to the comprehensive data available for Casement Aerodrome located approximately 14.7km from the centre of the proposed Project.

(ii) The likely and possible air quality impacts of the Remediation and Operational Phases of the proposed Project are identified.

(iii) A quantitative assessment of the potential air quality impacts of the proposed Project has been carried out and the results of the assessment are benchmarked against Air Quality Standards and Guidelines formulated for the protection of human health, amenity and the environment. The magnitude of potential air emissions is determined using a variety of techniques which include the data from previously completed and newly completed monitoring surveys, the Institute of Air Quality Management *"Guidance on the assessment of dust from demolition and construction" (IAQM 2014),* and the Institute of Air Quality Management *"Guidance on the assessment of odour for planning" (IAQM 2014).* A dispersion modelling assessment has been carried out using the US EPA AERMOD modelling suite to assess the impact of emissions to atmosphere from the flares and to confirm the optimum location of the flares on site and optimum stack height to promote effective dispersion of the emissions.

(iv) The overall air quality impact of the proposed Project is evaluated with particular emphasis on assessing the duration and extent of potential impacts as well as the longer term benefits associated with the completed

remediation programme. Particular attention is paid to the identification of sensitive receptors in the area and an evaluation of potential impacts on these receptors.

The assessment of air quality and odour has been carried out in accordance with the following guidance and has been tailored to this site and the proposed Project based on professional judgement and local circumstance:

- EPA Guidelines on the Information to be Contained in Environmental Impact Statements (EPA, 2002) (and revised and draft guidelines 2015/2017);
- EPA Advice Notes on Current Practice in the Preparation of Environmental Impact Statements (EPA, 2003a) (and revised advice notes 2015);
- The Institute of Air Quality Management "Guidance on the assessment of dust from demolition and construction" (Institute of Air Quality Management January 2014); and
- The Institute of Air Quality Management "Guidance on the assessment of odour for planning" (Institute of Air Quality Management May 2014).

The effects of the proposed Project are described by considering the possible impacts that could occur as a result of the proposed Project, the probability of their occurrence and the nature and significance of such impacts. The EPA *Revised Guidelines on the Information to be Contained in Environmental Impact Statements* (2015) are draft Guidelines which take account of the revised EIA Directive (2014/52/EU) and which have been considered in this assessment. Impacts are described in the draft Guidance under various headings which are summarised as follows:

- Probability – likely, possible, unlikely;
- Quality – positive, neutral, negative;
- Significance - imperceptible, not significant, slight, moderate, significant, very significant, profound; and
- Magnitude – extent, duration, frequency, context.

A description of the significance of effects is presented in Table 7.2 which shows the approach taken to quantify the significance and magnitude of potential air quality and odour impacts.

Table 7.2: Describing the Significance and Magnitude of Environmental Effects

Aspect	Description
Significance of Effects	
Imperceptible	An effect capable of measurement but without significant consequences.
Not significant	An effect which causes noticeable changes in the character of the environment but without significant consequences.
Slight	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.
Moderate	An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends.
Significant	An effect which, by its character, magnitude, duration or intensity significantly alters a sensitive aspect of the environment.
Very Significant	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment.
Profound	An effect which obliterates sensitive characteristics.
Magnitude of effects	
Extent	This is described by the size of the area, the number of sites and the proportion of the population affected by the effect.
Duration	**Momentary effects** last seconds to minutes.
	Brief effects last less than a day.
	Temporary effects lasting less than a year.
	Short-term effects last from one to seven years.

Aspect	Description
	Medium-term effects last from seven to fifteen years.
	Long-term effects last from fifteen to sixty years.
	Permanent effects last over sixty years.
Frequency	How often the effect will occur.
Context	The contextual relationship between the effect and the existing baseline.

Remediation Phase Impact Assessment Methodology

There are emissions to atmosphere of gases and odours from the landfill in its current condition, and these substances and others will continue to be emitted during the Remediation Phase. In order to ensure that the impact of these emissions is managed, the magnitude of the potential impact is assessed and a Management Plan is formulated from the findings of the assessment. The principal air quality impacts that may arise during the Remediation Phase of the proposed Project arise as a result of emissions to atmosphere of dust, particulate matter, VOCs, landfill gases and odours. The Remediation Phase impact assessment methodology is summarised here.

'Guidance on the assessment of dust from demolition and construction activities' was published in 2014 by the Institute of Air Quality Management. This Guidance describes a five-step approach to the assessment which is summarised as follows.

(i) Screen the proposed Project to determine if there is a requirement for a more detailed assessment.
(ii) Assess the risk of dust impacts for each of the four activities (demolition, earthworks, construction and construction traffic) and take account of the scale and nature of the works, and the sensitivity of the area.
(iii) Determine the site-specific mitigation for each potential activity.
(iv) Examine the residual effects and determine whether or not these are significant.
(v) Prepare the dust assessment report.

This approach has been applied in this assessment. A detailed assessment is required when there are human receptors within 350m of the boundary of the proposed Project and since the closest human receptors to the proposed Project boundary are within this distance, a detailed assessment is required. There are no European sites or designated sites within 50m of the site boundary which is the threshold distance for ecological sensitivity, so there are no significant Remediation Phase air quality and odour impacts predicted for ecological sites associated with the proposed Project. The Guidance advises that most projects will require a detailed assessment to ensure that the approach adopted is conservative, and therefore a detailed assessment has been carried out in this study.

The potential impact of emissions of landfill gases and VOCs from the landfill gas flares during the Remediation Phase was assessed using a computerised Dispersion Model to evaluate the impact of emissions to atmosphere on ambient air quality. The results of the assessment were compared with benchmarks, discussed in Section 7.2.5. The assessment of impact significance is based on a comparison of predicted impacts with air quality standards and guidelines, and consideration of the magnitude and duration of the potential impact. A more detailed description of the methodology for the dispersion modelling is presented in Section 7.2.4.

Odour impacts are also possible during some elements of work in the Remediation Phase. The Institute of Air Quality Management *"Guidance on the assessment of odour for planning"* was published in 2014 and offers some guidance on the assessment of odour for projects such as that proposed here. This Guidance is especially suitable for the assessment of the temporary impacts which could arise during the Remediation Phase which is of limited duration. The Guidance recommends a number of key stages in the odour impact assessment process as follows, and this methodology was adopted for the odour impact assessment study reported here:

a) The magnitude of the potential odour emissions from all sources is identified;
b) Sensitive receptors are identified and classified according to their relative sensitivity;
c) The magnitude of the odour impact on receptors is identified; and

d) The significance of the effect is assessed as either 'significant' or 'not significant'.

Operational Phase Impact Assessment Methodology

The completion of the proposed remediation of the landfill will result in considerable environmental improvements arising from the improved control of gases and odours generated from the decomposing waste. These improvements include better containment and capture of the gases and odours and therefore reduced levels of emissions. After completion of the Remediation Phase, emissions to atmosphere of gases and odours will still occur but at reduced levels and in a controlled manner thereby minimising odours and air quality impacts. The proposed Project will involve engineering works as described in Section 4.2 and Section 4.3 that lead to better containment and capture of gases and odours. The gases will be collected in the landfill gas management infrastructure and emissions to atmosphere will no longer be uncontrolled fugitive losses from the landfill surface. Instead, the gas will be contained, collected and burned in the new landfill gas flare. There will be some controlled emissions from passive vent systems where the gas concentrations are low and where such emissions will not lead to detectable odours.

The principal air quality and odour impacts that may arise during the Operational Phase of the proposed Project arise as a result of emissions to atmosphere of VOCs, landfill gases and odours from the landfill gas flares. The assessment methodology adopted for the assessment of the impact of these emissions is summarised here.

The potential Operational Phase impacts have been evaluated by means of a dispersion modelling study to evaluate the potential impact of emissions to atmosphere from the landfill gas flares. This type of study involves use of a computerised Dispersion Model to evaluate the impact of emissions to atmosphere during the Operational Phase on ambient air quality. The results of the assessment have been compared with benchmarks, discussed in Section 7.2.4. The assessment of impact significance is based on a comparison of predicted impacts with air quality standards and guidelines, and consideration of the magnitude and duration of the potential impact.

7.2.3 Climate Impact Assessment Methodology

This Section of the EIAR assesses the potential climate impact of the proposed Project by comparing the total emissions of Greenhouse Gases (GHG) with those that would occur if the site was left as it is. The Climate Action and Low-Carbon Development Act 2015, which provides for new arrangements aimed at achieving transition to a low-carbon, climate-resilient and environmentally sustainable economy by 2050, requires that Kildare County Council consider and reduce their carbon footprint in all aspects of the activities they undertake. This assessment provides information on how the proposed Project considers this objective in the selection of the preferred remediation option for the landfill site.

The principal GHG emissions associated with the landfill and the proposed Project are methane and carbon dioxide (CO_2). The main sources of these emissions for the current site and proposed Project are summarised as follows:

- Emissions resulting from the energy use of existing and new site buildings;
- Emissions resulting from the energy use of on-site plant and equipment;
- Fugitive emissions of methane within landfill gas (CO_2 fugitive emissions, or CO_2 from flared methane are considered to be short-cycle carbon)
- Embodied emissions resulting from the use of materials for construction of additional infrastructure;
- Emissions resulting from transport of materials to and off-site; and,
- Carbon savings resulting from sequestration from reinstated land cover.

For the purposes of this assessment the proposed remediation of the site is compared with an essentially un-remediated site baseline i.e. a *Do Nothing* scenario. Therefore, two scenarios have been assessed as follows:

Scenario 1 – Do Nothing

In this scenario, the landfill site will not be remediated, and all the gas generated in the waste body is released as fugitive emissions.

Scenario 2 – *In-situ* remediation of the proposed Project

In this scenario the proposed Project is assessed. Wherein this scenario, the waste remains in place, with waste re-profiling or waste excavation / movement minimised. The site will be capped thereby reducing diffuse landfill gas emissions. Gas extraction will occur from the areas of the site where this is required.

The assessment estimates the total GHG emissions from direct and indirect activities associated with the proposed Project. Annual emissions as well as overall emissions over the lifetime of the project (set at 32 years in line with the 2013 SKM Enviros Phase 1 Preliminary Life Cycle Assessment (LCA)) are determined. The assessment is presented in terms of tonnes of CO_{2e} i.e. the equivalent tonnage of carbon dioxide from all the various sources. While there are some uncertainties, the assessment allows a reliable comparison of the Climate Impact of the proposed Project relative to the Do Nothing scenario.

The Phase 1 Preliminary Life Cycle Assessment (LCA) of the remediation and potential end-use scenarios at the site, "*Kerdiffstown Landfill Outline Life Cycle Assessment, 2013*", is included in Appendix A7.8. The assessment looked at the overall impact of the various possible remediation scenarios which were under consideration at that time, including different quantities and types of GHG that could be emitted over the lifetime of the landfill against a Do Nothing scenario.

Since the detailed remediation design proposals were not available at that time, the 2013 assessment made various assumptions about work plans and timescales for remedial works as well as the overall GHG emissions estimates associated with various remedial options. The 2013 LCA Report presented a model of the site, with variables that can be adjusted to model different scenarios, using standard emission factors applicable for Ireland or the UK. The model was used initially to produce a relative ranking of the options that were being considered for the site, and the same Model is used here to refine the assessment based on the current design of the proposed Project.

A range of potential end-use options were considered during the initial assessment, including (a) medium to high density mixed use development; (b) completion of the site in accordance with previous planning permissions and restoration proposals, and, (c) some form of passive amenity function/open space end-use. The emissions from the remediated site would be essentially the same regardless of the final end-use design details since no high intensity or industrial uses are envisaged.

The assessment is based on the site conditions and considers the existing landfill gas generation and flaring rates, current leachate removal volumes etc. and modelled projections for the future requirements of the proposed Remediation Project. A Landfill Gas Management Plan (Appendix A4.5) has been completed for the site using GasSim for the 'Source Term' module to determine the quantity of landfill gas generation over time based on the mass of waste deposited and the composition of the waste, and outputs from this Model were incorporated into this assessment. In addition, details of the proposed Project relating to the likely import and export of materials and associated traffic movements were also considered.

7.2.4 Dispersion Modelling Methodology

A detailed dispersion modelling assessment was undertaken using the US EPA Model AERMOD and the current regulatory version of this Model (Version 16216r). The model computes average ground-level concentrations of pollutants emitted from emission sources at the facility which allows the impact of the emissions to be evaluated. A summary of the steps involved in the assessment is presented as follows:

(i) Characterise the receiving environment through detailed analysis of background air quality data that is representative of the area; this is described in Section 7.3.

(ii) Determine appropriate criteria for evaluating the significance of air quality impacts through reference to Air Quality Standards and Guidelines; this is described in Section 7.2.5.

(iii) Describe the emissions in quantitative terms and describe the Operating Conditions that will affect the emissions; this is described in Section 7.4.1 for the Remediation Phase and Section 7.4.3 for the Operational Phase.

(iv) Predict the potential air quality impacts using a dispersion model; this has been executed as described here and the results are presented in Section 7.4.1 for the Remediation Phase and Section 7.4.3 for the Operational Phase.

(v) Assess the impact by comparing the calculated levels against the adopted assessment criteria.

Information on a number of input variables is required for the dispersion model as follows:

- Emissions characteristics;
- Site layout and topography;
- Receptor locations;
- Meteorological data; and
- Baseline air quality.

The Environmental Protection Agency *"Air Dispersion Modelling from Industrial Installations Guidance Note (AG4)"* (EPA 2010a) gives guidance on the use of Dispersion Models which was followed in the execution of this study. A more detailed description of the methodology and the various input data sets are presented in Appendix A7.1.

7.2.5 Impact Assessment Criteria

Air Quality Standards in Ireland have been defined to ensure compliance with EC Directives; they are developed at different levels for different purposes. European legislation on air quality has been framed in terms of two categories, limit values and guide values. Limit values are concentrations that cannot be exceeded and are based on World Health Organisation (WHO) guidelines for the protection of human health. Guide values are set as long-term precautionary measures for the protection of human health and the environment. The WHO guidelines differ from EU air quality standards in that they are primarily set to protect public health from the effects of air pollution, whereas Air Quality Standards are recommended by governments, and other factors such as socio-economic factors, may be considered in setting the standards.

The air quality standards and guidelines referenced in this report are summarised in Table 7.3 to Table 7.5. These criteria were chosen to ensure that the potential impacts of the proposed Project during both Remediation and Operational Phases may be benchmarked against appropriate standards. There are no national or European Union air quality standards with which dust deposition can be compared. However, a figure of 350 mg/m^2-day based on the German Standard TA Luft Regulations is commonly applied by Local Authorities and the EPA to ensure that no nuisance effects will result from specified industrial activities.

The EPA Guidance Note "*Air Dispersion Modelling from Industrial Installations Guidance Note (AG4)"* (E Porter & E Collins, 2010; http://www.epa.ie/pubs/advice/air/emissions) which includes guidance on appropriate odour Standards against which odour emissions may be evaluated is the most widely used Guidance in Ireland for assessments of this type. This Guidance recognises that the exposure of the population to odour is assessed based on the odour concentration as well as the length of time that the population may perceive the odour. By definition, 1 odour unit per cubic metre (OU_E/m^3) is the detection threshold of 50% of a qualified panel of observers working in an odour-free laboratory using odour-free air as the zero reference, and standards are defined relative to this benchmark.

The EPA has issued guidance specific to intensive agriculture which sets target values for odour for pig-production units of 1.5 to 6.0 OU_E/m^3 as a 98 percentile of 1-hour averaging periods. Guidance from the UK Environment Agency *"H4 Odour Management"* (Environment Agency 2011) recommends that odour standards should vary from 1.5 – 6.0 OU_E/m^3 as a 98 percentile of 1-hour averaging periods at the worst-case sensitive receptor based on the offensiveness of the odour and with adjustments for local factors such as population density. Specifically, for wastewater treatment plants, the UK Guidance specifies a benchmark of 1.5 OU_E/m^3 as a 98 percentile of 1-hour averaging periods. Guidance from New Zealand is based on consideration of the sensitivity of the receiving environment rather than the offensiveness of the odour and specifies odour criteria of 1.0 – 10.0 OU_E/m^3 for the 99.9 to 99.5 percentile of 1-hour average ground level odour concentration, with target specifications of 1.0 to 2.0 OU_E/m^3 for high sensitivity receiving environments. Similar guidance from Europe, especially the Netherlands, sets comparable performance criteria.

The target specification is to ensure that there is no odour nuisance beyond the site boundary. Targets for odour nuisance vary as outlined above but there is a general consensus that the target performance specification for the 98 percentile of 1-hour average concentration should be 1.0 OU_E/m^3. Due to the location of residential properties in the vicinity of the proposed Project, it is considered appropriate to specify a stringent Performance Standard of 1.0 OU_E/m^3 for the 98 percentile of 1-hour average concentration in order to assess the potential for odour nuisance at site boundaries.

Table 7.3: Air Quality Impact Assessment Criteria

Pollutant	EU Regulation	Limit Type	Value
Dust deposition	None	Limit over 28 – 30 days	350 mg/m^2-day
Odour	None	Hourly limit for prevention of nuisance – not to be exceeded more than 176 hours per year (98 percentile)	1 OU_E/m^3

There are no formal Air Quality Standards defined for the emissions of VOCs from landfills. Guidance from the EPA defines Trigger Values which represent thresholds that require certain actions to be taken if achieved or exceeded. Trigger values for VOC emissions from landfill are specified in the "*EPA Air Guidance Note 6 (AG6) Surface VOC Emissions Monitoring on Landfill Facilities"*, 2010. This states that in relation to surface emissions from the waste body and identified features, the following shall constitute a trigger level:

- VOC greater than or equal to 50 parts per million by volume (ppmv) average over capped area; or,
- VOC greater than or equal to 100 ppmv instantaneous reading on open surfaces within the landfill footprint; or,
- VOC greater than or equal to 500 ppmv around all identified features.

These Trigger Values are a useful benchmark for evaluating the significance of diffuse emissions from the surface of the landfill.

The Clean Air for Europe (CAFE) Directive (Council Directive 2008/50/EC) sets out limit and target values for named air quality parameters and it was transposed into Irish legislation by the Air Quality Standards Regulations 2011 (S.I. No. 180 of 2011). The 4th Daughter Directive, which also defines limit values for pollutants, was transposed by the Arsenic, Cadmium, Mercury, Nickel and Polycyclic Aromatic Hydrocarbons in Ambient Air Regulations 2009 (S.I. No. 58 of 2009). This Directive and the Irish Regulations set out the main standards against which the potential impact of aspects of the proposed Project on air quality are assessed. These standards are summarised in Table 7.4.

In addition to the Air Quality Standards Regulations and the Directive Standards, it is also appropriate to consider the WHO Guidelines. These guidelines were developed by the WHO to provide appropriate air quality targets worldwide, based on the latest health information available. The air quality guidelines for particulate matter (PM_{10}), nitrogen dioxide and sulfur dioxide, and $PM_{2.5}$ are considered in this report (WHO, 2005; updated in 2008). While the WHO Guidelines are not mandatory, they represent current informed opinion on the levels to which we should be aspiring in order to minimise the adverse health impacts of air pollution. The WHO air quality standards and guidelines referenced in this report are summarised in Table 7.5.

Table 7.4: Air Quality Standards Regulations 2011 (S.I. No. 180 of 2011; based on EU Clean Air for Europe [CAFE] Directive 2008/50/EC)

Pollutant	EU Regulation	Limit Type	Margin of Tolerance	Value
Nitrogen dioxide	2008/50/EC	Hourly limit for protection of human–health - not to be exceeded more than 18 times/year	None	200 $\mu g/m^3$ NO_2
		Annual limit for protection of human health	None	40 $\mu g/m^3$ NO_2
		Annual limit for protection of vegetation	None	30 $\mu g/m^3$ $NO + NO_2$

Pollutant	EU Regulation	Limit Type	Margin of Tolerance	Value
Sulfur dioxide	2008/50/EC	Hourly limit for protection of human–health - not to be exceeded more than 24 times/year	150 µg/m^3	350 µg/m^3
		Daily limit for protection of human–health - not to be exceeded more than 3 times/year	None	125 µg/m^3
		Annual & Winter limit for the protection of human health and ecosystems	None	20 µg/m^3
Particulate Matter (as PM_{10})	2008/50/EC	24-hour limit for protection of human–health - not to be exceeded more than 35 times/year	50%	50 µg/m^3
		Annual limit for protection of human health	20%	40 µg/m^3
Particulate Matter (as $PM_{2.5}$)	2008/50/EC	Annual limit for protection of human health (Stage 1)	20% from June 2008. Decreasing linearly to 0% by 2015	25 µg/m^3
		Annual limit for protection of human health (Stage 2)	None To be achieved by 2020	20 µg/m^3
Carbon Monoxide	2008/50/EC	8-hour limit (on a rolling basis) for protection of human health	60%	10 mg/m^3 (8.6 ppm)
Benzene	2008/50/EC	Annual limit for protection of human health	0% by 2010	5 µg/m^3

Table 7.5: WHO Air Quality Guidelines

Pollutant	Limit Type	Value
Nitrogen dioxide	Hourly limit for protection of human health	200 µg/m^3 NO_2
	Annual limit for protection of human health	40 µg/m^3 NO_2
Sulfur dioxide	Daily limit for protection of human health	20 µg/m^3
	10-minute limit for protection of human health	500 µg/m^3
Particulate Matter (as PM_{10})	24-hour limit for protection of human health	50 µg/m^3
	Annual limit for protection of human health	20 µg/m^3
Particulate Matter (as $PM_{2.5}$)	24-hour mean for protection of human health	25 µg/m^3
	Annual mean for protection of human health	10 µg/m^3

7.3 Baseline Conditions

7.3.1 Meteorological Conditions

The magnitude of potential impacts of the proposed Project on air and climate will largely be influenced by the local meteorological conditions, in particular by wind speed and direction and by precipitation rates. An evaluation of the climatic conditions at the site is therefore useful for an assessment of the type required for the proposed Project.

Met Éireann operate a Synoptic Network of weather stations at Belmullet, Malin Head, Rosslare (closed since 2008), Johnstown Castle, Birr, Clones, Kilkenny and Mullingar while the Aviation Division of Met Éireann maintains observing stations at Shannon Airport, Knock Airport, Casement Aerodrome, Dublin Airport and Cork Airport. There is no long-term continuous meteorological monitoring at the proposed Project site but the general guidance on selection of meteorological data for air quality impact assessments is to choose representative data, recently acquired, which best represents conditions at the site. At least three years of recently acquired data is preferred. Comprehensive monitoring data is available for Casement Aerodrome (located approximately 14.7km from the centre of the proposed Project) which would be indicative of the meteorological conditions that are experienced at the proposed Project. Therefore, for the purpose of obtaining reliable information about the

climatological conditions at the site of the proposed Project, a full set of 3 years' meteorological data for the period 2013 – 2015 recorded at Casement Aerodrome was analysed. This is considered an appropriate data set for the study because of the close proximity of the station to the site and the similarity in topography in the immediate area of both Casement Aerodrome and the site of the proposed Project.

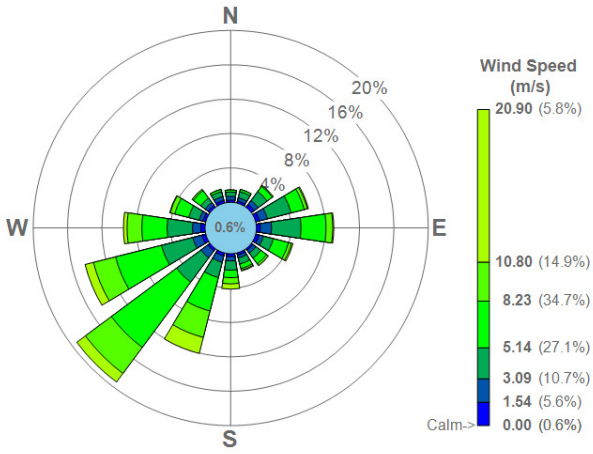
Wind speed and direction in particular are important in determining how emissions associated with the activity are dispersed. The prevailing wind direction determines which areas are most significantly affected by the emissions from the activity and wind speed determines in part the effectiveness of the dispersion of the emissions. The windroses for Casement Aerodrome are presented in Diagram 7.1 for each of the years 2013 – 2015. The dominant wind direction is from the south-west quadrant. The wind speed is below 5.14 metres per second (m/s) for just under 50% of the time. The average long-term wind speed over the period 1985 – 2010 is 5.5m/s.

Meteorological conditions at the site of the proposed Project were monitored during 2016 and a summary of the data for the period January to 6 October 2016 is presented in Table 7.6. The average wind speed recorded at the on-site station was 3.3m/s with wind speeds less than 5.14m/s for 77% of the time. The dominant wind direction was from the south-west quadrant with the wind blowing from this direction 55.6% of the time. The site-specific data compares well with the data from Casement Aerodrome which lends confidence to the selection of data from Casement Aerodrome for this assessment. The base elevation for the anemometer at Casement Aerodrome is 118mOD Malin Head with the anemometer recording at 10m above ground level, whereas the on-site station is located at an elevation of approximately 112mOD Malin Head, with the anemometers recording at 4.5m above ground level. Some differences in wind speed but not direction would be expected for this difference in anemometer height.

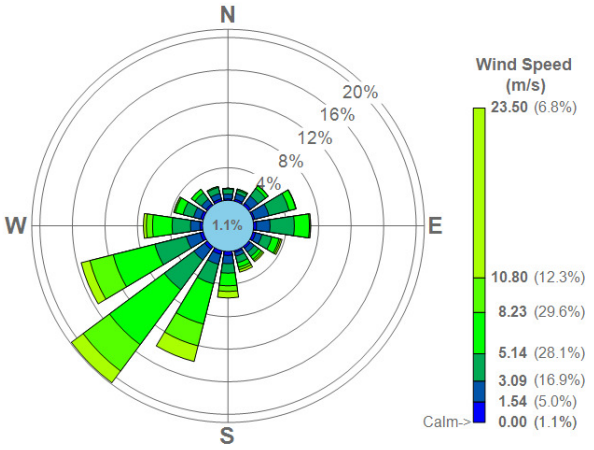
Table 7.6: On-Site Meteorological Data

Month	Average wind speed, m/s	Wind Direction SW Quadrant %
January 2016	3.9	77.3
February 2016	Not recorded	Not recorded
March 2016	Not recorded	Not recorded
April 2016	Not recorded	Not recorded
May 2016	3.2	20.6
June 2016	2.2	29
July 2016	3.3	54.9
August 2016	3.8	70.8
September 2016	3.3	81.1
October – December 2016	Not recorded	Not recorded
Average	3.3	55.6

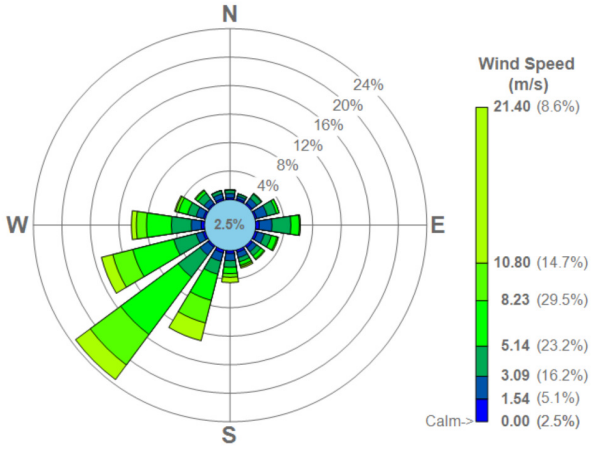
Casement Aerodrome 2013



Casement Aerodrome 2014



Casement Aerodrome 2015



Annual Average data for Casement Aerodrome 1981 - 2010	
Temperature, °C	9.7
Rainfall, mm	754
Mean num. of days with >= 0.2mm	183
Average wind speed, m/s	5.5

tms environment ltd

TMS Environment Ltd, 53 Broomhill Drive, Tallaght, Dublin 24
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Diagram 7.1

Windroses for Casement Aerodrome 2013 - 2015

Diagram 7.1: Windroses for Casement Aerodrome 2013 - 2015

7.3.2 Influences on Ambient Air Quality

The existing activities at and in the vicinity of the proposed Project have the potential to exert an influence on ambient air quality by the release of emissions to atmosphere as follows:

- emissions of fine particulate matter (PM_{10} and $PM_{2.5}$), sulfur dioxide (SO_2), nitrogen oxides (NO_x), carbon monoxide (CO) and carbon dioxide (CO_2) from domestic, commercial and industrial heating;
- emissions of fine particulate matter (PM_{10} and $PM_{2.5}$), SO_2, NO_x, CO and benzene from traffic on adjoining roads;
- emissions of fine particulate matter (PM_{10} and $PM_{2.5}$), SO_2, NO_x, CO, CO_2 and benzene from air traffic approaching / departing Casement Aerodrome;
- emissions of fine particulate matter (PM_{10} and $PM_{2.5}$), SO_2, NO_x, CO and CO_2 from the existing flare;
- Emission of VOCs from the existing flare and/or from the landfill mass; and
- Emissions of trace gases and odour from the existing flare and/or from the landfill mass.

There are a number of facilities located in the Monread Industrial Estate which have been linked in the past with odorous emissions and odour complaints. These facilities are considered to be located too far away from the proposed Project to exert a significant influence on ambient air quality.

The main potential air quality impacts arise as a result of dust and diffuse landfill gas emissions from the current uncapped surface of the landfill site, while secondary potential emission sources include the lined cell (Zone 3) and landfill management infrastructure such as the two existing landfill gas flares and the leachate management infrastructure. While landfill gas contains a complex mixture of substances, the primary constituents are methane, carbon dioxide, nitrogen and trace gases. The trace gases are typically linked with the odours that are characteristic of landfill gas emissions and include VOCs such as fatty acids, hydrogen sulfide and various organo-sulfur compounds such as mercaptans, thiols, and organo-sulfides. VOCs are grouped into methane and other non-methane VOCs (NMVOCs).

Landfill gas at the proposed Project is currently managed actively by directing extracted gases to the landfill gas flare and passive gas management is achieved through venting. The combustion of landfill gas in a flare converts methane to carbon dioxide and water vapour. Typical emissions from landfill gas flares include carbon dioxide, nitrogen oxides, sulfur dioxide, fine particulate matter, as well as potentially hydrogen chloride and hydrogen fluoride if chlorinated or fluorinated organic trace compounds are present in the gas. Typical emissions from the passive vents include trace gases and odours as noted above.

Overall, the contribution of traffic to air quality is considered to be the most significant influence on air quality in the immediate vicinity of the proposed Project, but all other sources also exert significant influences on air quality and are considered in this assessment.

The main substances which are of interest in terms of existing air quality are sulfur dioxide, nitrogen oxides, particulate dusts including PM_{10} and $PM_{2.5}$ which could originate from combustion sources and traffic. A description of existing levels of the various substances in ambient air is required to allow completion of the evaluation of air quality impacts associated with the proposed Project and is presented in Section 7.3.3.

7.3.3 Existing Ambient Air Quality

Dust and Fine Particulate Matter, PM_{10}

A considerable amount of baseline information has been collected during the period when the landfill site was operating and also in the period 2008 – 2017. The comprehensive database of environmental information provides a detailed statement of the air quality in the vicinity of the proposed Project. The data that is most representative of current baseline conditions at the proposed Project is the most recent environmental monitoring data recorded at the site; this includes two dust deposition rate surveys undertaken in 2016 as well as a survey of fine particulate matter (PM_{10}). When the landfill site was operating and receiving waste, there

were no controls in place and no landfill gas flares which is significant. The 2016 dust surveys involved measurements carried out over periods of 24 hours for the PM_{10} and 28 days for the dust deposition surveys.

Two dust deposition monitoring surveys were completed during the period 19 August 2016 to 14 October 2016 by Kildare County Council and the results are presented in Table 7.7. The laboratory analysis Certificates for the analysis of the deposited dust are presented in Appendix A7.2. Measurements were carried out at 10 locations shown in Figure 7.2 and as described below in Table 7.8. The survey results are all well within the benchmark standard of 350 mg/m^2-day to ensure that no nuisance effects occur as a result of deposition of dust from emissions. The deposition rate at D1 (located adjacent to Nass Golf Club and L2005 Kerdiffstown Road) is higher than the level recorded at the other monitoring locations but is still well within the levels expected for this type of environment. The average of the measurement data at all of the monitoring locations over the survey intervals was 64.7 mg/m^2-day. These levels are consistent with expectations for the area and indicate that air quality as represented by dust deposition rates is not significantly affected currently by the landfill site. These levels are also broadly similar to the levels found in the surveys carried out in previous years at the site.

Table 7.7: Dust Deposition Survey Results 2016

Monitoring Location	D1	D2	D3	D4	D5	D6	D7	D8	D9
19 Aug - 16 Sept 2016 (mg/m^2-day)	141	89	39	74	53	75	36	86	72
16 Sept – 14 Oct 2016 (mg/m^2-day)	140	46	59	12	33	46	85	36	35

Table 7.8: Monitoring Locations

Monitoring Location	Description
D1	North-western corner boundary adjacent golf course
D2	Eastern site boundary
D3	Elevated location along southern boundary
D4	Western site boundary
D5	On green area 25m from Kerdiffstown House
D6	Adjacent to Johnstown Garden Centre
D7	Near private residence adjacent site entrance
D8	Western site boundary
D9	South-eastern site boundary
D10	Western site boundary beside site offices

The PM_{10} monitoring data was acquired during the period 8 September 2016 to 20 September 2016 and the results are presented in Table 7.9. Measurements were carried out at 9 locations as shown in Figure 7.2. Measurements were carried out at one location close to the offices (D10) over 8 days, while measurements were also carried out at 8 locations around the boundaries of the proposed Project over 24-hour intervals. Air quality as represented by the measured PM_{10} levels is representative of an unpolluted rural environment, and all of the measurement results are within the prescribed Air Quality Standard of 50 µg/m^3, for the 24-hour average.

Table 7.9: PM_{10} Monitoring Results 2016

Monitoring Location	Measurement Dates		PM10 µg/m3
D1	19/09/16o	20/09/16	4
D2	09/09/16	10/09/16	< 1
D3	13/09/16	14/09/16	2
D4	08/09/16	09/09/16	1
D5	14/09/16	15/09/16	34

Monitoring Location	Measurement Dates		PM10 µg/m3
D6	15/09/16	16/09/16	12
D7	16/09/16	17/09/16	10
D8	12/09/16	13/09/16	< 1
D10	08/09/16	09/09/16	1.6
D10	09/09/16	10/09/16	0.5
D10	10/09/16	11/09/16	0.5
D10	11/09/16	12/09/16	0.7
D10	12/09/16	13/09/16	1.3
D10	13/09/16	14/09/16	1.1
D10	14/09/16	15/09/16	0.5
D10	15/09/16	16/09/16	0.9

The PM_{10} result obtained at D5 (Kerdiffstown House) was higher than all the other measurement results but within the Air Quality Standard. This monitoring location is located downwind of the landfill site and is in a very sheltered location which might explain the results. A further survey was conducted at D5 from 2 February 2017 to 9 February 2017 and the results are presented in Table 7.10. The results during the second survey are in the range 9 – 35 µg/m^3 and are higher than the levels recorded at the other locations. The survey results, except for two of the measurements at D5, also lie below the Air Quality Standard for $PM_{2.5}$ of 25 µg/m^3 (this limit will reduce to 20 µg/m^3 in 2020) for the annual average. The measurement results are for PM_{10} over 24-hour periods and the $PM_{2.5}$ Air Quality Standard is for the annual average but the comparison is useful for benchmarking and is included for information.

Table 7.10: PM_{10} Monitoring Results 2017

Monitoring Location	Measurement Dates		PM10 µg/m3
D5	02/02/17	03/02/17	9
D5	03/02/17	04/02/17	14
D5	04/02/17	05/02/17	10
D5	05/02/17	06/02/17	25
D5	06/02/17	07/02/17	14
D5	07/02/17	08/02/17	16
D5	08/02/17	09/02/17	35

Landfill Gases and Volatile Organic Compounds (VOCs)

Landfill gas constituents include VOCs and hydrogen sulfide, organic sulfides and mercaptans generated by the decomposing waste, as well as carbon dioxide, carbon monoxide, nitrogen dioxide and sulfur dioxide potentially present from the existing flare. Levels of many of these substances in ambient air in the vicinity of the facility were determined over a number of monitoring intervals to benchmark existing air quality in the area. The results of the surveys are presented in Table 7.11 and Table 7.12 and the laboratory analysis Certificates are presented in Appendix A7.3.

Table 7.11: NO_2, SO_2 and H_2S Monitoring Results 2016

Monitoring Location	Measurement Dates		NO_2 µg/m^3	SO_2 µg/m^3	H_2S µg/m^3
D1	08/09/16	22/09/16	9.66	< 2.1	< 0.05
	22/09/16	07/10/16	8.34	< 2.3	< 0.03
D2	08/09/16	22/09/16	9.45	< 2.1	0.10
	22/09/16	07/10/16	9.22	< 2.3	< 0.03

Monitoring Location	Measurement Dates		NO_2 µg/m³	SO_2 µg/m³	H_2S µg/m³
D3	08/09/16	22/09/16	10.20	< 2.1	0.21
	22/09/16	07/10/16	<0.65	< 2.3	0.03
D4	08/09/16	22/09/16	10.26	< 2.1	< 0.05
	22/09/16	07/10/16	Not measured	< 2.3	0.04
D5	08/09/16	22/09/16	10.39	< 2.1	< 0.05
	22/09/16	07/10/16	12.40	< 2.3	< 0.03
D6	08/09/16	22/09/16	26.95	< 2.1	< 0.05
	22/09/16	07/10/16	27.10	< 2.3	0.14
D7	08/09/16	22/09/16	11.53	< 2.1	< 0.05
	22/09/16	07/10/16	Not measured	< 2.3	< 0.03
D8	08/09/16	22/09/16	9.80	< 2.1	< 0.05
	22/09/16	07/10/16	<0.65	< 3.3	0.05
Average			12.9	< 2.2	0.05

Nitrogen dioxide and sulfur dioxide levels are unremarkable and are typical of the levels found in unpolluted rural environments. The survey presents a snapshot of measurement results over a relatively short time period but is a useful additional data set to benchmark existing baseline conditions. Hydrogen sulfide was detected at five of the eight locations but at levels significantly lower than the level which would be detectable as odour. The odour threshold for hydrogen sulfide is 0.47 parts per billion (ppb) (0.7µg/m³) and the level of hydrogen sulfide detected around the proposed Project is significantly lower than this threshold and therefore below the level at which it would result in a detectable odour.

VOCs as represented by benzene, toluene, ethyl benzene and xylenes (BTEX) were also monitored and the results are summarised in Table 7.12. The concentration of each substance was either below the limit of detection for the technique or at low levels typical of similar unpolluted environments.

Table 7.12: Volatile Organic Compounds (VOC) Monitoring Results 2016

Monitoring Location	Measurement Dates		Concentration µg/m³				
			Benzene	Toluene	Ethylbenzene	m/p-Xylene	o-Xylene
D1	08/09/16	22/09/16	1.11	3.18	3.92	4.09	1.60
	22/09/16	07/10/16	0.90	<0.70	<0.66	<0.66	<0.66
D2	08/09/16	22/09/16	0.88	0.89	<0.71	0.71	<0.71
	22/09/16	07/10/16	<0.73	0.77	<0.66	0.91	<0.66
D3	08/09/16	22/09/16	Not measured	Not measured	Not measured	Not measured	Not measured
	22/09/16	07/10/16	1.08	<0.70	<0.66	0.81	<0.66
D4	08/09/16	22/09/16	1.02	2.44	<0.71	0.95	<0.71
	22/09/16	07/10/16	0.94	<0.70	<0.66	0.68	<0.66
D5	08/09/16	22/09/16	1.00	6.53	<0.71	1.17	<0.71
	22/09/16	07/10/16	<0.73	<0.70	<0.66	<0.66	<0.66
D6	08/09/16	22/09/16	<0.79	1.57	<0.71	0.73	<0.71
	22/09/16	07/10/16	<0.73	0.71	<0.66	0.70	<0.66
D7	08/09/16	22/09/16	<0.79	1.96	<0.71	0.95	<0.71
	22/09/16	07/10/16	<0.73	0.71	<0.66	1.18	<0.66
D8	08/09/16	22/09/16	1.01	4.20	<0.71	1.27	<0.71
	22/09/16	07/10/16	<0.73	<0.70	<0.66	<0.66	<0.66

Surveys of diffuse emissions of VOCs and odours from the landfill gas area have been carried out annually since 2008 by Odour Monitoring Ireland Ltd in accordance with the EPA Guidance AG6 *"Surface VOC Emissions Monitoring on Landfills, 2010"*. The most recent survey report completed in August 2016 identified a

number of areas in the north-western area of the site (Zone 1) where diffuse emissions of VOCs and landfill gases from the surface were occurring as shown in Diagram 7.2. This area has been identified in various studies undertaken at the site as the area where the most odorous wastes are located and the area with the most significant potential for release of odours. There were no diffuse VOC emissions detected in the south-east lined cell area of Zone 3. The recorded emissions exceeded the recommended trigger levels in several areas as outlined in the EPA Guidance Note AG6 and discussed in Section 7.2.5 which led to actions being taken to limit the emissions. The measurement results indicate the potential level of emissions from this area and are an indicator of the level of emissions during the Remediation Phase.

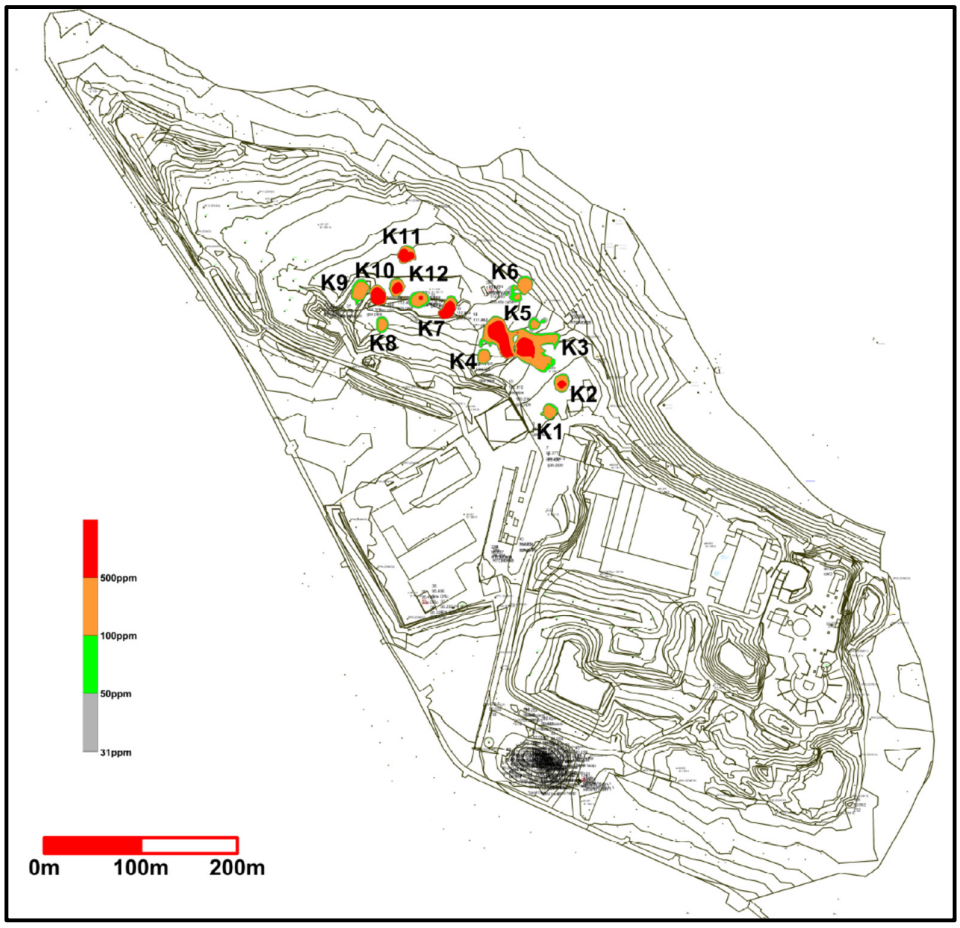

Diagram 7.2: VOC Surface Emission Mapping at Kerdiffstown 2016

The KLRP VOC / Surface Emissions / 2016/1 Surface Emissions Survey at Kerdiffstown, Naas, Co. Kildare report, 2016 also summarises results of previous surveys, and shows the effectiveness of the mitigation measures taken to manage areas where surface emissions had been identified in the previous years' surveys. The changes in the locations of diffuse emissions from the landfill surface over the period 2011 – 2016 are shown in Diagram 7.3 with the coloured areas representing a variation in VOC levels. Diagram 7.3 shows that the extent of VOC surface emissions has decreased at the site, most significantly in the south-east due to the temporary capping of this site area, thereby preventing diffuse emission releases. The report provides a valuable benchmark of the existing diffuse emissions and shows the areas with the greatest potential for release of such emissions, the complete report is attached in Appendix A7.4.

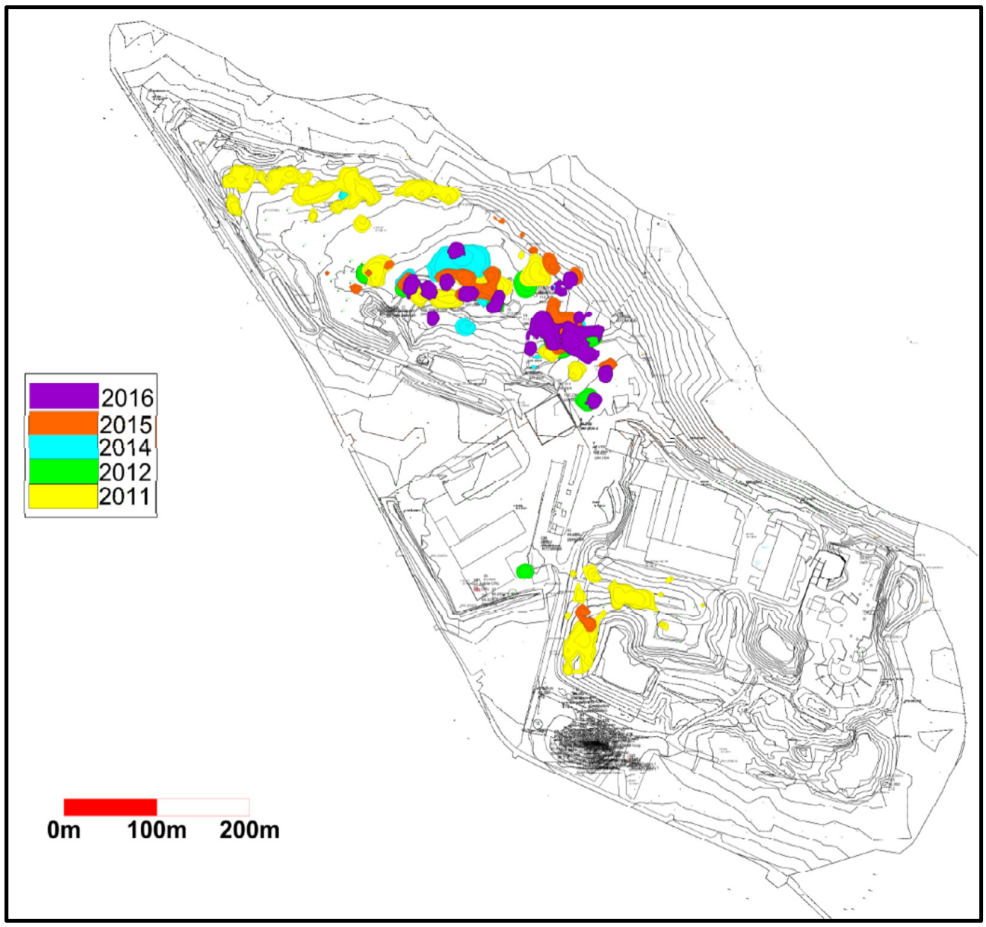

Diagram 7.3: VOC Surface Emission Location Mapping at Kerdiffstown, 2011 – 2016

Influence of Materials On-Site on Odour Emissions

A comprehensive characterisation of the site, the materials deposited and the classification of wastes in each area was undertaken on behalf of the EPA from 2010 to 2013. The findings of the investigations were presented in the "*Kerdiffstown Landfill Remediation Project Remediation Options Report, SKM Enviros, 2013*". This report describes the different areas of the landfill site in terms of the types of materials deposited and the odour generating potential of each area.

There are four principal areas classified according to the types of waste present and the odour emissions potential. The four principal waste zones on the site are shown in Figure 3.2 and are outlined below in Table 7.13.

Table 7.13: Description of Wastes Deposited on the Site

Area	Description of the Area
Zone 1 	Wastes deposited in the north-west area of the site, Zone 1 (and 1A) account for approximately 66% of the entire estimated volume of waste on site. As outlined in Table 3.1, the majority of waste in this zone is reported to comprise Municipal Solid Waste (MSW), although some logs do show Construction & Demolition (C&D) waste to also be present. The area is unlined and uncapped with a series of landfill gas wells extracting gas to a flare. Zone 1A to the north-west extents of the site does not contain MSW and hence is unlikely to generate odour.

Area	Description of the Area
Zones 2A and 2B 	Zones 2A and 2B comprise largely flat areas with concrete hardstandings and remnants of buildings from the waste processing facility. As a result, this area was assessed as one zone. However, review of ground investigations and subsequent monitoring data confirms that wastes in Zone 2A comprise more MSW than that in Zone 2B. The wastes are generally described as being dry, although damp or wet wastes are identified closer to the groundwater table with saturated wastes shown in the boreholes where waste is at the lowest elevation in Zone 2B. No saturated wastes have been identified in Zone 2A. MSW may be odorous, but the extensive hardstanding areas effectively prevent escape of odours.
Zone 3 	Zone 3 comprises a cell with engineered basal and side slopes lining system. Zone 3 has a temporary cap applied over the existing waste mass. Landfill gas wells extract gas to a flare. The wastes 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.
Zone 4 	Zone 4 contains predominantly 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 and PVC pipes.

From this characterisation, it is clear that the most odorous wastes are located in Zone 1 which is where the surface VOC emission surveys also identify areas with the greatest potential for release of emissions to atmosphere including odours. Other areas not currently linked with odorous emissions e.g. the lined cell may release odorous gases once the waste is disturbed during the Remediation Phase. This is also the finding reported in the "Kerdiffstown Landfill Odour Control Plan, 2013" which is attached in Appendix A7.7.

Odours

Odour emissions at the existing Kerdiffstown Landfill are primarily linked with diffuse landfill gas emissions, while other potential secondary odour sources include gas flare emissions. While the site was operational and receiving waste, the odour emissions from Kerdiffstown Landfill gave rise to sustained complaints from people living in, and visiting, the area at that time. At that time there were no environmental controls in place. The EPA intervened under Section 56 of the Waste Management Act 1996 after a fire occurred at the site in 2011 and implemented a series of emergency measures to contain and limit the environmental impact of the site. Since the fire was brought under control and extinguished in 2011, the EPA and later KCC have implemented works to deal with the most immediate risks presented at the site. A landfill gas management system was implemented as a priority to reduce the risk of further fires which consisted of the installation of an active landfill gas collection system. There are currently two flares on site, one with capacity 250m^3/hr, the second with capacity 500m^3/hr. Currently, all gas extracted from wellfields in the north-west and the lined cell is being burned at the 250m^3/hr flare, with the second flare as standby. This flare will continue to operate during the Remediation Phase of the proposed Project.

The installation of the landfill gas management system was very effective in managing the gases and odours associated with the most odorous wastes in the north-western area (Zone 1) of the site and in the south-eastern lined cell area (Zone 3). Odour complaints are now rare occurrences on site, with only six complaints logged between February 2011 and March 2013, seven in 2014, four in 2015 and three in 2016. Some complaints related directly to intrusive site investigations that were taking place in 2012 when boreholes were drilled

through the waste body to prove depth to natural ground and provide information of waste. For others, no specific cause for the complaint was identified.

Subjective olfactometric assessments were carried out at the same locations as those for the 2016 VOC measurement events. The methodology conformed to the general guidance issued by the EPA in the Guidance Note *"Air Guidance Note 5 (AG5): Odour Impact Assessment Guidance for EPA Licensed Sites"*. This Guidance offers a systematic and consistent approach to the assessment of odours on and in the local area of facilities and installations that are licensed by the EPA. While the study was aimed at establishing baseline ambient air quality as opposed to examining the air quality impact of a licenced facility, the use of this best-practice Guidance demonstrates the robust assessment procedures adopted for the study. No detectable odours were recorded during these surveys at the measurement locations. Odours were detected on site near the security high hut in Zone 1 approaching the D2 monitoring location, but the odour was not experienced at the boundary or at the D2 location.

Priority Construction Ltd. were undertaking works at the proposed Project during October 2016 and arranged for a survey of odour levels at four monitoring locations to be carried out by BHP Laboratories Ltd. and a summary of the results is presented in Table 7.14 with the full report presented in Appendix A7.5. No odorous compounds were detected during that survey.

Table 7.14: Odour Monitoring Results 2016

Monitoring Location	Measurement Date	Mercaptans mg/m^3	H_2S mg/m^3	Odour
D4	21/10/2016	< 1.25	< 0.3	None detected
D2	21/10/2016	< 1.25	< 0.3	None detected
D3	21/10/2016	< 1.25	< 0.3	None detected
D9	21/10/2016	< 1.25	< 0.3	None detected

Long Term Air Quality Monitoring Data

The main substances which are of interest in terms of existing air quality in all areas potentially affected by the proposed Project are sulfur dioxide, nitrogen oxides (nitric oxide, NO and nitrogen dioxide NO_2, collectively referred to as NO_x), fine particulate matter including PM_{10} and $PM_{2.5}$ which could originate from combustion sources, traffic and the existing commercial and industrial activities in the study areas. Carbon monoxide is also potentially of interest, and benzene may also be of interest from traffic sources.

Particulate matter is made up of tiny particles in the atmosphere that can be solid or liquid (except for water or ice) and is produced by a wide variety of natural and manmade sources. Particulate matter includes dust, dirt, soot, smoke and tiny particles of pollutants. Particulate matter of 10 micrometres (µm) in aerodynamic diameter or less are also referred to as **PM_{10}** or more strictly, particles which pass through a size selective inlet with a 50% efficiency cut-off at 10µm aerodynamic diameter. Similarly, **$PM_{2.5}$** refers to particulate matter of 2.5 µm or less in aerodynamic diameter. In the past domestic coal burning was a major source of particulate matter in Irish cities during winter months. Levels of particles have decreased significantly following the introduction of abatement strategies including Special Control Areas and other Regulations regarding the use, marketing, sale and distribution of certain fuels. The significance of particulate matter in relation to air quality is predominantly related to human health and respiratory effects.

Nitrogen oxides (NO_x, which is the sum of NO and NO_2), are generated primarily by combustion processes. The main anthropogenic sources (man-made sources) are mobile combustion sources (road and air traffic) and stationary combustion sources (including industrial combustion and domestic heating). The main source of nitrogen oxides in the vicinity of the study area is traffic. The significance of nitrogen oxides is health-related for nitrogen dioxide (NO_2) and ecological for nitrogen oxides (NO_x).

Sulfur dioxide (SO_2) also originates from combustion but predominantly from heating sources and not traffic. The trend in ambient SO_2 concentrations is clearly downward and this pollutant is not a matter for concern in

Ireland. The reduction in ambient sulfur dioxide concentrations in recent years can be attributed to fuel switching from high-sulfur fuels, such as coal and oil, to natural gas and to decreases in the sulfur content of oil.

Carbon monoxide (CO) is a colourless and odourless gas, formed when carbon in fuel is not burned completely. It is a component of motor-vehicle exhaust, which accounts for most of the CO emissions nationwide. Consequently, CO concentrations are generally higher in areas with heavy traffic congestion. CO is also a significant emission from air traffic.

Carbon dioxide (CO_2) may be emitted from any combustion sources which include road and air traffic and commercial and domestic heating.

Odour emissions are commonly associated with landfills of this type and are quantified and studied in this report. The principal odorous gases potentially present in emissions from the proposed Project will include trace gases emitted from the landfill surface and the combustion products CO, NO, NO_2 and SO_2 and fine particulate matter which may be emitted as a result of combustion of gases in the flare. Where available, data for existing levels of these substances in ambient air have been discussed in this Section of the report.

The available data from the National Ambient Air Quality Network is a reliable data set for consideration in this study. The EPA and local authorities maintain and operate a number of ambient air quality monitoring stations throughout Ireland in order to implement EU Directives and to assess the country's compliance with national air quality standards. Ireland's small population and generally good air quality means that a relatively small number of monitoring stations are sufficient across the country for the purposes of implementing the EU Air Directives. For ambient air quality management and monitoring in Ireland, four zones, A, B, C and D are defined in the Air Quality Standards (AQS) Regulations (S.I. No. 180 of 2011) and are defined as follows:

Zone A:	Dublin Conurbation.
Zone B:	Cork Conurbation.
Zone C:	24 cities and large towns. Includes Galway, Limerick, Waterford, Clonmel, Kilkenny, Sligo, Drogheda, Wexford, Athlone, Ennis, Bray, Naas, Carlow, Tralee, Dundalk, Navan, Newbridge, Mullingar, Letterkenny, Celbridge and Balbriggan, Portlaoise, Greystones and Leixlip.
Zone D:	Rural Ireland, i.e. the remainder of the State excluding Zones A, B & C.

The proposed Project is located close to Naas which is in Zone C, but the air quality in the area is best described under the Zone D (Rural Ireland) heading. Air Quality Data from representative air monitoring stations in Zone D is therefore considered representative of air quality at the proposed Project. The EPA publishes Ambient Air Quality Reports every year which details the air quality in each of the four zones. The most recent report, published by the EPA is the *Air Quality Monitoring Annual Report 2015*, (EPA 2016), which presents monitoring data collected during 2015. Best practice requires that an average of at least three years of recent monitoring data is used for assessments of this type so data for 2013 – 2015 has been reviewed from the *EPA Ireland Archive of Nitrogen Oxides Monitoring Data datasets* available from Environmental Research Data managed by EPA.

Data from the Air Quality Monitoring Annual Report 2013 (EPA 2014), the Air Quality Monitoring Annual Report 2014 (EPA 2015) and the Air Quality Monitoring Annual Report 2015 (EPA 2016) produced by the EPA were reviewed and a summary of the data for representative stations for the three most recent years is presented for each parameter of interest in Table 7.15. The approach taken is to take the average of the three most recent years (2013 – 2015) for Zone D wherever data is available. Where no data exists for Zone D, data for Zone C is provided.

It is noted from the data that existing ambient air quality in Ireland is good for all health-related pollutants. The short-term data acquired during the baseline surveys undertaken at the proposed Project in 2016 and 2017 is consistent with the longer term data reported in summary in Table 7.15.

Table 7.15: Background Air Quality Data for Zone D

Pollutant	Averaging Interval	2013	2014	2015	Average (2013 – 2015)
Nitrogen dioxide, NO_2	Annual Mean, µg/m^3	4	3	2	3
Nitrogen oxides, NO_x	Annual Mean, µg/m^3	5	3	2	3
Sulfur dioxide, SO_2	Annual Mean, µg/m^3	3	2	2	2
Particulate Matter PM_{10}	Annual Mean, µg/m^3	11	9	10	10
Particulate Matter $PM_{2.5}$	Annual Mean, µg/m^3	8	5	6	6
Carbon Monoxide	Annual Mean, µg/m^3	300	400	500	400
Benzene	Annual Mean, µg/m^3	0.5	0.09	0.13	0.24
Toluene	Annual Mean, µg/m^3	Not measured	Not measured	0.15	0.15
Ethylbenzene	Annual Mean, µg/m^3	Not measured	Not measured	< 0.01	< 0.01
Xylenes	Annual Mean, µg/m^3	Not measured	Not measured	0.03	0.03

7.4 Predicted Impacts

7.4.1 Remediation Phase Air Quality Impacts

Impact Identification

The potential air quality impacts during the Remediation Phase are summarised in this Section of the report.

a) Dust emissions associated with re-profiling and demolition works

One of the most significant potential air quality impacts associated with the Remediation Phase of the proposed Project is dust. Dust can be generated as a result of disturbance of materials, as a result of wind blowing across exposed surfaces and as a result of construction vehicle movements across exposed surfaces.

There are three potential impacts on air quality of the dust / particulate matter emissions:

- Dust deposition on surfaces is the main potential impact associated with the larger particles;
- Nuisance effects such as reduced visibility could be associated with excessively high levels of suspended particulate matter, and
- Respiratory effects could occur as a result of excessive levels of fine particles such as PM_{10} and $PM_{2.5}$.

Dust emissions associated with the Remediation Phase of the proposed development are anticipated to be predominantly in the 10 – 75µm particle size range so these particles, because of their size, will generally be deposited within 100m of the emission source. Only under exceptional meteorological conditions would the dusts be carried further downwind. The majority of the dust associated with construction activity is in the 10 – 75µm particle size range.

Suspended particulate matter (SPM) may also be released and this matter may remain suspended in the air. The main effect would be on visibility but this type of material could also be a respiratory nuisance if present at excessive levels. Emissions of dust in the form of fine particulate matter, PM_{10} and $PM_{2.5}$, may

also occur, primarily as a result of materials handling and storage since the dominant particle size is in the lower size ranges. There may also be some emissions of particles in these size ranges from the general site activities including the demolition of on-site concrete structures, re-profiling works, the installation of the engineered capping system and landfill management infrastructure and the installation of park infrastructure such as paths and pitches.

b) *Aspergillus* emissions from re-profiling and earthmoving activity

There is concern about a fungal disease, "invasive Aspergillosis" which may be contracted as result of disturbance of materials that release fungal spores into the atmosphere. Fungal spores (the *Aspergillus* moulds) are found everywhere but are of particular concern when large scale demolition, excavation and earth-moving activity take place. There is some concern about such emissions from large construction projects and this will be particularly important due to the re-profiling of waste during the proposed Project.

c) Landfill gases and Volatile Organic Compounds (VOCs)

Landfill gases and VOCs arise as a result of diffuse emissions from the landfill surface. These emissions are well controlled at present but when the re-profiling of waste during the Remediation Phase commences some diffuse emissions are expected.

d) Odour emissions associated with re-profiling and earth moving activity

A significant potential impact is odour which is anticipated to arise as a result of the proposed works. In particular works involving the re-profiling of waste and any re-profiling into the waste body are anticipated to result in odour emissions.

e) Remediation Phase transport emissions

Emissions of dust raised by vehicle movement on the roads near the proposed Project and also on-site has already been examined as part of the dust and particulate matter impacts. Emissions from the construction vehicles as a result of fuel combustion are considered here. The emissions include PM_{10} and $PM_{2.5}$, NO_2 and NO_x and CO and benzene.

Dust and Particulate Matter Impacts

The Remediation Phase will involve eight different Phases of significant construction works during which the site will be remediated and the final landforms will be constructed to facilitate the development of the multi-use public park. Some of the works will require the use of heavy earth-moving machinery and equipment that will be used for re-profiling, importation of materials to the proposed Project and construction and installation of landfill management infrastructure and the multi-use public park infrastructure.

The risk of dust being emitted in sufficient quantities to cause a nuisance or health impacts is evaluated by considering the scale of the works programme. The Institute of Air Quality Management Guidance Note gives advice on classifying the magnitude of the potential dust impacts and using the advice and information derived from the outline remediation phasing, as described in Section 4.3.1, for the proposed Project, the magnitude of the dust emissions has been estimated as shown in Table 7.16. The list of activities is representative of the types of activity that will occur and includes the main activities planned for the Remediation Phase. Chapter 4 Description of the Proposed Project presents a description of the works involved in each phase of works, and a summary of the principal activities is given in Table 7.1.

The potential air quality impact arises from emissions of particulate matter and may result in deposition of dust around the proposed Project, and being tracked-out onto the roads in the vicinity of the proposed Project. The overall magnitude of the potential emissions associated with the Remediation Phase is assessed as medium using these criteria.

The significance of the dust emissions and impacts is evaluated in terms of the sensitivity of the receptors in the area that could be affected by the emissions. In general, receptors located close to the site boundary are considered to have a high sensitivity with sensitivity decreasing with increasing distance from the source reflecting the exponential decrease in dust levels as distance increases. The receptor sensitivity in the

immediate vicinity of the proposed Project is High because of the proximity of a significant number of residential receptors. A summary of the assessment of sensitivity for each activity is presented in Table 7.16.

Table 7.16: Assessment of Magnitude of Dust Emission and Receptor Sensitivity for Remediation Phase for Closest Receptors

Activity	Magnitude of Dust Emission	Sensitivity of receptors and surrounding areas		
		Dust soiling	Human Health	Ecological
Minor works e.g. plant movement	Low	Low	High	Low
Demolition	Medium	Medium	High	Low
Crushing and screening of demolition arisings	Low	Low	High	Low
Demolition material stockpiling	Low	Low	Low	Low
Soil Stripping	Low	High	High	Low
Temporary surface water management measures	Low	Low	Low	Low
Clean stockpile use	Low	Low	Low	Low
Fill import / stockpiling	Low	Low	Medium	Low
Leachate Infrastructure installation & commissioning	Low	High	High	Low
Gas infrastructure installation & commissioning	Low	High	High	Low
Waste filling	Low	Medium	Medium	Low
Slope Remediation and Capping	Medium	High	High	Low
Temporary stockpiling of Zone 4 wastes	Low	Medium	Medium	Low
Final re-profiling / capping (backfilling of ponds)	Medium	Medium	Medium	Low
Construction of Surface Water Management Pond	Low	Low	Low	Low
Removal of SW screening bund	Medium	Medium	Medium	Low
Final re-profiling / capping	Medium	Medium	Medium	Low
Cleaning of ponds & commissioning.	Low	Low	Low	Low
Construction Traffic	Low	Low	Low	Low

Using the alternative assessment approach outlined in the EPA Guidelines on the Information to be Contained in Environmental Impact Statements (EPA, 2002) (and revised and draft guidelines 2015/2017) as outlined in Section 7.2, the significance of potential dust emissions during the Remediation Phase is summarised in Table 7.17.

Table 7.17: Assessment of Significance of Dust Emissions for Remediation Phase

Activity	Magnitude & significance of Dust Emissions at site boundary	Duration of Dust Emission
Minor works e.g. plant movement	Imperceptible	Momentary
Demolition	Not significant	Brief
Crushing and screening of demolition arisings	Not significant	Brief
Demolition material stockpiling	Not significant	Brief
Soil Stripping	Moderate	Short term
Temporary surface water management measures	Not significant	Short term
Clean stockpile use	Slight	Brief
Fill import / stockpiling	Moderate	Short term
Leachate Infrastructure installation & commissioning	Slight	Temporary
Gas infrastructure installation & commissioning	Slight	Temporary
Waste filling	Moderate	Temporary
Slope Remediation and Capping	Moderate	Temporary
Temporary stockpiling of Zone 4 wastes	Moderate	Brief
Final re-profiling / capping (backfilling of ponds)	Slight	Temporary
Construction of Surface Water Management Pond	Slight	Temporary
Removal of SW screening bund	Significant	Temporary
Final re-profiling / capping	Significant	Short-term
Cleaning of ponds & commissioning.	Slight	Temporary
Construction Traffic	Slight	Short-term

This assessment shows that the most significant potential impacts are those associated with the site re-profiling. The assessment also shows that the potential dust emissions associated with the removal of the screening bund in Zone 1 is significant, but temporary. There is predicted to be a temporary slight adverse impact on the closest receptors during the Remediation Phase with potential short-term impacts from traffic on the surrounding roads within about 50m of the proposed Project. There will be no lasting impact and the short-term impacts will be managed by means of an effective Dust Management Plan incorporating the mitigation measures outlined in Section 7.5. The Construction Environmental Management Plan (CEMP) developed by the appointed contractor will include a specific Dust Management Plan which will ensure that dust impacts are prevented or minimised during the Remediation Phase of the proposed Project.

Using the alternative assessment approach outlined in the EPA Guidelines on the Information to be Contained in Environmental Impact Statements (EPA, 2002) (and revised and draft guidelines 2015/2017) as outlined in Section 7.2, the significance of potential dust emissions during the Remediation Phase is summarised in Table 7.18. This table presents an assessment of significance of dust emissions for the indicative phases of remediation. The assessment of significance of potential dust emissions for the complete Remediation Phase is Moderate and the duration is short-term (i.e. lasting from one to seven years).

Table 7.18: Assessment of Significance of Dust Emissions for Indicative Phases of Remediation

Remediation Phase	Magnitude & Significance of Dust Emission at Site Boundary	Duration of Dust Emission
Phase 1	Moderate	Temporary
Phase 2	Moderate	Temporary
Phase 3	Moderate	Temporary
Phase 4	Moderate	Temporary
Phase 5	Moderate	Temporary
Phase 6	Moderate	Temporary
Phase 7	Moderate	Temporary
Phase 8	Moderate	Temporary

Aspergillosis and Fungal Spore Impacts

As noted above, there is concern about a fungal disease, "invasive Aspergillosis" which may be contracted as a result of disturbance of materials that release fungal spores into the atmosphere. This is a disease which is detrimental to persons with suppressed immune systems, such as hospital patients. The "*National Guidelines for the prevention of Nosocomial Invasive Aspergillosis during construction/renovation activities*" (developed by a sub-committee of the Scientific Advisory Committee of the National Disease Surveillance Centre, 2002) deals specifically with construction works occurring within or adjacent to hospitals. The report states that the fungal spores responsible for invasive Aspergillosis can originate from a number of sources such as construction, demolition, renovation, disturbance of soil, removal of fibrous insulation material, removal of suspended ceiling tiles and from poorly maintained air ventilation systems. The potential sources of the fungal spores associated with invasive Aspergillosis, as detailed above, are related to the occurrence of these operations either within or in very close proximity to hospital buildings.

Fungal spores (the *Aspergillus* moulds) are found everywhere but are of particular concern when large scale demolition, excavation and earth-moving activity takes place and especially in close proximity to areas where vulnerable individuals are located. The dispersion of spores (or indeed dust or any other substance) which are released at a particular location depends on a significant number of factors which include:

- rate and temperature of the release;
- release height;
- wind speed;
- rainfall;
- wind direction;
- topography;
- local meteorological conditions;
- nature of the substances released;
- potential for physical or chemical interactions; and
- concentrations of the substances released.

The dispersion of fungal spores will depend on all of the above factors and this dispersion is evaluated by considering the factors noted above and the distances from the source at which the predicted impacts are to be assessed. In the first instance, the key factors are the concentration of the spores released and the distance to sensitive receptors. Dispersion of fungal spores released as a result of any activity is a function of time and distance and spores would be completely dispersed i.e. no measurable concentration at c. 250m from the source of the release.

The National Guidelines report referred to above notes that the fundamental requirement in respect of eliminating *Aspergillus* infection from construction works is first to minimise the dust generated during construction. All Remediation Phase works will be carried out in a way that minimises dust generation and will be carried out in conformance with the National Guidelines referenced here.

The most sensitive receptor in the immediate vicinity of the proposed Project is Kerdiffstown House (REC001, refer to Figure 7.1) since it is located predominantly downwind of the landfill. Although this receptor is located within 250m of the site boundary, conformance with the best practice guidelines and in particular the phasing of works to be undertaken at the proposed Project will ensure that no significant adverse impacts occur as a result of the proposed Project. Larchfield Nursing Home (REC0038, refer to Figure 3.4) is located far enough from the boundary of the proposed Project (> 250m) to ensure that no adverse impacts will be observed.

Landfill Gas Flare Impact Assessment Inputs

Current management controls for landfill gas (and odours) at the site consists of two gas flares (one of which is currently operational) with gas extracted at a rate of approximately 150m^3/hr from Zones 1 and 3. Landfill gas is also managed by means of passive venting from areas where lower levels of gas production and less odorous gases are present, and some uncontrolled emissions are released from uncapped areas of the landfill. The 250m^3 flare, and the standby 500m^3 flare, will continue to be operated throughout the Remediation Phase of the proposed Project until a new 600m^3 flare, and a standby flare, are installed the new Landfill Infrastructure Compound. Only one flare operates at a time, and the impact of the emissions from the flare on air quality is assessed by carrying out a dispersion modelling assessment. Information on a number of input variables required for the dispersion model is described here. A representative location for the flare was chosen for the modelling exercise but the flare may be moved during the Remediation Phase to optimise the location. Although the flare may move during the remediation Phase, the modelled location is representative of the potential future flare locations and the selected location is suitable for the assessment. Any future movement of the flare would be to topographically suitable locations and does not affect the robustness of the assessment approach.

(i) Emissions characteristics

The principal assumption is that the flare runs continuously and that the emissions are at the maximum level at all times. In practice this will not occur as the emissions will decrease over time. A summary of the emission data is presented in Table 7.19. This data was derived from consideration of the most recently available monitoring data for the existing 250m^3 flare which was acquired in 2016. The Air Scientific *"Air Emissions Compliance Monitoring Emissions Report"* (Air Scientific 2016) is attached in Appendix A7.6. Data for PM_{10} was not recorded so a conservative assumption that the concentration of PM_{10} in the flare emissions is 10mg/m^3 was made based on data from similar facilities; this is likely to overestimate the PM_{10} emissions.

Hydrogen sulfide was not measured in the flare emissions during the monitoring event. It is however known that some of the sulfur present in landfill gas is released from the flare as hydrogen sulfide, with Literature estimates suggesting that at least 0.1% of the sulfur present could be emitted as hydrogen sulfide. For this assessment it is assumed that 1% of the sulfur present is emitted as hydrogen sulfide. The sensitivity of the assessment to this assumption is discussed in the sensitivity analysis presented below.

In this assessment, the assumption made is that all of the nitrogen oxides are present as NOx in line with current guidance on the use of dispersion modelling for air quality impact assessment. While this may overestimate the 1-hour ground level concentration (GLC), the conservative approach does not affect the outcome of the assessment.

Table 7.19: Input Data for AERMOD Dispersion Model: KLRP 250m^3 Flare

Parameter	Existing 250 Flare*
Stack height, m**	8
Flow rate, m^3/sec (based on extracted volume of 250m^3/hour)	0.0694
Temperature, K	1288
SO_2, g/sec	0.041198
CO, g/sec	0.000922
Particulates as PM_{10}, g/sec	0.000417
Particulates as $PM_{2.5}$, g/sec	0.000417
Nitrogen dioxide, NO_2, g/sec	0.000839
Hydrogen sulfide, H_2S, g/sec	0.000412

Notes
*Emission rates are derived from the most recent environmental monitoring at the existing flare on site, taking measurement uncertainty into account
**Stack height refers to height in metres above ground level

(ii) Site layout and topography

Site layout and topographical information was obtained from an aerial site survey carried out in February 2016 and from maps, orthographic photographs and digital Ordnance Survey data.

(iii) Averaging intervals

Averaging intervals were chosen to allow direct comparison of predicted ground level concentrations with the relevant assessment criteria as outlined in Section 7.2.5.

(iv) Receptor locations

Since the impact of the emissions can be observed at considerable distances from the emission sources, a fine grid, 2km x 2km centred on the main emission sources was constructed with receptors located at 50m intervals; a second grid of 6km x 6km with receptors at 50m intervals was also constructed. In addition to the receptor grids, a number of receptors were selected at sensitive locations in the area represented by the closest residential receptors. A summary of the representative receptors for which data was acquired is given in Table 7.20 and their locations are presented in Figure 7.1.

Table 7.20: Sensitive Receptor Locations for Dispersion Modelling Assessment

Receptor	Grid Co-ordinates
REC001	657954, 5902286
REC016	657891, 5901835
REC012	657935, 5901566
REC007	658228, 5901318
REC039	658273, 5901433

(v) Meteorological data

As noted in Section 7.3.1, meteorological conditions at the proposed Project are best described by data from the nearby Casement Aerodrome. For this assessment three years of meteorological data from 2013 to 2015 for Casement Aerodrome have been used.

(vi) Baseline air quality

Baseline air quality has been described in Section 7.3.3 from the very comprehensive database of information available for the site as well as longer term data acquired for similar locations in Ireland.

Landfill Gas Flare Air Quality Impact Assessment Predictions

The impact assessment involves execution of modelling runs to represent different potential scenarios associated with the emissions. The following Scenarios were considered in the modelling runs.

(i) **Meteorological data** – Model runs were executed to consider the effect of meteorological data set selection on the impact predictions;

(ii) **Pollutant concentrations** – Model runs were executed to evaluate the effect of varying pollutant emission rates on the impact predictions.

(iii) Model runs were conducted as part of a **sensitivity analysis** to investigate the effect of a number of variables in the input data and operating conditions on the modelling predictions.

The impact assessment predictions for PM_{10} and $PM_{2.5}$, CO, SO_2, NO_2, and NO_x are presented in this Section. In each case, the worst-case meteorological data set predictions are quoted. The results demonstrate that for those pollutants and emission scenarios studied, the Air Quality Standards are not breached as a result of the emissions under normal operating conditions as modelled in this report. The individual results for each

parameter of interest are discussed here, and the complete data set for the modelling predictions is presented in Appendix A7.9.

The background ambient air quality is considered in Section 7.3 of this report. In accordance with the guidance presented in the EPA Guidance AG4*, Air Dispersion Modelling from Industrial Installations Guidance Note (AG4), 2010,* the background concentrations are treated as follows:

- For the assessment of 24-hour and annual mean concentrations, the predicted contribution from the site is added to the average annual background concentration.
- For the assessment of 1-hour mean concentrations, the predicted contribution from the site is added to twice the average annual background concentration.

Particulate Matter / PM_{10} and $PM_{2.5}$

Particulate emissions from the landfill gas flare are very low and contribute primarily to airborne particulate concentrations due to the anticipated particle size. Since this consists primarily of PM_{10}, the impact assessment is based primarily on the assessment criteria for this parameter. The predicted ground level concentrations as a result of the emissions from the proposed Project combined with the background concentrations are as shown in Table 7.21 alongside the relevant Air Quality Standards.

Table 7.21: Predicted Remediation Phase Ground Level Concentration of PM_{10} Resulting from the Existing 250m³/hr Flare Emissions

Air Quality Standard		Background concentration, µg/m³	Predicted incremental contribution, µg/m³	Predicted GLC including background, µg/m³
24-hour limit not to be exceeded more than 35 times/year (90.4 percentile)	50 µg/m³	10	0.35	10.4
Annual limit	40 µg/m³	10	0.12	10.1

Note
The worst case meteorological year for the 90.4 percentile of the 24-hour average is 2013 and the worst case meteorological year for the annual average is 2014.

The data demonstrates that the emissions from the operation of the existing landfill gas flare during the Remediation Phase will not cause the air quality standards to be exceeded.

An isopleth showing the predicted 90.4 percentile of 24-hour ground level concentration of PM_{10} as a result of the emissions from the existing 250m³ flare during the Remediation Phase is presented in Figure 7.3. An isopleth is a line on a map connecting points having equal values, in this case showing the concentration of PM_{10}.

Data for $PM_{2.5}$ is presented in Table 7.22 using the very conservative assumption that all of the particulates are present as $PM_{2.5}$. This conservative approach will overestimate the significance of the $PM_{2.5}$ emissions. Even so, the data presented in Table 7.22 demonstrates that the emissions will not cause the air quality standards to be exceeded.

Table 7.22: Predicted Remediation Phase Ground Level Concentration of $PM_{2.5}$ Resulting from the Existing 250m³/hr Flare Emissions

Air Quality Standard Note		Background concentration, µg/m³	Predicted incremental contribution, µg/m³	Predicted GLC including background, µg/m³
Annual limit	25 µg/m³	6	0.12	6.1

Note
A limit of 20 µg/m³ will apply from 2020 and this limit is also complied with.
The worst case meteorological year is 2014.

An isopleth showing the predicted mean ground level concentration of PM_{10} as a result of the emissions from the existing 250m³ flare during the Remediation Phase are presented Figure 7.4 for PM_{10}. An isopleth showing the predicted annual mean ground level concentration of $PM_{2.5}$ as a result of the emissions from the existing 250m³ flare during the Remediation Phase is presented in Figure 7.5.

Carbon monoxide, CO

The modelling results for CO are presented in Table 7.23. In accordance with Guidance, for the assessment of the 8-hour mean concentrations, the predicted contribution from the site is added to two times the average annual background concentration.

Table 7.23: Predicted Remediation Phase Ground Level Concentration of CO Resulting from the Existing 250m³/hr Flare Emissions

Air Quality Standard		Background concentration, µg/m³	Predicted incremental contribution, µg/m³	Predicted GLC including background, µg/m³
8-hour rolling average	10,000 µg/m³	800	<1	800

Note
The worst case meteorological year is 2014.

The data presented in Table 7.23 demonstrates that the emissions from the flare do not cause the air quality standards to be exceeded. The isopleth was not plotted as the predicted concentrations are below the threshold that allows for plotting.

Sulfur dioxide, SO_2

The modelling results for SO_2 are presented in Table 7.24 for the maximum potential emission rates from the existing flare.

Table 7.24: Predicted Remediation Phase Ground Level Concentration of SO_2 Resulting from the Existing 250m³/hr Flare Emissions

Air Quality Standard		Background concentration, µg/m³	Predicted incremental contribution, µg/m³	Predicted GLC including background, µg/m³
Hourly limit - not to be exceeded more than 24 times/year (99.7 percentile)	350 µg/m³	4	129	133
Daily limit - not to be exceeded more than 3 times/year (99.2 percentile)	125 µg/m³	2	55	57
Annual and winter limit for protection of human health and ecosystems	20 µg/m³	2	7	9

Note
The worst case meteorological year is 2014.

The data presented demonstrate that the emissions from the flare do not cause the air quality standards to be exceeded. An isopleth showing the predicted 99.7 percentile of 1-hour ground level concentrations of SO_2 as a result of the emissions from the existing 250m³ flare during the Remediation Phase are presented in Figure 7.6. An isopleth showing the predicted 99.2 percentile of 24-hour ground level concentrations of SO_2 as a result of the emissions from the existing 250m³ flare during the Remediation Phase are presented in Figure 7.7. An isopleth showing the predicted annual mean ground level concentrations of SO_2 as a result of the emissions from the existing 250m³ flare during the Remediation Phase are presented in Figure 7.8.

The predicted annual mean ground level concentration approaches but does not exceed the limit for the protection of human health and ecosystems. There is some uncertainty about the concentration of SO_2 that may be present in the flare emissions and this is discussed in the sensitivity analysis at the end of this Section of the EIAR.

Nitrogen dioxide, NO_2, and nitrogen oxides, NO_x

The modelling results for nitrogen dioxide and nitrogen oxides are presented in Table 7.25 and Table 7.26.

Table 7.25: Predicted Remediation Phase Ground Level Concentration of NO_2 Resulting from the Existing 250m³/hr Flare Emissions

Air Quality Standard		Background concentration, µg/m³	Predicted incremental contribution, µg/m³	Predicted GLC including background, µg/m³
Hourly limit - not to be exceeded more than 18 times/year (99.8 percentile)	200 µg/m³	6	2.8	8.8
Annual limit for protection of human health	40 µg/m³	3	0.35	3.4

Note
The worst case meteorological year for the 99.8 percentile of 1-hour average is 2013 and the worst case meteorological year for the annual average is 2014.

Table 7.26: Predicted Remediation Phase Ground Level Concentration of NO_x Resulting from the Existing 250m³/hr Flare Emissions

Air Quality Standard		Background concentration, µg/m³	Predicted incremental contribution, µg/m³	Predicted GLC including background, µg/m³
Annual limit for protection of vegetation	30 µg/m³	3	0.35	3.4

Note
The worst case meteorological year is 2014.

The data presented in Table 7.25 and Table 7.26 demonstrates that the emissions from the flare do not cause the air quality standards to be exceeded. It is also noted that a conservative modelling approach was adopted with assumptions that all of the nitrogen oxides are present as NO_2 so the assessment is based on a worst-case impact assessment scenario.

An isopleth showing the predicted 99.8 percentile of 1-hour ground level concentrations of NO_2 as a result of the emissions from the existing 250m³ flare during the Remediation Phase is presented in Figure 7.9 and an isopleth showing the predicted annual mean ground level concentrations of NO_2 as a result of the emissions from the existing 250m³ flare during the Remediation Phase is presented in Figure 7.10.

An isopleth showing the predicted annual mean ground level concentration of NOx as a result of emissions from the existing 250m³ flare during the Remediation Phase is presented in Figure 7.11.

Odour

Odour is of particular significance in this assessment and is considered separately in this Section of the report. The other modelling predictions have focused on the comparison of impact predictions with Air Quality Standards which are designed for the protection of human health and ecosystems. A further issue to be considered is the potential for odour nuisance as a result of the emissions from the landfill gas flare. This potential is considered by examining the 1-hour ground level concentration of sulfur dioxide (SO_2) and hydrogen sulfide (H_2S) as a result of the emissions from the flare. These substances are chosen because of their significance in terms of potential odour impact. Other sulfur containing substances are not present at significant concentrations in the flare emissions due to the high combustion temperature so the assessment focuses on the predicted ground level concentration of SO_2 and H_2S which are the principal sulfur-containing species that may be present in flare emissions.

The 98 percentile of 1-hour ground level concentration of hydrogen sulfide and sulfur dioxide was also modelled and is shown in Table 7.27. An isopleth showing the predicted 98 Percentile of 1-hour ground level concentration of SO_2 as a result of emissions from the existing 250m³ flare during the Remediation Phase is presented in Figure 7.12.

Table 7.27: Predicted Remediation Phase Ground Level Concentration of SO_2 and H_2S Resulting from the Existing 250m³/hr Flare Emissions

Air Quality Indicator	Odour Threshold Note, µg/m³	Predicted GLC, µg/m³
SO_2 98 percentile of 1-hour ground level concentration	1,200	58.6
H_2S 98 percentile of 1-hour ground level concentration	0.7	0.59

Note
The Odour threshold is the benchmark against which the impact is assessed

The 98 percentile is the maximum concentration level for 98 percent of the time, or 8,584 hours in a year; so this level is reached or exceeded for just 2 percent of the time or for 176 hours per year. The data is evaluated

by comparing the 98 percentile of the 1-hour GLC to the odour threshold for SO_2 which is 1,200 µg/m³ and 0.7 µg/m³ for H_2S (*Odor Threshold Determinations of 53 Odorant Chemicals, Journal of the Air Pollution Control Association, 19:2, 91-95, 1969*). The assessment has shown that odour attributable to the emissions from the landfill gas flare is not detectable for the scenarios modelled. An isopleth showing the predicted 98 percentile of 1-hour ground level concentration of SO_2 as a result of emissions from the existing 250m³ flare during the Remediation Phase and an isopleth showing the predicted 98 percentile of 1-hour ground level concentration of H_2S as a result of emissions from the existing 250m³ flare during the Remediation Phase are presented in Figure 7.12 and Figure 7.13 respectively, and an extract of these figures is provided in Diagram 7.4 and Diagram 7.5 below.

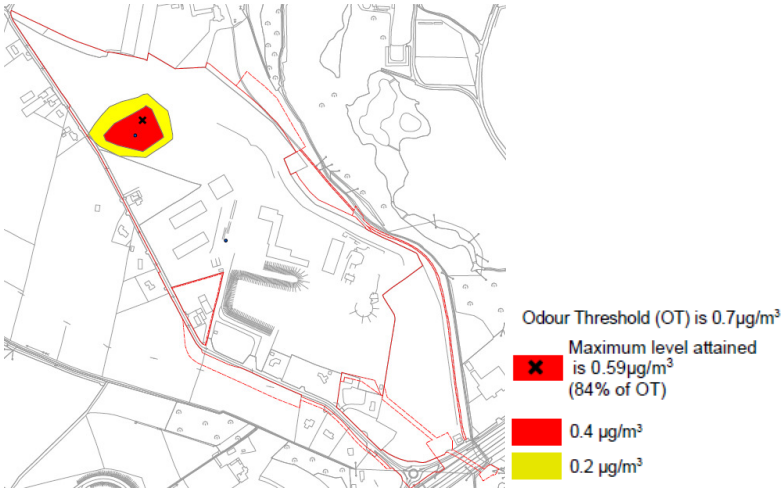

Diagram 7.4: Isopleth showing the predicted 98 percentile of 1-hour ground level concentration of SO_2 as a result of emissions from the existing 250m³ flare during the Remediation Phase

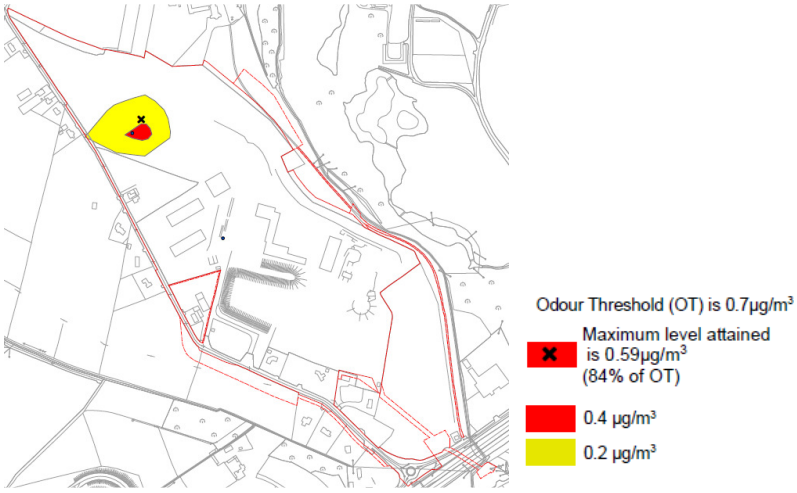

Diagram 7.5: Isopleth showing the predicted 98 percentile of 1-hour ground level concentration of H_2S as a result of emissions from the existing 250m³ flare during the Remediation Phase

Odour Impacts

The Remediation Phase will involve a number of different phases of works during which the proposed Project will be remediated with the final landforms suitable for the proposed end-use. The Remediation Phase will extend to approximately four years of intensive works with each of the eight Phases lasting approximately 6 months. The duration of impact at any given receptor will depend on the rate of progress of the works. The faster the rate of progress, the shorter the duration of impact that may be experienced at any receptor in the vicinity of the works. Some of the works will involve disturbance and re-profiling of waste in order to achieve the final landforms of the proposed Project. This is a significant potential impact the magnitude of which will vary depending on the activity and the area in which the works are being undertaken. It is therefore appropriate to consider the individual areas of the site and the specific activities which could lead to the generation of odours.

As outlined in Chapter 4 Description of the Proposed Project, the site is sub-divided into a number of discrete areas characterised mainly by the types and arrangement of deposited material in each area:

- Zone 1 is the largest zone, it is unlined and uncapped, with active landfill gas management. A significant proportion of the waste comprises Municipal Solid Wastes (MSW) and is therefore anticipated to be odorous. Zone 1A to the north-west extents of the site does not contain MSW and hence is unlikely to generate odour;
- Zone 2A and Zone 2B will be used as temporary stockpile areas for imported fill materials (Zone 2A contains more MSW than Zone 2B). MSW may be odorous, but the extensive hardstanding areas effectively prevent the escape of odours;
- Zone 3 comprises a lined cell with active landfill gas management and a temporary cap which currently prevents significant losses of odour;
- Zone 4 contains predominantly inert wastes and extensive covering with concrete hardstanding. Wastes in this area are anticipated to be non-odorous.

The remediation of the site in this proposed Project will involve re-profiling of materials in each zone but primarily in Zone 1, completion of the lined cell in Zone 3 with a permanent engineered capping system and the installation of new landfill infrastructure to manage the leachate and landfill gas generated at the site.

The risk of odours being released during the works is evaluated by considering the type of works being undertaken and the types and pattern of material deposition in each Zone. The Institute of Air Quality Management *"Guidance on the assessment of odour for planning"* (Institute of Air Quality Management 2014) was followed for the assessment of odours in this study together with information derived from the Outline Remediation Phasing Plans for the proposed Project. The outline description of the works is representative of the types of activity that will occur and includes the main activities planned for the Remediation Phase and is provided in Section 4.3.1 and in Figure 4.8 and Figure 4.9.

The significance of the odour emissions and impacts was evaluated in terms of the sensitivity of the receptors in the area that could be affected by the emissions. In general, receptors located close to the site boundary are considered high sensitivity with sensitivity decreasing with increasing distance from the source reflecting the dilution of any odour as distance increases. The overall receptor sensitivity in the immediate vicinity of the proposed Project is High. A summary of the assessment of sensitivity for each activity in each Zone is presented in Table 7.28.

Using the alternative assessment approach outlined in the EPA Guidelines on the Information to be Contained in Environmental Impact Statements (EPA, 2002) (and revised and draft guidelines 2015/2017) as outlined in Section 7.2, the significance of potential odour emissions during the Remediation Phase is summarised in Table 7.29.

Table 7.28: Assessment of Magnitude & Significance of Odour Emissions for Remediation Phase

Activity and Zone	Magnitude of Odour Impact at Site Boundary	Significance of Odour Impact
Site Entrance Area, Infrastructure & Off-site Works		
Site boundary fence, entrance & site compound	Negligible	Not significant
Permanent leachate infrastructure installation & commissioning	Negligible	Not significant
Leachate discharge pipeline construction	Negligible	Not significant
Permanent gas infrastructure installation & commissioning	Moderate Adverse	Significant
Construction of surface water discharge to the Morell River	Negligible	Not significant
Temporary surface water management measures (progressive)	Negligible	Not significant
Clean stockpile use	Negligible	Not significant
Zone 1		
Waste filling (surplus materials from other zones)	Slight Adverse	Not significant
Capping of NW zone	Negligible	Not significant
Construction of surface water management pond	Negligible	Not significant
NE slope boundary drainage	Negligible	Not significant
Remediation of NE slopes including capping	Moderate Adverse	Significant
Removal of existing flare stack	Slight Adverse	Not significant
Remediation / capping of remaining outer slopes	Moderate Adverse	Significant
Removal of SW screening bund	Negligible	Not significant
Final remediation / capping of central area.	Moderate Adverse	Significant
Gas wells installed	Moderate Adverse	Significant
Construction of soakaway	Negligible	Not significant
Cleaning of ponds & commissioning	Negligible	Not significant
Zone 2A (Import area)		
Demolition of concrete structures	Negligible	Not significant
Fill import / stockpiling	Negligible	Not significant
Stockpiled material use (incl. existing clean stockpile)	Negligible	Not significant
Re-profiling & capping	Slight adverse	Not significant
Vent trenches / gas management measures	Slight Adverse	Not significant
Zone 2B (Processing area)		
Demolition of structures	Negligible	Not significant
Crushing and screening of materials	Negligible	Not significant
Demolition material stockpiling	Negligible	Not significant
Temporary stockpiling of Zone 4 materials	Negligible	Not significant
Re-profiling & capping	Negligible	Not significant
Vent trenches / gas management measures	Slight Adverse	Not significant
Zone 3		
Toe bund construction	Slight Adverse	Not significant
Waste filling	Moderate	Significant
Capping	Moderate	Significant
Installation of gas wells	Slight Adverse	Not significant
Zone 4		
Demolition of structures / retaining wall	Negligible	Not significant

Activity and Zone	Magnitude of Odour Impact at Site Boundary	Significance of Odour Impact
Slope remediation & materials screening	Negligible	Not significant
Construction of surface water management ponds (for Remediation Phase)	Negligible	Not significant
Final remediation / capping (backfilling of ponds)	Negligible	Not significant
Cleaning of ponds; installation of ecological enhancements to ponds	Negligible	Not significant
Construction Traffic	Negligible	Not significant

Table 7.29: Assessment of Significance of Odour Emissions for Indicative Phases of Remediation Phase

Remediation Phase	Odour exposure	Magnitude of impact	Significance
Phase 1	Small	Slight adverse	Not significant
Phase 2	Medium	Moderate adverse	Significant
Phase 3	Medium	Moderate adverse	Significant
Phase 4	Medium	Moderate adverse	Significant
Phase 5	Medium	Moderate adverse	Significant
Phase 6	Medium	Moderate adverse	Significant
Phase 7	Medium	Moderate adverse	Significant
Phase 8	Negligible	Negligible	Not significant

Using the Institute of Air Quality Management Guidance, the potential odour impact is considered significant for much of the work in Zone 1 where the most odorous wastes are deposited. The works will be carefully phased to manage the impact and in particular those activities with the greatest potential for odour generation will not be progressed simultaneously. Therefore, while the impact is considered significant, it will be significant at different receptor locations throughout this Phase of works for limited periods of time. Other zones do not contain such significant amounts of odorous wastes and the works are anticipated to progress without significant adverse impact.

The dominant wind direction is from the south-west quadrant and therefore the receptor which may experience the most significant impact is Kerdiffstown House (REC001 refer to Figure 7.1), located predominantly downwind of the works in Zone 1.

Sensitivity Analysis

The sensitivity of the modelling predictions to varying input data was tested to evaluate the robustness of the modelling assumptions. A discussion of the principal findings of this sensitivity analyses is presented here.

(i) Meteorological Data

Data from Casement Aerodrome was used as the primary data set in this assessment. Given the close proximity of the Airport to the proposed Project, it is considered that the data is a reliable indicator of meteorological conditions at the site. The robustness of the assessment was strengthened by using 3 years of recent data (2013 – 2015) for the assessment. Details are presented in this report of the worst-case year and the additional modelling results acquired for all of the other years of data is presented in Appendix A7.9. There was very little variation noted between the data sets used in the study but a conservative approach was adopted with the worst-case data set, as evidenced by the highest predictions, reported in this report.

A further sensitivity check was performed by running the Model using meteorological data from Dublin Airport. There was no significant difference between the predictions for the two alternative data sets, and the complete results of the analysis are summarised in Appendix A7.9.

(ii) Stack Height

Stack height is a particularly important variable in this assessment. The effect of varying stack height was investigated and the assessment showed that for the scenario modelled, the existing stack height is adequate to ensure effective dispersion of the emissions. Further details are included in Appendix A7.9.

(iii) Modelling Uncertainty

The inherent uncertainty in dispersion modelling is approximately 50 to 100%. As a general rule it is recommended that the predicted contribution to ground level concentrations from the activity shall not exceed approximately 67% of the air quality standard. This approach was considered in the assessments undertaken here and where appropriate higher stack heights were recommended to allow this criterion to be satisfied.

(iv) Sulfur Concentration in the Landfill Gas

Sulfur from landfill gas comes from organic sulfur (sulfides and mercaptans mainly) and hydrogen sulfide. When the gas is burned, the sulfur is emitted primarily as SO_2 but there is also some H_2S and organic sulfur emitted. How much of each depends on a lot of factors – the nature of the decomposing waste, the age of the waste, efficiency of the flare, etc. There is some uncertainty about the relative distribution of sulfur in different forms in the emissions from flares.

The available information on sulfur in the flare emission comes from measurements carried out at the site and from Literature. H_2S levels in the flare inlet have been measured since January 2017. The average concentration from weekly measurements is 1,350ppm (2,025 mg/m^3) and the range is 520 – 1,862 ppm (780 – 2,793 mg/m^3).

The Dispersion Model presented in this EIAR uses the flare emission data from 2016 to derive the sulfur content in the emissions. For H_2S as noted above, it was assumed (based on Literature estimates) that 1% of the total sulfur was present as H_2S. In order to test the sensitivity of the assessment to the sulfur input data, separate model runs were executed to evaluate the potential impact of the emissions from the flare if higher sulfur levels than those reported above are present in the extracted gas that is burned in the flare.

From the data presented in Table 7.27 for the impact assessment predictions for SO_2, it is clear that even doubling the emission rate of SO_2 in the emissions from the flare would not have a short term adverse impact on air quality in the area as evidenced by the predictions for the 99.7 percentile of 1-hour ground level concentration and the 99.2 percentile of 24-hour ground level concentration. For the annual mean however, the predicted ground level concentration as shown in Table 7.27 is approaching the air quality standard and any further increase in the sulfur dioxide concentration in the flare emissions would cause a breach of this air quality standard. Higher SO_2 levels are considered possible but unlikely during the Remediation Phase based on available information about gas quality throughout the Kerdiffstown Landfill. It is however prudent to consider what actions are required if sulfur levels in the flare inlet gas are higher than those modelled. Further modelling runs were therefore executed which show that a stack height increase to 11m for the existing 250m^3 flare would allow for effective dispersion of the emissions without breach of the air quality standard if the sulfur levels are 50% higher than those modelled for Table 7.27. The results of this additional sensitivity analysis are presented in Appendix A7.9.

A stack height increase is not immediately achievable for a retrofitting solution to an existing flare, so other options are also considered. In particular, using a chemically treated activated carbon filter on the inlet gas to the flare would reduce the sulfur levels by up to 90% and this would ensure that the predicted ground level concentrations are well within the air quality standards.

For the assessment of odour as a result of flare emissions, the 98 percentile 1-hour ground level concentration of SO_2 and H_2S was assessed as discussed in Table 7.27. Odour attributable to SO_2 emitted from the flare is not detectable even if the emissions are much higher. However, at a very low level of H_2S in the emissions as shown in Table 7.27, the 98 percentile reaches 85% of the odour threshold. Kildare County Council are monitoring the level of hydrogen sulfide in the landfill gas weekly and will continue to do so as part of the active management of landfill gas at the site throughout the Remediation Phase of the proposed Project. If higher sulfur, and H_2S, levels are detected in the landfill gas flare inlet during the Remediation Phase, then a suitable

abatement system, likely to be an activated carbon filter, will be fitted to reduce the levels of sulfur reaching the flare. This is considered an unlikely scenario but there is a management solution available to deal with this if it arises.

(v) Landfill Gas Flare Breakdown

There is a stand-by flare available for the Remediation Phase which the gas can be diverted to if the 250m^3 operating flare breaks down or is taken out of service for maintenance. There are therefore no adverse air quality impacts predicted due to the landfill gas flare breakdown.

The general findings of the sensitivity analyses are that where necessary, the gas treatment and dispersion arrangements can be optimised so that the effect of further variations on input data were insignificant. For all other elements investigated there was very little difference between the predictions using the different data sets.

Remediation Phase Transport Impacts

The principal substances that are emitted from the vehicles are fine particulate matter, nitrogen oxides and carbon monoxide. Dust and particulate matter impacts associated with the passage of vehicles on roads has already been assessed as part of the dust and particulate matter impacts. The level of traffic movements has been reviewed in the context of potential contributions to air quality in the area. Potential emissions from traffic using the L2005 Kerdiffstown Road and roads linking onto the M7 were taken into consideration in this assessment. Using the guidance from the National Roads Authority (NRA) *"Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes*, NRA 2011" it was concluded that the additional transport will not generate significant emissions in terms of local air quality and no measurable change in air quality relative to the existing situation is predicted. UK Government guidance "*Review and Assessment: Technical Guidance, LAQM TG (03)",* Department of Environment, Food and Rural Affairs, 2003 indicates that roads with less than 10,000 vehicles per day are unlikely to have a significant impact on air quality and do not require specific assessment. The only road with a traffic throughput of greater than 10,000 vehicles per day in the vicinity of the site is the M7 motorway.

7.4.2 Lifecycle Climate Impacts of the Proposed Project

A simplified boundary of the site and the emissions was drawn up for each of the scenarios assessed. Although there are some minor differences between the boundaries for each of the scenarios, the indicative boundary used is shown on Diagram 7.6 below. The red line boundary shows the assessment boundary, which includes reasonably anticipated on and off-site activities to the extent that they are currently known. The blue dotted line boundary shows the site boundary, which includes the materials in the landfill as well as materials stored on-site.

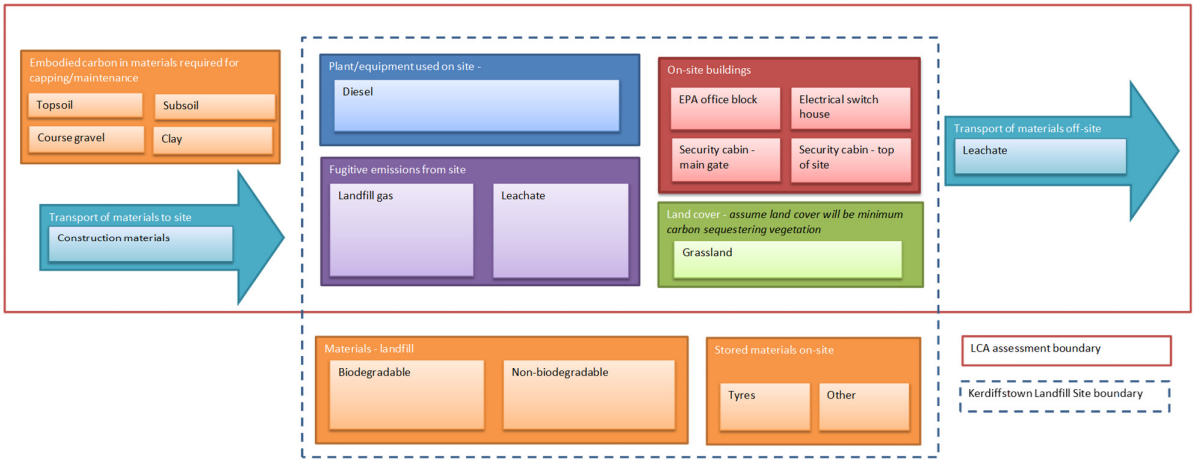

Diagram 7.6: Indicative Boundary for Lifecycle Greenhouse Gas Assessment (Source: Outline Life Cycle Assessment, SKM Enviros 2013, refer to Appendix A7.8)

The results of the LCA assessment for the two scenarios are shown in Table 7.30 below.

Table 7.30: Greenhouse Gas Emissions over the Proposed Project Lifetime

Activity	Total lifetime emissions, tonnes CO_{2e}	
	Scenario A: Do Nothing	Scenario B: Remediation
On-site buildings	1,055	728
On-site plant and equipment		2,428
Fugitive emissions	826,554	459,764
Capping materials		18,134
Transport of materials to / off site	2,994	1,729
Land cover		-12,858
Total	**830,603**	**469,915**

Scenario A (*Do Nothing*) has the highest overall net emissions and Scenario B, the proposed Project is the lowest at 43% less than that of Scenario A. The most significant source of emissions for both scenarios is from the methane in fugitive landfill gas. Since Scenario B involves capping the landfill, capturing landfill gas and flaring it, the fugitive emissions are lower than for Scenario A (uncapped with no significant flaring). Once landfill gas has been captured and flared, it is converted to CO_2 and is no longer within the boundary of the assessment as this CO_2 is considered to come from a biogenic short-cycle carbon source. However, capping the landfill comes at a cost of embodied carbon for materials and transport of those materials to site. The relative contribution of these activities is minor in the overall scheme which indicates that, based on current information, the best way to reduce the overall LCA emissions from the site would be to maximise the efficiency of the landfill gas capture and flaring, but aim to use the least amount of capping material possible to achieve this outcome. This has been considered in formulating the overall remediation strategy for the site.

It is noted that the 2013 Lifecycle Assessment (refer to Appendix A7.8) assessed a number of possible options for the landfill. Scenario B as reported in that assessment considered a version of the *in-situ* remediation which was slightly different from that proposed now. The 2013 assessment showed that the total emissions over the lifetime of Scenario B was 516,527 tonnes CO_{2e} which is 10% higher than the emissions estimate in Table 7.30 for the proposed Project.

7.4.3 Operational Phase Air Quality Impacts

Introduction

Following remediation, the site will continue to generate landfill gases which will be managed to minimise emissions of gases and odours. The design of the landfill gas management system has been described in Section 4.2.8 and the Landfill Gas Management Plan is presented in Appendix A4.5. The principal objective of the Landfill Gas Management Plan is to provide effective and efficient collection of gas to ensure that the landfill gas is appropriately controlled and managed throughout the life of the proposed Project.

Control measures have been developed to take account of the different potential of each zone for generating gas from the decomposing waste and their final end-use following remediation works. The landfill gas management system, as outlined on Figure 4.18 and described in Section 4.2.8 consists of a system of gas collection wells which are actively extracted with the gas being flared at high temperature in the landfill gas flare, as well as perimeter gas venting trenches in zones where low levels of gas generation occur. The system design considered the gas output from the GasSim Landfill gas model as outlined in Chapter 12 Soils, Geology, Contaminated Land and Groundwater. The model estimate is 550m^3/hour and a flare capacity of 600m^3/hour provides a slight over-estimation for risk assessment and specification of gas management infrastructure.

The potential air quality impacts associated with the Operational Phase of the proposed Project arise primarily as a result of the gas management system that will manage the landfill gas from the former landfill. The landfill gas will be managed by a system of passive vents and active management techniques. Passive venting techniques will be used in areas where the gas generation rate is low and allows use of this technique. Landfill gas will be extracted from the landfill areas where needed via a system of gas wells installed in Zone 1 and Zone 3 and will be burned in the flare that will be located in the Landfill Infrastructure Compound. It is proposed to remove the existing 250m^3 and standby 500m^3 flares. A new 600m^3/hr flare will be installed with a smaller 250m^3 back-up flare located in the Landfill Infrastructure Compound. Gas models which assess the gas potential from the site have demonstrated that approximately 600m^3/hr should be produced in 2017. Only one flare will operate at a time. The assessment of potential impacts is completed by carrying out a dispersion modelling assessment to predict the impact of the emissions from the 600m^3/hr flare on air quality and this Section of the report describes the study methodology and the findings of the assessment.

Dispersion Model Input Data for Landfill Gas Flare

Evaluation of the impact of the emissions on air quality using dispersion modelling requires information on a number of input variables which are described here.

(i) Emissions characteristics

The principal assumption is that the flare will run continuously and that the emissions are at the maximum level at all times. In practice this will not occur as the emissions will decrease over time. A summary of the emission data is presented in Table 7.31. This data was derived from consideration of the most recently available monitoring data for the existing flare which was acquired in 2016; the full measurement report is attached in Appendix A7.6. Data for PM_{10} was not recorded so a conservative assumption that the concentration of PM_{10} in the flare emissions is 10mg/m^3 was made based on data from similar facilities. This is likely to overestimate the PM_{10} emissions.

Hydrogen sulfide was not measured in the flare emissions during the monitoring event. It is however known that some of the sulfur present in landfill gas is released from the flare as hydrogen sulphide, with Literature estimates suggesting that at least 0.1% of the sulfur present could be emitted as hydrogen sulfide. For this assessment it is assumed that 1% of the sulfur present is emitted as hydrogen sulfide. The sensitivity of the assessment to this input parameter is discussed in the Sensitivity Analysis at the end of this Section of the EIAR.

In this assessment, the assumption made is that all of the nitrogen oxides are present as NO_x in line with current Guidance on the use of dispersion modelling for air quality impact assessment. While this may overestimate the

1-hour ground level concentration (GLC), the conservative approach does not affect the outcome of the assessment.

Table 7.31: Input Data for AERMOD Dispersion Model: KLRP 600m³ Flare, Operational Phase

Parameter	Proposed 600 flare*
Stack height, m**	11
Flow rate, m^3/sec (based on extracted volume of 600m^3/hour)	0.0531
Temperature, K	1288
SO_2, g/sec	0.16479
CO, g/sec	0.003687
Particulates as PM_{10}, g/sec	0.001667
Particulates as $PM_{2.5}$, g/sec	0.001667
Nitrogen dioxide, NO_2, g/sec	0.003355
Hydrogen Sulfide, H_2S, g/sec	0.001339

Note
*Emission rates are derived from the most recent environmental monitoring at the existing flare on site, taking measurement uncertainty into account
**Stack height refers to height in metres above ground level

(ii) Site layout and topography

Layout and topographical information was obtained as outlined in Appendix A7.1.

(iii) Averaging intervals

Averaging intervals were chosen to allow direct comparison of predicted ground level concentrations with the relevant assessment criteria as outlined in Section 7.2.5.

(iv) Receptor locations

Since the impact of the emissions can be observed at considerable distances from the emission sources, a fine grid, 2km x 2km centred on the main emission sources was constructed with receptors located at 50m intervals; and a second grid of 6km x 6km with receptors at 50m intervals was also constructed. In addition to the receptor grids, a number of receptors were selected at sensitive locations in the area represented by the closest residential receptors. A summary of the representative receptors for which data was acquired is given in Table 7.20 and their locations are shown in Figure 7.1.

(v) Meteorological data

As noted in Section 7.3.1, meteorological conditions at the proposed Project are best described by data from the nearby Casement Aerodrome. For this assessment three years of meteorological data from 2013 to 2015 for Casement Aerodrome have been used.

(vi) Baseline air quality

Baseline air quality is described in Section 7.3.3 from the very comprehensive database of information available for the site as well as longer term data acquired for similar locations in Ireland.

Operational Phase Air Quality Impact Assessment Predictions

The impact assessment involves execution of modelling runs to represent different potential scenarios associated with the emissions. The following Scenarios were considered in the runs.

(i) **Meteorological data** – Model runs were executed to consider the effect of meteorological data set selection on the impact predictions;

(ii) **Pollutant concentrations** – Model runs were executed to evaluate the effect of varying pollutant emission rates on the impact predictions.

(iii) Model runs were conducted as part of a **sensitivity analysis** to investigate the effect of a number of variables in the input data and operating conditions on the modelling predictions.

The results demonstrate that for those pollutants and emission scenarios studied, the Air Quality Standards are not breached as a result of the emissions under normal operating conditions as modelled in this report. The individual results for each parameter of interest are discussed here, and the full dispersion modelling data set is presented in Appendix A7.9.

The background ambient air quality has been considered in Section 7.3.3 of this report. In accordance with the guidance presented in the EPA Guidance AG4, the background concentrations are treated as follows:

- For the assessment of 24-hour and annual mean concentrations, the predicted contribution from the site is added to the average annual background concentration.
- For the assessment of 1-hour mean concentrations, the predicted contribution from the site is added to twice the average annual background concentration.

Particulate matter / PM_{10} and $PM_{2.5}$

Particulate matter and PM_{10} emissions from the landfill gas flare are low and will contribute primarily to airborne particulate concentrations due to the anticipated particle size; since this consists primarily of PM_{10}, the impact assessment is based primarily on the assessment criteria for this parameter. The predicted ground level concentrations as a result of the emissions from the proposed Project combined with the background concentrations are as shown in Table 7.32 alongside the relevant Air Quality Standards.

Table 7.32: Predicted Operational Phase Ground Level Concentration of PM_{10} Resulting from the proposed 600m³/hr Flare Emissions

Air Quality Standard		Background concentration, µg/m³	Predicted incremental contribution, µg/m³	Predicted GLC including background, µg/m³
24-hour limit not to be exceeded more than 35 times/year (90.4 percentile)	50 µg/m³	10	0.38	10.4
Annual limit	40 µg/m³	10	0.12	10.1

Note
The worst case meteorological year for the 90.4 percentile of 24-hour average is 2013 and the worst case year for the annual average is 2014.

The data demonstrate that the emissions from the proposed Project will not cause the air quality standards to be exceeded.

An isopleth showing the predicted 90.4 percentile of 24-hour ground level concentration of PM_{10} as a result of emissions from the proposed 600m³ flare during the Operational Phase is presented in Figure 7.14. An isopleth showing the predicted annual mean ground level concentration of PM_{10} as a result of emissions from the proposed 600m³ flare during the Operational Phase is presented in Figure 7.15.

Data for $PM_{2.5}$ is also presented using the very conservative assumption that all of the particulates are present as $PM_{2.5}$. This conservative approach will overestimate the significance of the $PM_{2.5}$ emissions. Even so, the data presented in Table 7.33 demonstrate that the emissions from the flare during the operation of the multi-use public park will not cause the air quality standards to be exceeded.

Table 7.33: Predicted Operational Phase Ground Level Concentration of $PM_{2.5}$ Resulting from the proposed 600m³/hr Flare Emissions

Air Quality Standard [Note]		Background concentration, µg/m³	Predicted incremental contribution, µg/m³	Predicted GLC including background, µg/m³
Annual limit	25 µg/m³	6	0.12	6.1

Note
A limit of 20 µg/m³ will apply from 2020 and this limit is also complied with.
The worst case meteorological year is 2014.

An isopleth showing the predicted annual mean ground level concentration of $PM_{2.5}$ as a result of emissions from the proposed 600m³ flare during the Operational Phase is presented in Figure 7.16.

Carbon monoxide, CO

The modelling results for CO are presented in Table 7.34. For the assessment of the 8-hour mean concentrations, the predicted contribution from the site is added to two times the average annual background concentration.

Table 7.34: Predicted Operational Phase Ground Level Concentration of CO Resulting from the proposed 600m³/hr Flare Emissions

Air Quality Standard		Background concentration, µg/m³	Predicted incremental contribution, µg/m³	Predicted GLC including background, µg/m³
8-hour limit	10,000 µg/m³	800	<1	800

Note
The worst case meteorological year is 2014.

The data presented in Table 7.34 demonstrates that the emissions from the proposed Project will not cause the air quality standards to be exceeded.

Sulfur dioxide, SO_2

The modelling results for SO_2 are presented in Table 7.35 for maximum potential emission rates from the proposed Project.

Table 7.35: Predicted Operational Phase Ground Level Concentration of SO_2 Resulting from the proposed 600m³/hr Flare Emissions

Air Quality Standard		Background concentration, µg/m³	Predicted incremental contribution, µg/m³	Predicted GLC including background, µg/m³
Hourly limit - not to be exceeded more than 24 times/year (99.7 percentile)	350 µg/m³	4	75	79
Daily limit - not to be exceeded more than 3 times/year (99.2 percentile)	125 µg/m³	2	27.3	29.3
Annual limit	20 µg/m³	2	7	9

Note
The worst case meteorological year is 2014.

The data presented demonstrates that the emissions from the proposed Project will not cause the air quality standards to be exceeded.

An isopleth showing the predicted 99.7 percentile of 1-hour ground level concentration of SO_2 as a result of emissions from the proposed 600m³ flare during the Operational Phase is presented in Figure 7.17. An isopleth showing the predicted 99.2 percentile of 24-hour ground level concentration of SO_2 as a result of emissions from the proposed 600m³ flare during the Operational Phase is presented in Figure 7.18. An isopleth showing the predicted annual mean ground level concentration of SO_2 as a result of emissions from the proposed 600m³ flare during the Operational Phase is presented in Figure 7.19.

The predicted annual mean ground level concentration approaches but does not exceed the limit for the protection of human health and ecosystems. There is some uncertainty about the concentration of SO_2 that may be present in the flare emissions and this is discussed in the sensitivity analysis Section at the end of this Section of the EIAR.

Nitrogen dioxide, NO_2, and nitrogen oxides, NO_x

The modelling results for nitrogen dioxide and nitrogen oxides are presented in Table 7.36 and Table 7.37.

Table 7.36: Predicted Operational Phase Ground Level Concentration of NO_2 Resulting from the proposed 600m³/hr Flare Emissions

Air Quality Standard		Background concentration, µg/m³	Predicted incremental contribution, µg/m³	Predicted GLC including background, µg/m³
Hourly limit - not to be exceeded more than 18 times/year (99.8 percentile)	200 µg/m³	6	1.4	7.6
Annual limit for protection of human health	40 µg/m³	3	0.1	3.1

Note
The worst case meteorological year for the 99.8 percentile of 1-hour average is 2013 and the worst case year for the annual average is 2014.

Table 7.37: Predicted Operational Phase Ground Level Concentration of NOx Resulting from the proposed 600m³/hr Flare Emissions

Air Quality Standard		Background concentration, µg/m³	Predicted incremental contribution, µg/m³	Predicted GLC including background, µg/m³
Annual limit for protection of vegetation	30 µg/m³	3	0.1	3.1

Note
The worst case meteorological year is 2014.

The data demonstrates that the emissions from the flare during the Operational Phase will not cause the air quality standards to be exceeded. It is also noted that a conservative modelling approach was adopted with assumptions that all of the nitrogen oxides are present as NO_2 so the assessment is based on a worst-case impact assessment scenario.

An isopleth showing the predicted 99.8 percentile of 1-hour ground level concentration of NO_2 as a result of emissions from the proposed 600m³ flare during the Operational Phase is presented in Figure 7.20. An isopleth showing the predicted annual mean ground level concentration of NO_2 as a result of emissions from the proposed 600m³ flare during the Operational Phase is presented in Figure 7.21.

An isopleth showing the predicted annual mean ground level concentration of NOx as a result of emissions from the proposed 600m³ flare during the Remediation Phase is presented in Figure 7.22.

Odour

Odour is of particular significance in this assessment and is considered in this Section of the report. The other modelling predictions have focused on the comparison of impact predictions with Air Quality Standards which are designed for protection of human health and ecosystems. A further issue to be considered is the potential for odour nuisance as a result of the emissions from the landfill gas flares. This potential is considered by examining the maximum 1-hour ground level concentration of sulfur dioxide (SO_2) and hydrogen sulfide (H_2S) as a result of the emissions. These substances are chosen because of their significance in terms of potential odour impact. Other sulfur containing substances are not present at significant concentrations in the flare emissions due to the high combustion temperature so the assessment focuses on the predicted ground level

concentration of SO_2 and H_2S which are the principal sulfur-containing species that may be present in flare emissions.

The 98 percentile of 1-hour ground level concentration of hydrogen sulfide and sulfur dioxide was also modelled and the results are shown in Table 7.38.

Table 7.38: Predicted Operational Phase Ground Level Concentration of SO_2 and H_2S Resulting from the proposed 600m³/hr Flare Emissions

Air Quality Standard	Odour threshold, µg/m³	Predicted GLC, µg/m³
SO_2 98 percentile of 1-hour ground level concentration	1,200	51.5
H_2S 98 percentile of 1-hour ground level concentration	0.7	0.68

Note
The odour threshold is the benchmark against which the impact is assessed

The 98 percentile is the maximum concentration level for 98 percent of the time, or 8,584 hours in a year; so this level is reached or exceeded for just 176 hours per year.

An isopleth showing the predicted 98 percentile of 1-hour ground level concentration of SO_2 as a result of emissions from the proposed 600m³ flare during the Operational Phase is presented in Figure 7.23 and an isopleth showing the predicted 98 percentile of 1-hour ground level concentration of H_2S as a result of emissions from the proposed 600m³ flare during the Operational Phase is presented in Figure 7.24. Extracts of these are shown in Diagram 7.7 and Diagram 7.8 respectively. The data is evaluated by comparing the 98 percentile of the 1-hour GLC to the odour threshold for SO_2 which is 1,200µg/m³ and 0.7 µg/m³ for H_2S. The assessment has shown that odour attributable to the emissions from the landfill gas flare is not detectable for the scenarios modelled.

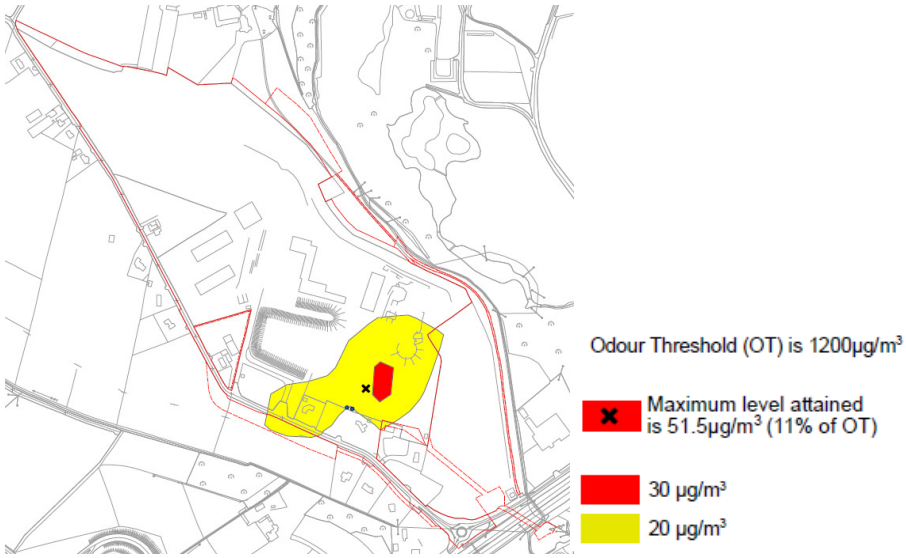

Diagram 7.7: Isopleth Showing the Predicted 98 percentile of 1-hour Ground Level Concentration of SO_2 as a Result of Emissions from the Proposed 600m³ Flare During the Operational Phase

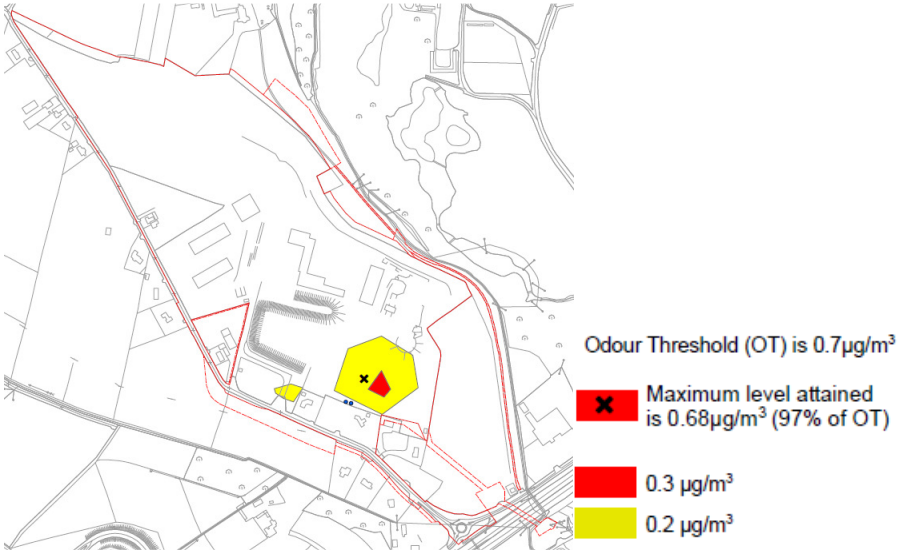

Diagram 7.8: Isopleth showing the predicted 98 percentile of 1-hour ground level concentration of H_2S as a result of emissions from the proposed 600m³ flare during the Operational Phase

Sensitivity Analysis

The sensitivity of the Operational Phase modelling predictions to varying input data was tested to evaluate the robustness of the modelling assumptions. A discussion of the principal findings of this sensitivity analyses is presented here.

(i) Meteorological Data

Data from Casement Aerodrome was used as the primary data set in this assessment. Given the close proximity of the Airport to the Kerdiffstown site, it is considered that the data is a reliable indicator of meteorological conditions at the site. The robustness of the assessment was strengthened by using 3 years of recent data (2013 – 2015) for the assessment. Details are presented in this report of the worst-case year (2013 or 2015) and the additional modelling results acquired for all of the other years of data is presented in Appendix A7.9. There was very little variation noted between the data sets used in the study but a conservative approach was adopted with the worst-case data set, as evidenced by the highest predictions, reported in this report.

(ii) Stack Height

Stack height is a particularly important variable in this assessment. The effect of varying stack height was investigated and the assessment showed that for the scenario modelled, the proposed 11m stack height is adequate to ensure effective dispersion of the emissions. Further details are included in Appendix A7.9.

(iii) Modelling Uncertainty

The inherent uncertainty in dispersion modelling is approximately 100%. As a general rule it is recommended that the predicted contribution to ground level concentrations from the activity shall not exceed approximately 67% of the air quality standard. This approach was considered in the assessments undertaken here and where appropriate higher stack heights were recommended to allow this criterion to be satisfied.

(iv) Sulfur Concentration in the Landfill Gas

As noted in Section 7.4.1 there is some uncertainty about the sulfur content of the landfill gas that will arise when the proposed Project is completed. Kildare County Council are monitoring the level of hydrogen sulfide in the landfill gas weekly and will continue to do measurements as part of the active management of landfill gas at the site throughout the gas-generating life of the landfill. If higher sulfur, and H_2S, levels are detected in the landfill gas flare inlet during the Remediation and Operational Phase, then a suitable abatement system, likely

to be an activated carbon filter, will be fitted to reduce the levels of sulfur reaching the flare. This is considered an unlikely scenario but there is a management solution available to deal with this if it arises.

(v) Landfill gas flare breakdown

There is a stand-by flare available for the Operational Phase which the gas can be diverted to if the 600m^3 operating flare breaks down or is taken out of service for maintenance. There are therefore no adverse air quality impacts predicted from flare breakdown.

The general findings of the sensitivity analysis are that where necessary, the gas treatment and dispersion arrangements can be optimised so that the effect of further variations on input data were insignificant. For all other elements investigated there was very little difference between the predictions using the different data sets.

7.5 Mitigation Measures

7.5.1 Remediation Phase

The Remediation Phase of the proposed Project represents the most significant potential for air quality and odour impacts. As identified and quantified in this report, the principal impacts relate to dust and particulate matter and odour emissions. Compliance with the EPA Guidance on the Operation of Landfills, "*Landfill Manuals - Landfill Operational Practices*" 1997 will ensure that the highest standards of environmental protection are achieved.

Prior to commencement of the Remediation Phase, the appointed contractor will prepare a Construction Environmental Management Plan (CEMP). The CEMP will contain the mitigation measures and plans identified in the following Sections and ensure that they are fully implemented during the construction phase, to prevent or reduce the impacts identified in the impact assessment.

The CEMP will contain a Dust Management Plan which will be formulated for the Remediation Phase of the proposed Project, 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 Dust Management Plan shall address the following:

- The appointed contractor for the remediation works will be assigned with overall responsibility for Dust Management reporting back to the KCC Site Manager;
- The design, and in particular the phasing of the Remediation Phase work will consider dust impact management and choose design approaches to minimise dust emissions;
- The Remediation Phase 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.

The following is a summary of the main mitigation features of the proposed Project and the specific mitigation measures which will be employed in order to minimise dust emissions from the activity and the associated impacts of such emissions:

- The areas on site which vehicles will be travelling on will be hard-surfaced where practicable thus significantly reducing the potential for dust emissions from the vehicles;

- A wheel washing facility with water collection and filtering before any discharge to the surface water management system will be set up. Gate security staff will be briefed on inspection of vehicles for cleanliness ahead of leaving site. During the initial stages of site set-up, a mobile wheel washing vehicle will be available at short notice, if necessary. The use of a wheel wash facility at the entrance to the proposed Project will minimise the transfer of any dust onto the roads in the vicinity of the site; this will also minimise the potential for dust build-up on surfaces which could be blown across the site.
- In order to minimise the potential for wind-generated emissions from storage of materials, the storage areas will be oriented in a favourable manner with respect to the prevailing wind to minimise the effects of wind blow on release of dust and particulate.
- The relatively coarse particle size (10 – 75µm) associated with the proposed Project means that the particles will generally be deposited close to the emission source and will not travel significant distances away from the site.
- Fixed and mobile water sprays will be used to control dust emissions from material stockpiles and road and hardstanding surfaces as necessary in dry and/or windy weather.
- 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 deposition 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.

During the Remediation Phase the risk of odour impacts will increase significantly, when waste containing materials will become exposed during re-profiling and other works. The prevailing wind at the site is south-westerly, so the sensitive receptors to the north and north-east of the site are therefore at risk of receiving odour and air quality impacts. Weather conditions have a significant effect on dispersion and propagation of odours with the strongest odours generally experienced on sites like this during low wind conditions, when there is little dilution of air. Further, a sudden drop in barometric pressure tends to result in an increase in gas diffusing from the waste body, and high atmospheric temperatures also result in more odours being released in warm weather. Careful attention to these factors will ensure that odours related to weather effects are minimised during the Remediation Phase of the proposed Project.

During the Remediation Phase the appointed contractor will work in accordance with the guidance provided in the National Guidelines for the prevention of Nosocomial Invasive Aspergillosis during construction/renovation activities (developed by a sub-committee of the Scientific Advisory Committee of the National Disease Surveillance Centre, 2002).

Odour mitigation measures are discussed in the draft Odour Control Plan (OCP) for the proposed Project which will be finalised as part of the overall CEMP. A Draft OCP was formulated to inform the design process for this proposed Project and is attached in Appendix A7.7. Odour incidents are being minimised at the site through best practice and regular monitoring. Odour minimisation and prevention measures which are currently implemented and which will continue to be updated during the Remediation Phase will include:

- Carrying out subjective odour assessments (sniff tests) and logging details of odorous emissions during daily and weekly site assessments in accordance with EPA guidance;
- Noting wind direction, temperature and barometric pressure on a daily basis;
- Ensuring that landfill gas flaring is balanced and optimised to maximise gas collection from installed gas wells and flaring according to operational recommendations;
- Investigating any odour that appears stronger than the normal emission;
- 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.

Disturbing the waste is unavoidable during the Remediation Phase of the proposed Project and therefore odour emissions are unavoidable. The magnitude and impact of any such odours will be minimised by implementing a phased approach to the Remediation Phase, and by ensuring that effective mitigation measures are in place. The proposed approaches are summarised here.

Minimisation of evaporation of odours will be promoted through adoption of the following measures:

- Maintain an adequate supply of temporary cover material prior to any works commencing (e.g. clean topsoil, clay or liner membrane);
- Any disturbance and exposure of odorous waste will be kept to the minimum practical duration;
- The surface area of exposed waste will be kept to a minimum size at all times;
- Temporary cover will be applied to all work areas as quickly as practicable;
- The carrying out of major waste movements during hot weather when odours volatise most readily will be avoided;
- Leaving open waste exposed in direct sunlight, which increases evaporation, will be avoided;
- Water spray to lower the temperature of exposed waste, and inhibit evaporation will be used;
- Screening of materials containing waste, unless adequately contained, will be avoided; and
- Any waste containing material that has to be transported from one side of the site to another will be covered and contained during transport.

- Planning of works to take place under suitable weather conditions for minimising odours will be actively implemented during the Remediation Phase. If unacceptable odours are generated from a particular activity it may be necessary to cover the exposed waste, and cease the activity until additional odour control measures can be put in place. This may include the provision of additional water bowsers, or waiting for cooler weather conditions. The appointed contractor will agree such measures with the KCC Site Manager.
- Nearby sensitive receptors and local Community Liaison Group will be kept informed of the progress and plans regarding the Remediation Phase. Nearby sensitive receptors will be informed prior to any remediation works being carried out. They will be informed of the works phasing plan, and the locations of works planned for the duration of remediation works will be regularly updated and communicated. Where adverse metrological conditions coincide with works phasing that cannot be averted, residents will be informed of the heightened risk of short-term odour nuisances.
- During remediation works there will be a requirement for monitoring of odour emissions from the site to be undertaken which shall include the following:
  - Frequent sniff sampling and logging of odour characteristics at the working face;
  - Frequent sniff tests at the site perimeter downwind from the working face;
  - Frequent sampling of specified compounds with colour indicator tubes specified at
  - Appropriately low detection ranges.
  - Frequent measurement of Total VOC concentrations using a FID (flame ionization detector) handheld field detector; and,
  - Regular sniff tests off-site near sensitive receptor locations.

If monitoring indicates higher than expected odour emissions, or impacts at sensitive receptors, additional mitigation measures will need to be implemented. If necessary, and in adverse conditions, the works may have to be stopped and the workface contained with a temporary cover, until adequate mitigation can be assured. The appointed contractor will agree such measures with the KCC Site Manager.

Kildare County Council are monitoring the level of hydrogen sulfide in the landfill gas weekly and will continue to do so as part of the active management of landfill gas at the site throughout the Remediation Phase of the proposed Project. If higher sulfur, and H_2S, levels are detected in the landfill gas flare inlet during the Remediation Phase, then a suitable abatement system, likely to be an activated carbon filter, will be fitted to reduce the levels of sulfur reaching the flare. This is considered an unlikely scenario but there is a management solution available to deal with this if it arises.

7.5.2 Operational Phase

The principal mitigation measures proposed for the Operational Phase of the proposed Project are the comprehensive proposals for the management of landfill gas at the proposed multi-use public park. Landfill gas will be actively and passively managed by means of an extensive network of extraction wells and perimeter gas venting trenches. Actively extracted gas will be diverted to the new flare located within the purpose-built Landfill Gas Infrastructure compound which will convert the landfill gas into harmless substances. There will be two landfill gas flares, one operating in duty and one in back-up mode. The location of the Landfill Infrastructure Compound and the height of the landfill gas flare stacks has been chosen to optimise the management of the landfill gas at the proposed Project. The assessment has shown that the proposed management plans will ensure that no odours are detectable as a result of the emissions from the proposed Project during the Operational Phase. Over time, the gas concentrations will decrease so that eventually the landfill gas flares would no longer be required. It is not anticipated that any diffuse odour impacts will occur during the Operational Phase, as the capping and ongoing landfill gas management of the site will be effective in managing and preventing diffuse emissions.

The design of the pipeline to transfer leachate off site will require installation of air valves and manholes. These manholes will include sealant to prevent release of odours. The connection point to Johnstown Pumping Station will be fitted with a carbon filter to further mitigate an odour release.

7.6 Residual Impacts

The proposed mitigation measures have been shown to be effective in the management of air quality and odour impacts associated with the proposed Project. The Remediation Phase will be managed so that there are no significant residual air quality impacts after completion. The comprehensive mitigation and management proposals will ensure that there are no significant residual impacts during the Operational Phase.

7.7 Difficulties Encountered in Compiling Information

There were no specific difficulties encountered when carrying out this assessment.

7.8 Cumulative Impacts

The cumulative impact of the proposed Project and other permitted developments in the area can be assessed by taking account of the existing baseline environment and the predicted impacts associated with the operation of the proposed Project in combination with predicted impacts of any other proposed developments in the area.

There are a number of additional development projects proposed in the vicinity of the proposed Project that are considered in terms of a cumulative impact on air quality that may be experienced at receptors and/or at the site boundaries. These projects are discussed in the following paragraphs.

7.8.1 Kerdiffstown Quarry

A Waste Facility Permit has been granted for the recovery of excavation or dredge spoil, comprising natural materials of clay, silt, sand, gravel or stone and which comes within the meaning of inert waste, through deposition for the purpose of the improvement or development of land at the former quarry at Kerdiffstown. In accordance with the permit (Waste Facility Permit Number: WFP – KE – 16 – 0084 – 01) the permit holder shall ensure that the maximum tonnage of soil and stone recovered at the site is 98,928 tonne. The importation of

inert materials will raise the ground levels at the site and stabilise the side slope of the redundant quarry. The quarry, receptor COM016 on Figure 3.4, is located across the L2005 Kerdiffstown Road opposite the western boundary of Zone 1 of the proposed Project site and west of the receptor REC018. The Waste Facility Permit restricts the truck movements onto the quarry site to a maximum of 35 per day and restricts the working hours to 08:00 to 17:00 Mondays to Fridays and 08:00 to 13:00 on Saturdays. This approximates to four loads of inert materials coming to the site per hour at maximum capacity. The project is anticipated to be completed over a three-year period which would significantly reduce the number of truck movements to approximately one per hour on average over the duration of the project.

The quarry infilling will use only inert materials and therefore any potential impact on air quality will be related to dust and particulate emissions; inert materials are not odorous and therefore odour impacts will not occur as a result of the quarry infilling. The Waste Facility Permit requires the quarry works to meet a limit for dust deposition at the site boundaries of 350mg/m^2-day. The only receptor that has significant potential to be impacted by works at both sites is REC018. Since dust deposition at both the quarry site boundary and the proposed Project site boundaries will be limited to 350mg/m^2-day, there is therefore no potential for a significant adverse cumulative impact since both proposed Projects will operate within levels that will ensure that adverse air quality impacts do not occur. The use of different approach roads to serve the two sites is also beneficial since this will minimise the traffic movements on each road thereby minimising the impact on nearby receptors. There will be no adverse air quality impact from the Operational Phase of the infilled quarry.

7.8.2 The M7 Naas Newbridge Bypass Upgrade and M7 Osberstown Interchange & R407 Sallins Bypass Schemes

The M7 Naas Newbridge Bypass Upgrade and M7 Osberstown Interchange & R407 Sallins Bypass M7 Naas to Newbridge By-Pass Upgrade Schemes involves the addition of a third lane to both the north-bound and south-bound lanes of the M7 Motorway between Johnstown and Greatconnell, and a new re-configured interchange at Newhall and a grade separated junction, M7 Osberstown Interchange, located between the existing M7 Maudlins and Newhall Interchanges. The potential air quality impact is related to dust and particulate matter, and no odour impacts are predicted. The nearest receptors to the proposed Project are too far removed to be significantly impacted by the road construction works and the overall cumulative impact is considered to be neutral.

7.8.3 Applegreen Service Station at Naas (withdrawn)

The Planning Application for the development of the Applegreen Service Station on the eastern outskirts of Naas town and south of the N7 Road has been withdrawn. The nearest boundary for the proposed Service Station is approximately 600m from the proposed Project site entrance. The cumulative impacts from this project (if it were to proceed at a point in the future) and the proposed Project is anticipated to be neutral given the considerable distance between the site and the proposed Project.

7.8.4 Housing Development at Craddockstown, Naas

A housing development has been granted permission to build a 284 housing-unit scheme at Craddockstown to the south of Naas town centre. The proposed housing development site is located over 2km south of the proposed Project site. Due to the extended distance between the two sites and the type of development proposed the cumulative impact from the housing development project and the proposed Project is anticipated to be neutral.

7.8.5 Upper Liffey Valley Sewerage Scheme & Osberstown Wastewater Treatment Plant Upgrade

The Upper Liffey Valley Sewerage Scheme & Osberstown Wastewater Treatment Plant Upgrade is an Irish Water project which proposes to upgrade various wastewater elements (gravity sewers, pumping stations, storm handling facilities and rising mains) in the vicinity of the proposed Project. Works will be undertaken on drainage networks collecting wastewater from three catchments, namely Catchment A (Sallins, Clane and Prosperous); Catchment B (Naas, Johnstown and Kill); and Catchment C (Newbridge, Kilcullen, Athgarvan, Curragh and Carragh). Part of the upgrade includes a proposed new pumped sewer, a section of which will be installed along the L2005 Kerdiffstown Road adjacent to the proposed upgrade works as part of the proposed Project. It is

anticipated that the construction of the new pumped sewer will be scheduled at the same time as the upgrade works to the L2005 Kerdiffstown Road to minimise potential impacts on local residents and traffic.

If construction works proceed for both schemes at the same time, the plant and machinery required will have to operate at different sections along the Kerdiffstown Road due to the nature of the work and the size and type of machinery required. In effect, the construction work for one project would be followed by the other project but they would never directly overlap. Assuming that the works for both schemes are managed as described above to minimise air quality impacts, the cumulative impact is anticipated to be not significant. In the event that either the proposed Project or the new pumped sewer construction is delayed there will be no cumulative impact.

The assessment has shown that cumulative impacts at the boundaries of the proposed Project and at sensitive receptors in the area are predicted to be imperceptible. It is therefore not considered that any additional mitigation measures above those already provided, are required to account for cumulative impacts.

7.9 References

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