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RINGASKIDDY RESOURCE RECOVERY CENTRE

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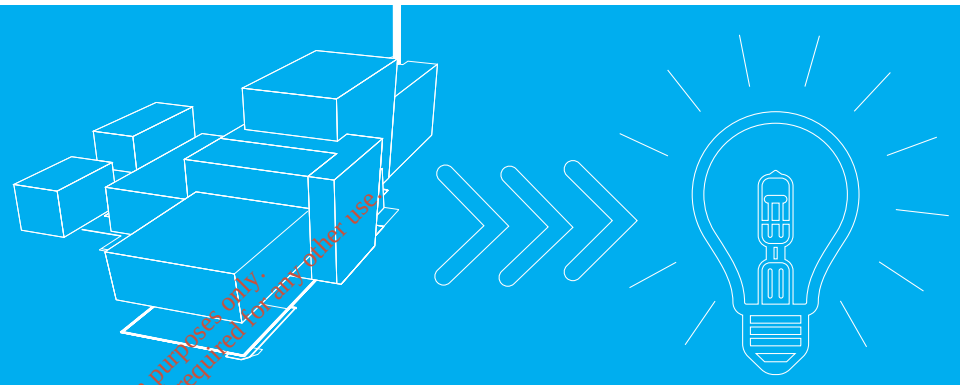

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Natura Impact Statement

ARUP

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Dixon.Brosnan

environmental consultants

Project

Stage One Screening Report and Stage Two Natura Impact Statement for a proposed Ringaskiddy Resource Recovery Centre and associated works at Ringaskiddy, Co. Cork

Client

Project ref	Report no	Client ref	
1538	1538	Indaver	

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1. Introduction

Indaver proposes to develop a Resource Recovery Centre (including waste-to-energy facility) in Ringaskiddy in County Cork.

The proposed development will consist principally of a waste-to-energy facility (waste incinerator with energy recovery) for the treatment of up to 240,000 tonnes per annum of residual, household, commercial and industrial, non-hazardous and hazardous waste which is currently landfilled or exported. Of the 240,000 tonnes of waste, up to 24,000 tonnes per annum of suitable hazardous waste will be treated at the facility.

In line with European Union and national policy, this residual waste will be diverted away from landfill and exports, moving the management of waste up the waste hierarchy, allowing Ireland to become more self-sufficient in the treatment of waste and reducing the environmental impact of residual waste management. The proposed development will maximise the extraction and recovery of valuable material (in the form of ferrous and non ferrous metals) and energy (in the form of 21 megawatts of electricity) resources from residual waste.

In 2008, Indaver submitted an application for permission under section 37E for a waste-to-energy facility at Ringaskiddy, Co. Cork directly to An Bord Pleanála for its approval (*Indaver Ireland Ringaskiddy Waste–to-Energy Facility Environmental Impact Statement, November 2008*). An oral hearing on the application was held in 2009.

An additional report (*Appropriate Assessment of the Potential Impacts on the Cork Harbour SPA, ARUP 2009*) was prepared in response to queries raised during the oral hearing.

Subsequently, An Bord Pleanála requested further information on the proposed development in January 2010. This included modifications to the scheme, works to prevent flooding of the public road accessing the Indaver site and works to protect the coastal boundary of the Indaver site. The further information was provided to the Board as an addendum to the 2008 EIS (*Indaver Ireland Ringaskiddy Waste–to-Energy Facility Addendum to 2008 EIS, August 2010).*

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As part of the response to the request for additional information an additional report *(Appropriate Assessment screening report for proposed modifications to a Waste to Energy Facility and Transfer station, road upgrade works and coastal protection works at Ringaskiddy, Co. Cork, DixonBrosnan, 2010*) was prepared and submitted to the Board. Ultimately, the Board decided to refuse permission under the application submitted in 2008. However, the conclusion from the competent authority was that there would be no significant impacts on the SPA from the proposed development.

Indaver has decided to apply to the Board for permission for a development on the site. This NIS was prepared in support of this latest application. The above mentioned reports were consulted during the preparation of this document.

Accordingly, this Stage One Screening Report and Natura Impact Statement for Appropriate Assessment comprises a compilation of the information relevant to the competent authority's assessments relating to the potential significant impacts of the proposed Indaver Ringaskiddy Resource Recovery Centre on Natura 2000 sites within the surrounding area. The Environmental Impact Statement [EIS], which has been prepared for this proposed development and submitted with the application for permission under section 37E, provides much of the detail upon which this NIS is based, particularly in relation to the receiving environment and baseline ecology. Thus, this NIS contains reference to the information set out in considerable detail in the EIS. Where relevant, reference is also made to the previous reports prepared for this site.

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2. Regulatory Context and the Appropriate Assessment Procedure

2.1 Regulatory context

Article 6(3) of *Council Directive 92/43/EEC of 21 May 1992 on the Conservation of Natural Habitats and of Wild Fauna and Flora* (as amended) (hereafter 'the Habitats Directive') requires that, any plan or project not directly connected with or necessary to the management of a designated site, but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives. For the purposes of the application for permission in respect of the proposed Ringaskiddy Resource Recovery Centre development, the requirements of Article 6(3) have been transposed into Irish law by Part XAB of the Planning and Development Act 2000, as amended.

The possibility of there being a significant effect on a designated or "European" site will generate the need for an appropriate assessment to be carried out by the competent authority for the purposes of Article 6(3). In this instance, the competent authority is An Bord Pleanála. As set out in Section 177U of the Planning and Development Act 2000 as amended, a screening for appropriate assessment of an application for consent for the proposed development must be carried out by the competent authority (in this case, An Bord Pleanála) to assess, in view of best scientific knowledge, if the proposed development, individually or in combination with another plan or project is likely to have a significant effect on any European site. A Stage Two Appropriate Assessment is required if it cannot be excluded, on the basis of objective information, that the proposed development, individually or in combination with other plans or projects, will have a significant effect on a European site. The first (Screening) Stage for appropriate assessment operates merely to determine whether a (Stage Two) Appropriate Assessment must be undertaken on the implications of the plan or project for the conservation objectives of relevant European sites.

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2.2 Appropriate Assessment Procedure

The assessment requirements of Article 6(3) establish a stage-by-stage approach.This assessment follows the stages outlined in the 2001 European Commission publications "*Assessment of plans and projects significantly affecting Natura 2000 sites: methodological guidance on the provisions of Articles 6(3) and 6(4) of the Habitats Directive 92/43/EEC"* (2001) and *Managing Natura 2000 Sites: the provisions of Article 6 of the 'Habitats' Directive 92/43/EEC (Draft)* Office for Official Publications of the European Communities, Luxembourg (EC, 2015);

The stages are as follows:

Stage One: Screening — the process which identifies any appreciable impacts upon a Natura 2000 site of a project or plan, either alone or in combination with other projects or plans, and considers whether these impacts are likely to be significant;

Stage Two: Appropriate assessment — the consideration of the impact on the integrity of the Natura 2000 site of the project or plan, either alone or in combination with other projects or plans, with respect to the site's structure and function and its conservation objectives. Additionally, where there are adverse impacts, an assessment of the potential mitigation of those impacts;

*Stage Three: Assessment of alternative solutions:*The process which examines alternative ways of achieving the objectives of the project or plan that avoid adverse impacts on the integrity of the Natura 2000 site. It is confirmed that no reliance is placed by the developer on Stage Three in the context of this application for development consent;

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Stage Four: Assessment where no alternative solutions exist and where adverse impacts remain — an assessment of compensatory measures where, in the light of an assessment of imperative reasons of overriding public interest (IROPI), it is deemed that the project or plan should proceed (it is important to note that this guidance does not deal with the assessment of imperative reasons of overriding public interest). Again, for the avoidance of doubt, it is confirmed that no reliance is placed by the developer on Stage Four in the context of this application for development consent

Documentation/guidelines of relevance to this NIS include the following:

- European Commission, 2001. *Assessment of plans and projects significantly affecting Natura 2000 sites: Methodological guidance on the provisions of Articles 6(3) and (4) of the Habitats Directive 92/43/EEC.* Office for Official Publications of the European Communities, Brussels (EC, 2001);
- European Commission, 2000a. *Communication from the Commission on the Precautionary Principle.*, Office for Official Publications of the European Communities, Luxembourg (EC, 2000a);
- *Managing Natura 2000 Sites: the provisions of Article 6 of the 'Habitats' Directive 92/43/EEC (Draft)* Office for Official Publications of the European Communities, Luxembourg (EC, 2015);
- *Managing Natura 2000 Sites: the provisions of Article 6 of the 'Habitats' Directive 92/43/EEC (EC, 2000)*
- Guidance document on Article 6(4) of the 'Habitats Directive' 92/43/EEC – Clarification of the concepts of: alternative solutions, imperative reasons of overriding public interest, compensatory measures, overall coherence, opinion of the commission; (EC, 2007);
- *Appropriate Assessment of Plans and Projects in Ireland. Guidance for Planning Authorities*. Department of the Environment, Heritage and Local Government, Dublin (DEHLG, 2010a);
- Department of Environment Heritage and Local Government Circular NPW 1/10 and PSSP 2/10 on Appropriate Assessment under Article 6 of the Habitats Directive – Guidance for Planning Authorities (DEHLG, 2010b);
- European Commission Staff Working Document '*Integrating biodiversity and nature protection into port development'* (EC, 2011b);
- *Interpretation Manual of European Union Habitats. Version EUR 28*. European Commission (EC, 2013);
- Applications for approval for Local Authority Developments made to An Bord Pleanála under 177AE of the Planning and Development Act, 2000, as amended (Appropriate Assessment): Guidelines for Local Authorities. An Bord Pleanála, Dublin (ABP, 2013).

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3. Methodology

3.1 Study Area and Scope of Appraisal

In line with the precautionary principle, the study area for the preparation of this Stage One Screening Report and Natura Impact Statement extended to a radius of 20km from the applicant's site boundary. Thus any appreciable direct, indirect or cumulative impacts which could arise from the proposed development in relation to the designated sites within this zone were considered. No potential ecological risks to designated sites outside this 20km

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radius were identified. It is noted that local potential ecological impacts within the development site itself, which is not designated as a European site, are considered in detail by **Chapter 12 *(Biodiversity)*** of the EIS. The location of the site is shown in **Appendix 1, Figure 1,** and an overview of the proposed development is provided in **Appendix 1, Figure 2**

3.2 Desktop Study

A desktop review facilitates the identification of the baseline ecological conditions and key ecological issues relating to Natura 2000 sites and facilitates an evaluation assessment of potential in-combination impacts. Sources of information used for this NIS include previous reports prepared for the Indaver site, information from statutory and non-statutory bodies and information from other projects in the Cork Harbour area. The sources of information and relevant documentation utilised are as follows:

Information on the Indaver Site

- Indaver Ringaskiddy Resource Recovery Centre Environmental Impact Statement, 2015
- Indaver Ringaskiddy Waste–to-Energy Facility Environmental Impact Statement, November 2008
- Appropriate Assessment of the Potential Impacts of the Ringaskiddy Waste-To-Energy facility on the Cork Harbour SPA, ARUP 2009
- Indaver Ireland Ringaskiddy Waste–to-Energy Facility Addendum to 2008 EIS, August 2010
- Appropriate Assessment screening report for proposed modifications to a Waste to Energy Facility and Transfer station, road upgrade works and coastal protection works at Ringaskiddy, Co. Cork, DixonBrosnan, 2010

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Information from statutory and non-statutory bodies

- National Parks & Wildlife Service (NPWS) - www.npws.ie including qualifying interests and conservation objectives for Natura 2000 sites.
- Environmental Protection Agency (EPA) – www.epa.ie
- National Biodiversity Data Centre – www.biodiversityireland.ie
- County Cork Biodiversity Action Plan 2009 2014 (Cork County Council, 2009);
- OPW Draft Guidance on the Assessment of potential future scenarios for Flood Risk Management

Other plans and projects

- Ringaskiddy Port Redevelopment EIS (Port of Cork/RPS, 2014)
- Ringaskiddy Port Redevelopment. Further Information in accordance with Section 37F [1] Revised Screening for Appropriate Assessment (Port of Cork/RPS, 2015)
- IMERC Masterplan A Masterplan for the Irish Maritime and Energy Resource Cluster
- Spike Island Masterplan Spike Island
- Port of Cork Monkstown Marina Proposals
- East Tip Remediation Project, Haulbowline Island

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- Hammond Lane Metal Cork
- Cork Lower Harbour Energy Group Wind Turbines
- N28 Road Upgrade
- Cork Lower Harbour Main Drainage Scheme sewage treatment plant, Shanbally

3.3. Consultation

Prior to the submission of the application for permission to the Board, meetings were held with Dr. Jervis Good and Danny O'Keefe (National Parks and Wildlife Service) on May 27, 2015, and September 9, 2015. At the meetings, the issues to be addressed in the NIS were discussed. A letter from the Development Applications Unit (DAU) of the Department of Arts, Heritage and the Gaeltacht, dated 11 September 2015, set out the heritage related observations/recommendations of the Department (**Appendix 2**). This information is provided in various sections within the NIS as follows:

- Effects of air emissions (Point 1 of DAU letter) and dioxins and furans (Point 2 of DAU letter) are primarily addressed by assessing the available data as presented by a literature review on the potential ecological effects of mercury, dioxins, thalium and cadmium on bird receptors and otter (**Appendix 3**)
- Bird collision risk (Point 6 of DAU letter). This is addressed by a literature review on the risk of bird collisions with the proposed stack taking into account recent developments in Cork Harbour. (**Appendix 4**)
- Assessment of potential bio-monitoring programme (Requested at the NPWS meeting, May 2015). (**Appendix 5**)
- Flue gas treatment residue and filter ash transport in Cork Harbour (Point 4 of DAU letter and flue gas treatment residue and filter transport in the Elbe Estuary (Point 5 of DAU letter). This is addressed by **Section 4.5.8** of this report.
- Increased predator attraction (Point 7 of DAU letter). This is addressed by **Section 4.5.10** of this report.
- Further information on the potential for accidental releases, both onsite and offsite, with a particular emphasis on risks associated with shipping of residues overseas for recovery or disposal. (**Section 4.5.8).**
- Trans-boundary effects, including flue gas cleaning residues disposal in salt mines or landfill, in Europe. (**Section 4.5.9**)
- Information on air emission monitoring data from Indaver's plant at Carranstown, Co Meath. (Requested at the NPWS meeting, May 2015). (**Appendix 6**).
- Comparative data from similar waste-to-energy incinerator facilities (Point 3 of DAU letter). This information is provided in (**Appendix 6**).
- Effects of hazardous compounds (Point 8 of DAU letter). This is addressed in **Appendix 6.**
- Information on plant start-up and shut-down procedures including frequency of start-up and shut-down, and emergency response procedures (Requested at the NPWS meeting, May 2015). (**Appendix 6**)

3.4 Relevant information

Information on the project which was used to assess potential impacts is included in the appendices as follows. This information, where relevant, is summarised in the text of this report.

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Introduction to the project (Appendix 7) and Proposed site and project description (Appendix 8).

These provide an overview of the proposed development and a description of the proposed site and the Ringaskiddy Resource Recovery Centre development.

Construction Activities (Appendix 9)

This appendix describes the construction operations and phasing for the proposed Ringaskiddy Resource Recovery Centre and outlines the measures to be taken to ensure the impact of the construction activities on the environment is minimised.

Biodiversity (Appendix 10)

Provides a comprehensive assessment of the impacts on ecology based on desktop studies and field surveys. In addition to surveys previously carried out at the site, the following surveys were also carried out in 2014/2015: habitat mapping , surveys of wintering birds, breeding birds surveys, common tern breeding survey, mammals, with a particular emphasis on badger, otter and bats and intertidal survey.

Air (Appendix 11)

Provides a detailed appraisal of potential impacts on air which could arise from emissions generated during construction works or from emissions during operation. The scope of the study consists of the following components:

- Review of maximum emission levels and other relevant information needed for the modelling study;
- Identification of the significant substances which are released from the facility;
- Review of background ambient air quality in the vicinity of the facility;
- Air dispersion modelling of significant substances released from the facility;
- Particulate deposition modelling of Dioxins & Furans, Polycyclic Aromatic Hydrocarbons (PAHs) and heavy metals released from the facility;
- Identification of predicted ground level concentrations of released substances at the facility boundary and at sensitive receptors in the immediate environment;
- Evaluation of the significance of these predicted concentrations, including consideration of whether these ground level concentrations are likely to exceed the most stringent ambient air quality standards and guidelines.

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Noise and vibration (Appendix 12)

Provides an assessment of the potential noise and vibration impacts on the surrounding environment associated with the construction and operation of the proposed facility. As the proposed development is located 0.5km from the closest Natura 2000 site (Cork Harbour SPA) the risk of significant impacts is considered very unlikely. However as there could potentially be impacts on birds listed as qualifying interests for this SPA, where they occur outside the site boundary, noise and vibration is considered relevant. The conclusions of this appendix are included in text of this report.

Appendix 13

Hazard Identification and Risk Assessment Report

Sampling And Analysis Of Soil And Sediment Samples (Appendix 14)

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Sampling And Analysis Of Soil And Sediment Samples For PCDDs, PCDFs And PCBs At Various Locations Around Cork Harbour.

Appendix 15

Ecological Risk Assessment for PCDD/F for Indaver Ringaskiddy Resource Recovery Centre.

3.5 Author of Report for Screening and Appropriate Assessment

This report for screening and NIS was prepared by Carl Dixon MSc. (Ecological Monitoring) and Vincent Murphy MSc. (Ecosystem Conservation and Landscape Management). Both have considerable experience in ecological assessment and the preparation of Natura Impact Statements for a range of large and small scale developments. Where relevant, specialist input was also received from Dr. Sorcha Sheehy PhD in relation to potential impacts on birds. A survey of the intertidal area in proximity to the proposed development was carried out by Dr. Stiofan Creaven. Additional information was provided by Arup and by Indaver, where required.

4. Stage 1 Screening

The screening report is laid out as follows: Section 4.1 - description of the project, Section 4.2 - main features of the project, 4.3 - appraisal of ecological baseline conditions, 4.4 - Natura 2000 sites, 4.5 Identification of potential impacts and 4.6 Screening Conclusion.

4.1 Description of the project (See Appendices 7 and 8).

Indaver proposes to develop a Resource Recovery Centre in Ringaskiddy in County Cork. The proposed development will include a waste-to-energy facility for the treatment of up to 240,000 tonnes per annum of residual household, commercial and industrial, non-hazardous and suitable hazardous waste. Of the 240,000 tonnes of waste, up to 24,000 tonnes per annum of suitable hazardous waste will be treated at the facility. In line with European and national policy, this residual waste will be diverted away from landfill and exports, moving the management of waste up the hierarchy, allowing Ireland to become more self-sufficient in the treatment of waste and reducing the environmental impact of residual waste management. The proposed development will maximise the extraction and recovery of valuable material (in the form of ferrous and non ferrous metals) and energy (in the form of 21 megawatts of electricity) resources from residual waste. The location of the site is shown in **Appendix 1 Figure 1,** and an overview of the proposed development is provided in **Appendix 1, Figure 2.**

The site for the Ringaskiddy Resource Recovery Centre is located approximately 15km to the south-east of Cork City, in the townland of Ringaskiddy on the Ringaskiddy Peninsula in the lower part of Cork harbour. The site is located approximately 800m east of the village of Ringaskiddy.

The L2545, the main road from Ringaskiddy village to Haulbowline Island forms the northern boundary of the site. The eastern boundary of the site extends to the foreshore of Cork harbour along Gobby Beach. The site surrounds the Hammond Lane Metal Recycling Co Ltd facility. The site is relatively level to the immediate south of the L2545 road and rises up steeply to the south. At the top of this steep scarp the ground rises more gently to the southern site boundary along the top of the ridge.

The site encircles the Hammond Lane Metal Recycling Company's facility. Hammond Lane expanded its facilities in 2015. There is also an ESB Networks compound located adjacent to the eastern boundary of the Hammond Lane facility. The land to the immediate south of

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the Indaver site is owned by IDA Ireland and is in agricultural use. The land to the west of the site is also in agricultural use.

4.2 Main features of the Ringaskiddy Resource Recovery Centre

The main elements of the proposed Ringaskiddy Resource Recovery Centre are a waste-to-energy facility (waste incinerator), an upgrade of a section of the L2545 road, coastal protection measures on Gobby Beach, a connection to the national electrical grid, and raising the ground levels in part of the site. The proposed Ringaskiddy Resource Recovery Centre is described below.

The waste-to-energy facility, or incinerator with energy recovery,will treat up to up to 240,000 tonnes per annum of residual household, commercial and industrial non-hazardous and hazardous waste which is currently landfilled or exported. The 240,000 tonnes per annum will include up to 24,000 tonnes per annum of suitable hazardous waste, which will be treated at the facility.

It is proposed that the waste-to-energy facility will operated 24 hours per day, seven days a week and for an average of 8,000 hours per year. There will be planned shut downs for maintenance. Waste acceptance will be limited to the hours 06.00 to 20.00 on week days and 09.00 to 14.00 on Saturdays.

4.2.1 Overview of waste-to-energy facility

The waste-to-energy facility will have the following elements:

- Main process building: this building will be up to 176m x 81m in plan and up to 45.7m in height, with a stack extending to 75m above Ordnance Datum. This building will accommodate the main waste-to-energy plant and equipment including the bunker, the furnace, the boiler and the flue gas cleaning equipment and ancillary equipment. The warehouse, for spare parts storage, an administration area containing facilities and offices for the waste-to-energy operations staff and a laboratory, and a workshop will be located in this building.
- Turbine hall: this building will be located to the south of the main process building and will be circa 25m x 15m in plan and 16m in height. This building will house the steam turbine. The aero-condenser structure will be locate adjacent to the turbine hall and will support the air cooled condenser fans.
- Security building/gate house: this will be a small, single storey area which forms part of the the administration building. The site security personnel will be based in this building, from which they will control access to the site.
- Administration building; this building will be a two-storey building located to the west of the main entrance. The building will primarily contain office space and meeting rooms for staff but will also have a visitors' centre and a training centre.
- Firewater storage tank and pump house: The storage tank for the water to be used in fighting a fire and a building to house the fire water pumps will be located in the south-eastern corner of the site.
- Surface water attenuation tank and firewater retention tank: tanks for the storage of surface water and potentially contaminated water, following use in fighting a fire, will be located underneath the administration building car park in the northern part of the site.
- Weigh bridges: these will be located in the main entrance, adjacent to the gate house.

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- Light fuel oil storage tank, ammonia storage tank: a tank for the storage of light fuel oil and a tank for the storage of ammonia will be located in the southern part of the site.
- Aqueous waste tank: aqueous waste will be stored in a take, which will be located adjacent to the aero-condenser structure.
- The electricity import/export substation and compound within the Indaver site will be located east of the main entrance to the waste-to-energy facility.
- Site Lighting will include a mixture of 6m high pole mounted lights to light up entrances and roads with full cut off LED light head fixtures to reduce any light pollution into the surrounding area. There will be 3 number low intensity obstacle lights at the top of the stack, Emergency access: a second site access will be provided, for use in emergencies.
- A public amenity footpath and viewing gallery, located outside the facility's security fence, will be provided along part of the southern and eastern site boundaries.

The design of the proposed facility has been optimised to include the most up to date emissions control and flue gas cleaning technology. The waste-to-energy process will consist of a number of main process elements as follows:

- waste acceptance
- waste intake and storage
- combustion process
- energy recovery process
- Emissions reduction/ flue gas cleaning.

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4.2.2 Waste Intake

Solid Waste

Solid hazardous and non-hazardous waste will arrive at the site in covered trucks. All trucks carrying waste to the waste-to-energy facility will pass through a scanner to detect the presence of any radioactive elements. Radioactive waste will not be accepted in the facility.

The trucks carrying waste will be weighed when entering and leaving the facility. Drivers will present their documentation, relating to the waste load, to the staff in the security gatehouse. Some trucks, on long-term contracts and carrying non-hazardous waste, will access the facility using a swipe card, which will record their details.

Following completion of the waste acceptance procedures, the trucks carrying solid waste will proceed via the site road to the enclosed waste reception or tippinghall.

The trucks containing solid waste will enter the supervised reception hall and will be directed towards discharge chutes. The trucks will discharge the waste into the bunker through chutes in the wall of the waste reception hall.

To prevent the emission of odours, the waste reception hall will be maintained under negative pressure, i.e. air will be drawn in through any openings rather than escaping out. Air for combustion will be drawn from the reception hall through the waste bunker. As the waste reception hall will be an enclosed area, windborne litter will not be generated.

The waste bunker capacity has been chosen to allow the facility to accept waste during periods when the furnace is shut down for maintenance and also to allow the facility to continue operating over prolonged periods, such as long weekends, without deliveries.

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Crane operators, positioned in the control room/crane operator room overlooking the bunker, will use travelling grab cranes to mix the waste in the bunker, so that despite the variety within the solid waste loads delivered, the feed to the furnace will be relatively uniform. The waste will be transferred by crane from the bunker via a hopper to the furnace.

Aqueous waste

Aqueous waste, which will be delivered by road tanker, will be sampled and analysed prior to offloading. This sampling may be done before or after arrival on site. If sampled and analysed on site, the sampling will be done in the aqueous waste unloading area adjacent to the aqueous waste storage tank. Key parameters will be analysed to ensure conformity with the specified waste acceptance criteria and with the parameters agreed with customers. In the event that the specification for the aqueous waste load is not met, the waste will not be accepted and arrangements will be made for the dispatch of the road tanker to the most suitable facility either in Ireland or abroad. If the aqueous waste load meets the acceptance criteria, the waste will be offloaded either into the aqueous waste storage tank or, directly, by injection to the furnace.

4.2.3 Combustion Process

A moving grate furnace is proposed for the facility. Grate furnaces are used for the destruction of a wide variety of waste streams and are a well-recognised, robust and established technology for these purposes. Waste is burned on the grate for a period of 1 hour approximately, and the resultant flue gases must maintain a temperature of 850°C for a minimum of 2 seconds after the last injection of air to ensure complete combustion of any volatiles and unburned flue gas components. In reality the flue gas temperatures range from 850°C to 1,200°C in the combustion zone above the grate. These temperatures ensure destruction of organics and other flue gas components. This means that a hazardous substance that is fed into the furnace does not come out unchanged as the same hazardous substance, either in the residues or in the exhaust gases. In the furnace the hazardous substance is oxidised which means it under goes a chemical reaction and is converted into one or more different substances with different properties. These different substances are removed in the ash or flue gas cleaning residues and a very small quantity is discharged to the air in the exhaust gases. Compounds such as dioxins which form after combustion is complete (and at lower temperature windows in the boiler of around 450°C) are removed by the injection of activated carbon/clay.

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The moving grate furnace will operate in a similar fashion to an escalator, pushing waste from the top of the furnace to the bottom to ensure complete combustion. The moving grate furnace is considered to be a ‘Best Available Technique’ for the treatment of the types of waste proposed.

The moving grate mechanism will transport the waste slowly from the feed point at the top of the furnace to the ash discharge at the bottom of the furnace. The rate at which the waste will travel through the furnace will be controlled to optimise the combustion. The waste will be in the furnace for approximately one hour.

As the waste enters the hot furnace the material will be heated due to contact with the hot flue gases and radiated heat from the walls of the furnace. The initial heat will drive off the moisture from the waste. In the next stage in the combustion process, the combustible gases and vapours will be driven off.

The volatile components of the organic material contained in municipal solid waste typically are produced in the form of hydrogen, carbon monoxide, methane and ethane. The combustion of these volatiles will take place in the furnace, immediately above the surface of the waste and in the combustion chamber above the grate.

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The volatile gases and vapours released will immediately ignite in the furnace due to the temperature of the furnace gas, which will be within the range 850˚C and 1,000˚C. Typical mean residence times of the gases and vapours in the combustion chamber will be 2 to 4 seconds.

The final section of the grate will be the burnout section where the ash will be held for long enough to ensure sufficient burnout.

The grate will discharge the resultant bottom ash into a water bath/ wet de-slaggers, and then via a conveyor to the ash hall.

Ash, which is finer than the bottom ash, will fall through the slits and gaps between the grate bars of the furnace into hoppers located under the grate. This finer ash, known as 'grate siftings', will be transferred by conveyor belt from the hoppers to the water bath/wet de-slaggers.

4.2.4 Energy Recovery

The hot flue gases from the moving grate furnace will be directed through a steam boiler. In the boiler heat will be transferred from the hot flue gases to water to generate steam. The steam from the boiler will drive a turbine, which will drive an electricity generator. Approximately 21MW of electricity will be generated, of which approximately 18.5MW will be exported to the national electrical grid.

4.2.5 Emission Reduction

Dioxins and Furans

Dioxins and furans are complex chlorinated hydrocarbon molecules, which are formed as a consequence of any combustion process. The facility will be designed to minimise the formation of dioxins and furans (the term 'dioxin' is taken to include dioxins and furans) in the furnace by maintaining the flue gases at a high temperature of over 850˚C for over 2 seconds. However, there is the potential that formation of dioxins would occur over the temperature range 450˚C to 250˚C during cooling of the flue gases in the latter stages of the boiler. In order to minimise the formation of dioxins in the boiler the following design measures will be implemented:

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- Automatic controlled cleaning, by mean of fixed installed cleaning devices, of the heat transfer surfaces in the boiler to reduce the amount of metals, particularly copper, present which can act as a catalyst in the formation of dioxins.
- Rapid cooling over the range 450˚C to 250˚C by increasing the velocity of the flue gases through the section of the boiler where cooling over this temperature range will occur. This increase in velocity will accelerate heat transfer and cool the gases more rapidly.

These measures will reduce the dioxin concentration in the flue gases to a low level. The flue gas cleaning equipment, described below, will further reduce dioxin concentrations in the flue gas to well below the EU emission limits.

Oxides of Nitrogen

All combustion processes lead to the formation of oxides of nitrogen. These will be controlled in two ways. The combustion process in the furnace will be optimised to minimise the oxidation of nitrogen in the combustion air and the furnace materials will be selected to ensure optimal flue gas temperature. Ammonia solution or urea will be injected into the flue gases into the first section of each boiler. This process uses the chemical reaction of ammonia and nitrogen oxides at high temperature to convert nitrogen oxides to nitrogen and water vapour.

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4.2.6 Flue Gas Cleaning

The flue gas cleaning equipment will reduce dioxin concentrations in the flue gas to levels well below the limit set in the EU Industrial Emissions Directive 2010/75/EC. Typical dioxin emissions from a facility with this equipment are one tenth of the concentration limit in the EU Industrial Emissions Directive.

The flue gas leaving the boiler will still be relatively hot at approximately 180˚C and will be further cooled in the cooling section to a temperature of about 145˚C. The lower temperature is required for the optimal operation of the lime and activated carbon or clay injection downstream.

A fixed amount of activated carbon or a carbon/clay mixture will be injected into the flue gases in the cooling stage and also into the flue gas either in the dry reactor or just after it. Activated carbon consists of small, porous carbon particles, which due to their porosity have a very large surface area. Dioxins, furans, other trace organic compounds and heavy metals in the flue gases will be adsorbed onto the activated carbon particles. The flue gases will then pass through a baghouse filter which will remove the dust, salts and the carbon particles from the gases. The dust cake forming in the baghouse filter will be removed and collected in hoppers located below.

The flue gases will then be discharged through the stack, the top of which will be at a level of 75mOD.

The stack emissions will be monitored as required by the EU Industrial Emissions Directive and in compliance with industrial emission licence.

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4.2.7 Ash and Solid Residues

Three types of ash and residues will be produced in the waste-to-energy plant. The average annual ash tonnages, assuming the plant is operating for 8000 hours, are given below:

- Bottom ash, 52,664 tonnes (15% moist)
- Boiler ash, 2,000 tonnes
- Flue gas cleaning residues, 9,104 tonnes

The bottom ash will be a non-hazardous material and may be suitable for use in road construction. It is expected that the flue gas cleaning residues will be classified as requiring disposal in a hazardous waste landfill. It will be exported abroad for recovery in a salt mine or for disposal to a hazardous waste landfill, until a suitable landfill for hazardous waste is developed in Ireland. The boiler ash will be treated the same way as the flue gas cleaning residues. An annual average of 2,400 tonnes of ferrous metals, such as steel and 240 tonnes non-ferrous metals will be recovered from the bottom ash for recycling.

4.2.8 Process Inputs

The average conusmption of water in the proposed faclity will be 6.08 cubic metres per hour. Circa 400 tonnes of light fuel oil will be used per annum to raise the temperature of the furnace at start up and to maintain the temperature as required. Other materials which will be consumed will included lime, sodium hydroxide, hydrochoric acid, ammonia or urea, activated carbon and activate carbon/clay mix.

4.2.9 L2545 Road Upgrade

Upgrade works are proposed to a section of the L2545 local road, which is the road that adjoins the northern boundary of the site. The proposed works will consist of raising the level of a section of the road and improving the surface water drainage to alleviate local flooding issues along the road.

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Background to flooding of the L2545 road

Part of the L2545 road close to Gobby Beach is below the calculated 1 in 200 year high tide level. The L2545 road, which adjoins the northern boundary of the site, is prone to flooding during periods of heavy rainfall combined with high tide. The existing storm water drainage system along the road is collected in a 450mm diameter pipe. This drainage pipe discharges into the sea at Gobby Beach. Once the level of the tide rises above the level of the outfall from the pipe, the surface water is unable to discharge and collects in the pipe. Rain water falling on the road subsequently cannot discharge and collects on the road. In addition, there are a minimal number of gullies along the road to collect the rain water and transfer it to the 450mm diameter pipe.

Part of the western field area of the Indaver site is at a lower level than the adjacent road. A number of channels have been cut in the mound which forms the road boundary of the western field. These channels allow surface water to drain from the road into the western field.

Description of L2545 Upgrade

The L2545 upgrade has been designed to address the above issues.

The proposed L2545 upgrade works will include raising a 185m length of the road to a maximum height of 3.45m above ordnance datum between the car park and the eastern end of the Hammond Lane Metal Company premises. This level is approximately 0.9m above the existing road level. This will elevate the road to above the 200 year design tidal high water level, which has been estimated as 2.73m OD, plus an allowance for climate change. This will offer a high level of protection to the road from tidal flooding. There will be a smooth transition from the new level down to existing road levels, in accordance with road design standards. The recently constructed footpath on the northern side of the road will also be raised to the new road level.

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The proposed road drainage upgrade will extend along the entire northern boundary of the Indaver site. Oversized drainage pipes will be placed underneath the road to provide storage for rainwater. The storage has been designed to cater for the 6.5 hours, when the tide level is above the level of the end of the outfall pipe, and a 1 in 30 year rainfall event plus an allowance for climate change. New drainage channels and gullies will be provided in the road and a new Class 1 bypass hydrocarbon interceptor will be installed on the outfall pipe. All of the above works will be within Indaver ownership, apart from a small area in Hammond Lane ownership. Consent has been given by Hammond Lane to undertake these works. Further details on flood risk are provided in **Flood Risk Assessment, Appendix 16**

4.2.10 Increase in levels of the Indaver site

The ground levels of the Indaver site vary considerably in both the north-south direction and the east-west direction. Along the southern boundary of the site the levels vary from circa 10m OD to circa 41m OD. Along the northern boundary of the site the ground levels vary from circa 2.4m OD to circa 4.0m OD. The levels of the low-lying parts of the site will be raised to 4.55m OD. This level will offer a very high standard of flood protection to the site.

4.2.11 Coastal Protection Measures

Coastal protection measures are proposed along the eastern boundary of the Indaver site. It is proposed that approximately 1,100m^3 of sacrificial material, comprising shingle of appropriate size and rounded shape, are deposited on the beach in the area extending from the car park at the north-eastern corner to the southern boundary of the Indaver site.

The sacrificial material has been designed to remain on site and help lower the natural erosion rate over a number of years. The length of time that the material remains in place

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will depend on the occurrence of extreme wave events. The sacrificial material and the glacial till face will be monitored and the sacrificial material will be replenished as required

The proposed protection measures are a soft solution and will not have significant affect the adjoining areas of coastline in the vicinity of the site. The net coastal sediment transport will go from south to north according to wind conditions and swell. Therefore the material is likely to move towards the north in the medium and long term. The Cork Harbour Special Protection Area (SPA) is located to the south west of the site. The sacrificial material will not impact on the SPA.

4.2.12 Grid Connection

The waste-to-energy facility will be connected to the national electrical grid via the ESB Lough Beg 38kV electrical substation adjacent to the eastern boundary of the Hammond Lane facility. ESB Networks has confirmed that the extension of the 38kV line into the Indaver site could be over ground or underground. Indaver has selected the underground option and the proposed routing for the underground lines has been identified on the drawings. The routing has been designed in line with ESB guidelines and standards. The electricity import/export substation and compound will be located east of the main entrance to the waste-to-energy facility. The compound will be divided into two adjacent parts. One part will be dedicated to the infrastructure required by ESB Networks and will also contain a substation building for the ESB metering and associated equipment. The other part will accommodate Indaver's equipment and will contain a transformer and other associated equipment. Within the ESB Lough Beg 38kV substation, the connection will be via a cable connection within the ESB substation building or a cable connection directly to a cable on the existing end mast.

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4.2.13 Implementation of Best Available Techniques in the Waste-To-Energy Facility

Best Available Techniques are techniques recommended by the EU for use in designing industrial facilities to minimise pollution.

Best Available Techniques have been included in the design of the proposed Ringaskiddy Resource Recovery Centre and will be applied in its ongoing operation, management and control. These include:

- plant management systems,
- plant safety systems,
- waste inspection, checking, testing and acceptance,
- waste handling and storage,
- choice of furnaces and flue gas cleaning systems,
- design, operation and control of the furnaces and flue gas cleaning systems,
- energy recovery and energy efficiency,
- optimisation of resource use, and
- handling of residues

4.3 Appraisal of ecological baseline conditions

Appendix 10 of this NIS details the ecological baseline of the proposed development site based on direct surveys of the entire Indaver site and surrounding area and a review of desktop data. A flora and fauna report was prepared previously by the Aquatic Services Unit, University College Cork in 2001 for an EIS for the Indaver Ireland planning application for a Waste Management Facility at this location. Dixon Brosnan previously prepared the Flora and Fauna chapters for similar EISs submitted in 2008 and an addendum to the EIS prepared in 2010. These reports were consulted during the preparation of the EIS.

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In addition to the baseline surveys carried out for previous applications, the following surveys were carried out in 2014/2015:

- Habitat mapping
- Surveys of wintering birds
- Breeding birds surveys
- Common tern breeding survey
- Intertidal survey

4.3.1 Habitat Mapping

Terrestrial habitat mapping was carried out in line with the methodology outlined in the Heritage Council publication *Best Practice Guidance for Habitat Survey and Mapping* (Heritage Council, 2011) in 2014 and 2015. All habitats within the study area were classified to level 3 of the classification scheme outlined in *A Guide to Habitats in Ireland* (Fossit, 2000) and cross-referenced with habitats listed under Annex I of the Habitats Directive.

Due to an absence of high agricultural management, a high proportion of the study area, including the proposed development site, is covered in scrub which has become more dominant over time. The remainder of the site consists of pasture and tillage fields that remain under conventional agricultural management. Some areas of Japanese Knotweed were recorded outside the proposed development footprint; this will be eradicated from the site.

The following habitats were recorded within the entire Indaver landholding: Hedgerow WL1/Treelines WL2, Dry meadow and grassy verge GS2/Wet grassland GS4, Scrub WS1, Immature woodland WS2, Broadleaved woodland WD1, Improved agricultural grassland GA1, Conifer woodland WD3, Dense bracken HD1 and Arable crops BC1. Habitat value ranged from Low value (Local Importance) to Negligible. The impact on these habitats ranged from Minor to Negligible.

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4.3.2 Marine Habitats

A survey of the intertidal area in proximity to the proposed development was carried out by Dr. Stiofan Creaven in June, 2015. The survey report is included in **Appendix 17** to the NIS. The marine flora and fauna was examined with survey effort timed to correspond with low water on a Spring tide when as much of the shore as possible is exposed. The survey classified the habitats encountered during the survey as follows:

- The upper shore here can be classed as Barren Littoral Shingle (EUNIS habitat code A2.111).
- Bedrock and boulders were found scattered throughout the mid and lower shore. Vertical surfaces on these were characterised by a barnacle-limpet community (EUNIS habitat code A1.1131).
- Boulder tops, dominated by *Fucus spiralis*, can be classified as *Fucus spiralis* on sheltered upper eulittoral rock (EUNIS habitat code A1.312). In summer, the green alga *Ulva intestinalis* can become very common – as seen on the shore at Ringaskiddy. Vertical surfaces often lack the fucoid cover and are characterised by the barnacle-limpet community (EUNIS habitat code A1.1131) also seen on this beach.
- The presence of a substantial deposit of decaying algal matter in the mid shore complicates the allocation of a habitat type to this zone though the floral and faunal community encountered closely resembles *Fucus vesiculosus* on variable salinity mid eulittoral boulders and stable mixed substrata (EUNIS habitat code A1.323). The presence of ephemeral seaweeds (green algae here) occupying available space and

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patches of sediment found between the hard substrata containing the lugworm *Arenicola marina* and the sand mason *Lanice conchilega*, support this classification. The exposure level of this shore probably changes seasonally from sheltered to moderately exposed/exposed during storm events.

- The lower shore is characterised by littoral muddy sands with the habitat falling into a Polychaete/Bivalve-dominated muddy sand shore (EUNIS habitat code A2.24). Based on analysis of infaunal samples taken during the transects, this most closely resembles a *Macoma balthica* and *Arenicola marina* in muddy sand shores biotope (EUNIS habitat code A2.241) though with *Abra* present instead of *Macoma*. It also has elements of *Lanice conchilega* in littoral sand (EUNIS habitat code A2.245).

An attempt was made to obtain faunal samples at all stations visited. This effort was successful at two stations. The assemblage recorded is close to the EUNIS LS.LSa.MuSa.Lan Lanice conchilega in littoral sand grouping but instead of *Macoma balthica*, *Abra* is present. (EUNIS code A2.24 – Polychaete/bivalve dominated muddy sand shores). The common cockle (*Cerastoderma edule*) was also present here.

The report concluded that these habitats are all commonly encountered in an Irish context. Samples were faunally poor with only ten taxa present. All species found are typical of fine grained sediments of the North East Atlantic. No rare or uncommon species were recorded.

4.3.3 Birds

A detailed bird survey report is included as **Appendix 18**. Information on birds is summarised below.

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Breeding Bird and site usage

Breeding bird surveys were carried out by DixonBrosnan during May 2008 using transect and point count methods. A total of 35 bird species were recorded during site visits. These results were largely comparable with those from surveys carried out at the same site in 2001. A breeding bird survey was carried also carried out by DixonBrosnan in May and June 2010 covering the area of shoreline potentially affected by coastal works and adjoining areas of habitat. Areas of scrub and grassland was found to support a mixture of typical countryside birds including Chaffinch, Willow Warbler, Wood Pigeon, Blackbird and corvid species.

As the coastal area in proximity to the site does not have extensive mudflats, there was a preponderance of species associated with rocky/shingle shore habitats. Such species include Rock Pipit, Ringed Plover and Oystercatcher. Other species noted include piscivorous species such as Common Tern, Cormorant, Grey Heron and Little Egret. Four gull species namely Herring Gull, Greater Blackbacked Gull, Common Gull and Blackheaded Gull were also recorded.

Of the species recorded during the survey, six species (Oystercatcher, Cormorant Common Tern, Grey Heron, Blackheaded Gull and Common Gull) are listed as birds of special conservation interest for the Cork Harbour SPA.

Certain bird species are listed by BirdWatch Ireland as Birds of Conservation Concern in Ireland (Lynas et al., 2007). Red List bird species are of high conservation concern, and Amber List species are of medium conservation concern. Two Red Listed species were recorded (Herring Gull and Black Headed Gull) and five amber listed species were recorded. (Swallow, Starling, Greater Black-Backed Gull, Cormorant and Common Gull).

In 2015, further breeding bird surveys were undertaken over three visits in May and June using a adapted version of the British Trust for Ornithology's (BTO) Common Bird Census Technique (Bibby *et al*., 2000 & Gilbert *et al*., 1998), with aspects of species specific survey

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methodologies employed where required (Gilbert *et al*., 1998). More detail on the methodology and the results are provided in **Appendix 18.**

A total of 28 species were recorded in the breeding bird survey. However it is noted that not all of these species were breeding within the site. The results indicate that the bird community currently using the site is similar to that recorded previously. The reduction in bird species diversity (35 species in 2008 in comparison to 28 species in 2015) may be due to increased dominance of scrub and a reduction in areas of semi-natural grassland.

Survey of Common tern-breeding

A breeding population of Common Tern is known to occur near the entrance to the Port of Cork approximately 750km from the proposed development area. A previous survey for the Ringaskiddy Port Redevelopment EIS (Port of Cork/RPS, 2014) recorded 45-50 breeding pairs on concrete structures (dolphins) adjacent to the entrance of the Port of Cork. Dixon Brosnan resurveyed this Common Tern breeding colony over three days in May and June 2015, as this is the most significant breeding bird colony in the surrounding landscape. Approximately 50-55 breeding pairs were recorded (mean 53 breeding pairs).

Winter bird surveys

The winter bird surveys were undertaken on six dates between October 2014 and March 2015 (refer to **Appendix 18**). The survey methodology was based on that used by the British Trust for Ornithology's (BTO) Wetland Bird Survey (WeBS) and also that for the Irish Wetland Bird Survey (I-WeBS). Ninety minute counts were undertaken monthly at either high tide, mid tide and low tide. Survey vantage point locations for the winter bird counts are shown in **Appendix 18.**

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A total of 38 bird species were recorded during the 2014/2015 winter bird surveys as detailed below in **Table 1**. It is noted that many of these birds were recorded overflying the channel, and that the survey covered a radius of approximately 300m from each vantage point. Five species (Mediterranean Gull, Dunlin, Little Egret, Great Northern Diver and Common Tern) are listed on Annex I of the Birds Directive. Certain bird species are listed by BirdWatch Ireland as Birds of Conservation Concern in Ireland. Red List bird species are of high conservation concern and the Amber List species are of medium conservation. Six red listed species were recorded namely Herring Gull, Curlew, Redshank, Black-Headed Gull, Dunlin and Knot.

The closest Special Protection Area (SPA) is the Cork Harbour SPA (Site Code 004030). A total of thirteen species listed as qualifying interests for the Cork Harbour SPA were recorded, namely, Cormorant, Oystercatcher, Dunlin, Curlew, Redshank, Greenshank, Great Crested Grebe, Grey Heron, Teal, Black-headed Gull, Common Gull, Lesser Black-backed Gull and Common Tern.

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Table 1. Winter bird counts results

Species	High tide count total	Mid tide count (total)	Low tide count (total)
Oystercatcher	20	52	109
Blackheaded Gull		3	53
Herring Gull		4	17
Black Guillemot			3
Lesser Blackbacked gull	3	1	6
Cormorant	9	9	14
Common Gull	10	27	64
Redshank	2	4	11
Curlew		4	7
Mallard	3		
Glaucous Gull	1	1	5
Grey Heron	1	3	10
Hooded Crow	9	9	28
Wood Pigeon	23	3	12
Rook	234	31	10
Blackbird	2		8
Robin			2
Tree Sparrow	6		
Thrush		1	
Little Egret		4	7
Greater Blackbacked Gull	3	6	2
Greenshank		3	14
Mediterranean Gull			1
Teal			4
Great Crested Grebe		1	2
Brent Goose		69	107
Sanderling		2	
Goldfinch	1		2
Grey Wagtail	1	2	7
Meadow Pipit		1	2
Wren			1
Blue Tit		1	3
Turnstone			4
Knot			4
Great Northern Diver	2	1	1
Dunlin		225	
Jackdaw	7		
Starling		30	

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Winter roost cormorant

A night-time tree-roosting Cormorant survey was undertaken within Monkstown Creek during the 2011/12 and 2013/14 wintering seasons as part of the Ringaskiddy Port Redevelopment, Environmental Impact Statement (Port of Cork, 2014). The surveys recorded that during both wintering periods the Monkstown Creek tree-roost regularly supported nationally important numbers of roosting Cormorants. The number of cormorants using the Monkstown Creek tree-roost rose through late summer and autumn, peaking in October/November. The total peak number of birds recorded using the tree-roost was 334 birds, representing 2.45% of the most recently published Irish wintering population of 13,710 and 54.19% of the Cork Harbour SPA qualifying population at the time of designation (620 wintering individuals). The peak count also represents 133% of the most recently 5-year mean for Cork Harbour (252 individuals). The closest site, included within this night-time tree-roosting Cormorant survey, is located 1km from the proposed development area within the Indaver site.

Birds summary

Overall, the study area is of local value for a range of terrestrial bird species that are relatively common in the Irish countryside. The study area is of more value than the intensively agriculturally managed land in this area due to the presence of a greater diversity of habitats and semi-natural habitat. These have arisen due to an absence of active management of parts of the site. However, the study area does not support a community of birds or individual species that would be considered significant conservation value, and the study area, which is small, does not provide critical resources for such communities and/or species.

The coastal area adjoining the site consists primarily of rock and shingle, and therefore does not support the high numbers of wintering waders that are characteristic of high value mudflats with high densities of macro-invertebrates. Some species that are considered of high conservation value (Annex I of the Birds Directive, qualifying species for the Cork Harbour SPA and Red List) were noted in this general area. Many of these birds were recorded overflying the channel, and the site itself and the shoreline adjoining the site, did not support high numbers of these species.

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4.4 Natura 2000 sites

4.4.1 Designated sites within a 20km radius

Natura 2000 sites within a 20km radius of the proposed development site are listed below in Table 2. These Natura 2000 sites are shown in Figure 3. It is noted that use of a 20km radius is a precautionary measure, as impacts at this distance from the proposed development are highly unlikely in the absence of significant aqueous emissions to the marine environment. Air emissions will not be significant at 20km from the site.

Table 2. Designated sites within 20km

Designated site	Distance from site of proposed development
Candidate SAC sites	
Great Island Channel candidate Special Area of Conservation (Site code 001058)	Approximately 5 km north
SPA sites	
Cork Harbour Special Protection Area (Site code 004030)*	Approximately 0.5 km south
Ballycotton Bay Special Protection Area (Site code 004022)	Approximately 18.4km east
Sovereign Islands SPA (Site code 004124)	Approximately 19.7km southwest

*The SPA has been extended to include the estuary at Ringabella.

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4.4.2 Qualifying interests

The qualifying interests for the Great Island Channel cSAC, Cork Harbour SPA and Ballycotton Bay SPA and Sovereign Islands SPA and the relevant conservation objectives are listed in **Tables 3, 4, 5 and 6** respectively.

Table 3. Qualifying interests for the Great Island Channel SAC (001058)

Habitat Code	Habitat	Conservation objectives
1140	Mudflats and sandflats not covered by seawater at low tide	Maintain
1330	Atlantic salt meadows (Glauco-Puccinellietalia maritimae)	Restore

Table 4. List of qualifying interests under the EU Birds Directive for Cork Harbour SPA 004030

Annex of EU Birds Directive	Common Name	Scientific name	Conservation objectives
N/A	Cormorant	*Phalacrocorax carbo*	Maintain
N/A	Shelduck	*Tadorna tadorna*	Maintain
N/A	Oystercatcher	*Haematopus ostralegus*	Maintain
Annex 1	Golden Plover	*Pliuvialis apricaria*	Maintain
N/A	Lapwing	*Vanellus vanellus*	Maintain
N/A	Dunlin	*Calidris alpine*	Maintain
N/A	Black-tailed godwit	*Limosa limosa*	Maintain
N/A	Bar-tailed godwit	*Limosa lapponica*	Maintain
N/A	Curlew	*Numenius arquata*	Maintain
N/A	Redshank	*Tringa tetanus*	Maintain
N/A	Greenshank	*Tringa nebularia*	Maintain
Annex 1	Common tern	*Sterna hirundo*	Maintain
N/A	Little grebe	*Tachybaptus ruficollis*	Maintain
N/A	Great crested grebe	*Podiceps cirstatus*	Maintain
N/A	Grey heron	*Ardea cinerea*	Maintain
N/A	Wigeon	*Anas Penelope*	Maintain
N/A	Teal	*Anas crecca*	Maintain
N/A	Pintail	*Anas acuta*	Maintain
N/A	Shoveler	*Anas clypeata*	Maintain
N/A	Red-breasted merganser	*Mergus serrator*	Maintain
N/A	Grey plover	*Pliuvialis sqyuatarola*	Maintain
N/A	Black-headed gull	*Larus ribundus*	Maintain
N/A	Common gull	*Larus canus*	Maintain
N/A	Lesser black-backed gull	*Larus fuscus*	Maintain
	Wetlands		

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Table 5. List of qualifying interests under the EU Birds Directive for Ballycotton Bay SPA (Site Code 004022)

Annex of EU Birds Directive	Common Name	Scientific name	Conservation Objectives
N/A	Teal	*Anas crecca*	**Objective 1:** To maintain the favourable conservation condition of the non-breeding waterbird Special Conservation Interest species listed for Ballycotton Bay SPA. **Objective 2:** To maintain the favourable conservation condition of the wetland habitat at Ballycotton Bay SPA as a resource for the regularly-occurring migratory waterbirds that utilise it.
N/A	Ringed Plover	*Charadrius hiaticula*	
Annex 1	Golden Plover	*Pliuvialis apricaria*	
N/A	Grey plover	*Pliuvialis sqyuatarola*	
N/A	Lapwing	*Vanellus vanellus*	
N/A	Black-tailed Godwit	*Limosa limosa*	
N/A	Bar-tailed Godwit	*Limosa lapponica*	
N/A	Curlew	*Numenius arquata*	
N/A	Turnstone	*Arenaria interpres*	
N/A	Common gull	*Larus canus*	
N/A	Lesser Black-backed gull	*Larus fuscus*	
	Wetlands		

Table 6 List of qualifying interests under the EU Birds Directive for Sovereign Islands SPA(Site code 004124)

Annex of EU Birds Directive	Common Name	Scientific name	Conservation Objecitve
N/A	Cormorant	*Phalacrocorax carbo*	To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA

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4.4.3 Site synopses

Cork Harbour Special Protection Area (Site Code 004030)

Cork Harbour is a large, sheltered bay system, with several river estuaries - principally those of the Rivers Lee, Douglas, Owenboy and Owennacurra. The SPA site comprises most of the main intertidal areas of Cork Harbour, including all of the North Channel, the Douglas River Estuary, inner Lough Mahon, Monkstown Creek, Lough Beg, the Owenboy River Estuary, Whitegate Bay and the Rostellan and Poulnabibe inlets.

Owing to the sheltered conditions, the intertidal flats are often muddy in character. These muds support a range of macro-invertebrates, notably *Macoma balthica*, *Scrobicularia plana*, *Hydrobia ulvae*, *Nepthys hombergi, Nereis diversicolor* and *Corophium volutator*. Green algae species occur on the flats, especially *Ulva lactua* and *Enteromorpha* spp. Cordgrass (*Spartina* spp.) has colonised the intertidal flats in places, especially where good shelter exists, such as at Rossleague and Belvelly in the North Channel. Salt marshes are scattered through the site and these provide high tide roosts for the birds. Salt marsh species present include Sea Purslane (*Halimione portulacoides*), Sea Aster (*Aster tripolium*), Thrift (*Armeria maritima*), Common Saltmarsh-grass (*Puccinellia maritima*), Sea Plantain (*Plantago maritima*), Laxflowered Sea-lavender (*Limonium humile*) and Sea Arrowgrass (*Triglochin*

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maritima). Some shallow bay water is included in the site. Cork Harbour is adjacent to a major urban centre and a major industrial centre. Rostellan Lake is a small brackish lake that is used by swans throughout the winter. The site also includes some marginal wet grassland areas used by feeding and roosting birds.

The site is designated as a Special Protection Area (SPA) under the E.U. Birds Directive, of special conservation interest for the following species: Little Grebe, Great Crested Grebe, Cormorant, Grey Heron, Shelduck, Wigeon, Teal, Pintail, Shoveler, Red-breasted Merganser, Oystercatcher, Golden Plover, Grey Plover, Lapwing, Dunlin, Blacktailed Godwit, Bar-tailed Godwit, Curlew, Redshank, Black-headed Gull, Common Gull, Lesser Black-backed Gull and Common Tern. The site is also of special conservation interest for holding an assemblage of over 20,000 wintering waterbirds. The E.U. Birds Directive pays particular attention to wetlands and, as these form part of this SPA, the site and its associated waterbirds are of special conservation interest for Wetland & Waterbirds.

Cork Harbour is an internationally important wetland site, regularly supporting in excess of 20,000 wintering waterfowl, for which it is amongst the top five sites in the country. The two-year mean of summed annual peaks for the entire harbour complex was 55,401 for the period 1995/96 and 1996/97. Of particular note is that the site supports internationally important populations of Black-tailed Godwit (905) and Redshank (1,782) - all figures given are average winter means for the two winters 1995/96 and 1996/97. At least 18 other species have populations of national importance, as follows: Little Grebe (51), Great Crested Grebe (204), Cormorant (705), Grey Heron (63), Shelduck (2,093), Wigeon (1,852), Teal (922), Pintail (66), Shoveler (57), Red-breasted Merganser (88), Oystercatcher (1,404), Golden Plover (3,653), Grey Plover (84), Lapwing (7,688), Dunlin (10,373), Bartailed Godwit (417), Curlew (1,325) and Greenshank (26). The Shelduck population is the largest in the country (over 10% of national total). The site has regionally or locally important populations of a range of other species, including Whooper Swan (10), Pochard (145) and Turnstone (79). Other species using the site include Gadwall (13), Mallard (456), Tufted Duck (113), Goldeneye (31), Coot (53), Mute Swan (38), Ringed Plover (34) and Knot (38). Cork Harbour is a nationally important site for gulls in winter and autumn, especially Black-headed Gull (4,704), Common Gull (3,180) and Lesser Black-backed Gull (1,440).

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A range of passage waders occurs regularly in autumn, including such species as Ruff (5-10), Spotted Redshank (1-5) and Green Sandpiper (1-5). Numbers vary between years and usually a few of each of these species over-winter.

The wintering birds in Cork Harbour have been monitored since the 1970s and are counted annually as part of the I-WeBS scheme.

Cork Harbour has a nationally important breeding colony of Common Tern (3-year mean of 69 pairs for the period 1998-2000, with a maximum of 102 pairs in 1995). The birds have nested in Cork Harbour since about 1970, and since 1983 on various artificial structures, notably derelict steel barges and the roof of a Martello Tower. The birds are monitored annually and the chicks are ringed.

Extensive areas of estuarine habitat have been reclaimed since about the 1950s for industrial, port-related and road projects, and further reclamation remains a threat. As Cork Harbour is adjacent to a major urban centre and a major industrial centre, water quality is variable, with the estuary of the River Lee and parts of the Inner Harbour being somewhat eutrophic. However, the polluted conditions may not be having significant impacts on the bird populations. Oil pollution from shipping in Cork Harbour is a general threat. Recreational activities are high in some areas of the harbour, including jet skiing which causes disturbance to roosting birds.

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Cork Harbour is of major ornithological significance, being of international importance both for the total numbers of wintering birds (i.e. > 20,000) and also for its populations of Black-tailed Godwit and Redshank. In addition, there are at least 18 wintering species that have populations of national importance, as well as a nationally important breeding colony of Common Tern. Several of the species which occur regularly are listed on Annex I of the E.U. Birds Directive, i.e. Whooper Swan, Golden Plover, Bar-tailed Godwit, Ruff and Common Tern. The site provides both feeding and roosting sites for the various bird species that use it. (NPWS, 2008).

Site synopsis Great Island Channel SAC (Site Code: 001058)

The Great Island Channel stretches from Little Island to Midleton, with its southern boundary being formed by Great Island. It is an integral part of Cork Harbour which contains several other sites of conservation interest. Geologically, Cork Harbour consists of two large areas of open water in a limestone basin, separated from each other and the open sea by ridges of Old Red Sandstone. Within this system, Great Island Channel forms the eastern stretch of the river basin and, compared to the rest of Cork Harbour, is relatively undisturbed. Within the site is the estuary of the Owennacurra and Dungourney Rivers. These rivers, which flow through Midleton, provide the main source of freshwater to the North Channel.

The site is a Special Area of Conservation (SAC) selected for the following habitats and/or species listed on Annex I / II of the E.U. Habitats Directive (* = priority; numbers in brackets are Natura 2000 codes):

[1140] Tidal Mudflats and Sandflats

[1330] Atlantic Salt Meadows

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The main habitats of conservation interest in Great Island Channel SAC are the sheltered tidal sand and mudflats and the Atlantic salt meadows. Owing to the sheltered conditions, the intertidal flats are composed mainly of soft muds. These muds support a range of macro-invertebrates, notably Macoma balthica, Scrobicularia plana, Hydrobia ulvae, Nepthys hombergi, Nereis diversicolor and Corophium volutator. Green algal species occur on the flats, especially Ulva lactua and Enteromorpha spp. Cordgrass (Spartina spp.) has colonised the intertidal flats in places, especially at Rossleague and Belvelly.

The saltmarshes are scattered through the site and are all of the estuarine type on mud substrate. Species present include Sea Purslane (Halimione portulacoides), Sea Aster (Aster tripolium), Thrift (Armeria maritima), Common Saltmarsh-grass (Puccinellia maritima), Sea Plantain (Plantago maritima), Greater Sea-spurrey (Spergularia media), Lax-flowered Sea-lavender (Limonium humile), Sea Arrowgrass (Triglochin maritimum), Sea Mayweed (Matricaria maritima) and Red Fescue (Festuca rubra).

The site is extremely important for wintering waterfowl and is considered to contain three of the top five areas within Cork Harbour, namely North Channel, Harper's Island and Belvelly-Marino Point. Shelduck is the most frequent duck species with 800-1,000 birds centred on the Fota/Marino Point area. There are also large flocks of Teal and Wigeon, especially at the eastern end. Waders occur in the greatest density north of Rosslare, with Dunlin, Godwit, Curlew and Golden Plover the commonest species. A population of about 80 Grey Plover is a notable feature of the area. All the mudflats support feeding birds; the main roost sites are at Weir Island and Brown Island, and to the north of Fota at Killacloyne and Harper’s Island. Ahanesk supports a roost also but is subject to disturbance. The numbers of Grey Plover and Shelduck, as given above, are of national importance.

The site is an integral part of Cork Harbour which is a wetland of international importance for the birds it supports. Overall, Cork Harbour regularly holds over 20,000 waterfowl and contains internationally important numbers of Black-tailed Godwit (1,181) and Redshank

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(1,896), along with nationally important numbers of nineteen other species. Furthermore, it contains large Dunlin (12,019) and Lapwing (12,528) flocks. All counts are average peaks, 1994/95 – 1996/97. Much of the site falls within Cork Harbour Special Protection Area, an important bird area designated under the E.U. Birds Directive.

While the main land use within the site is aquaculture (oyster farming), the greatest threats to its conservation significance come from road works, infilling, sewage outflows and possible marina developments.

The site is of major importance for the two habitats listed on Annex I of the E.U. Habitats Directive, as well as for its important numbers of wintering waders and wildfowl. It also supports a good invertebrate fauna. (NPWS, 2013).

Site synopsis Soverign Islands SPA (Site Code: 004124)

The Sovereign Islands are two very small islands located approximately 1 km off the Cork coastline at the entrance to Oysterhaven Bay. The islands are rocky stacks separated by a narrow sound of about 20 m width. The eastern island is flat-topped and rises to 24 m above sea level, the western one is more peaked and rises to 30 m. The geology is Lower Carboniferous limestones and shales. Both islands are largely devoid of soil apart from small amounts of organic matter trapped in cracks. Vegetation is sparse, with species such as Sea Beet (Beta vulgaris), Spurrey (Spergularia spp.) and Orache (Atriplex spp.) recorded. The surrounding seasto a distance of 200m, where seabirds forage, bathe and socialise, are included in the site.

The islands are important for breeding seabirds, with most on the eastern stack. A Cormorant colony has been known since the late 1960s and in 1999 156 nests were counted. Herring Gulls and Great Black-backed Gulls also breed, with 10 and 75 pairs respectively in 1999. The only other seabird which has been recorded breeding in recent years is Black Guillemot, with 10 individuals in April 1999.

This site is of ornithological importance mainly for the breeding colony of Cormorant, which is the largest in County Cork and is of National Importance. The population of Great Black-backed Gulls is also of National Importance. The site provides a very safe refuge for the nesting birds. Regular monitoring of the seabird populations has been carried out since the 1980s. (NPWS, 2003).

Site synopsis Ballycotton Bay SPA (Site Code: 004022)

Situated on the south coast of Co. Cork, Ballycotton Bay is an east-facing coastal complex, which stretches northwards from Ballycotton to Ballynamona, a distance of c. 2 km. The site comprises two sheltered inlets which receive the flows of several small rivers. The southern inlet had formerly been lagoonal (Ballycotton Lake) but breaching of the shingle barrier in recent times has resulted in the area reverting to an estuarine system.

The principal habitat within the site is inter-tidal sand and mudflats. These are mostly well-exposed and the sediments are predominantly firm sands. In the more sheltered conditions of the inlets, sediments contain a higher silt fraction. The inter-tidal flats provide the main feeding habitat for the wintering birds. Sandy beaches are well represented. The shingle beach is mobile and is influenced by storms, which create open conditions that favour a particular suite of species. Species found here include Grass-leaved Orache (Atriplex littoralis), Black Mustard (Brassica nigra), Sand Couch (Elymus farctus) and Lyme-grass (Leymus arenarius). Also growing on the shingle beach is Sea-kale (Crambe maritima), a rare species that is listed in the Red Data Book. Salt marshes fringe the flats in the sheltered inlets and these provide high tides roosts. A small area of shallow marine water is also included.

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Ballycotton Bay supports an excellent diversity of wintering waterfowl species, and has nationally important populations of nine species as follows (all figures are average peaks for the 5 winters 1995/96-1999/00): Teal (1,296), Ringed Plover (248), Golden Plover (4,284), Grey Plover (187), Lapwing (4,371), Sanderling (79), Bar-tailed Godwit (261), Curlew (1,254) and Turnstone (288). Other species which occur in important numbers, and at times exceed the threshold for national importance, include Shelduck (137), Wigeon (757), Mallard (366), Oystercatcher (362), Dunlin (812), Black-tailed Godwit (168), Redshank (149) and Greenshank (17). The population of Golden Plover is of particular note as it represents 2.8% of the national total, while the Grey Plover and Lapwing populations each represent 2.5% of their respective national totals. Ballycotton Bay was formerly of importance for Bewick's Swan but the birds have abandoned the site since the reversion of the lagoonal habitat to estuarine conditions. The site is also important for wintering gulls, especially Lesser Blackbacked Gulls (1,606) in autumn and early winter. Common Gull (310) and Great Black-backed Gull (324) are well represented in winter.

The site is a well-known location for passage waders, especially in autumn. Species such as Ruff, Little Stint, Curlew Sandpiper, Green Sandpiper and Spotted Redshank occur annually though in variable numbers. Small numbers of Ruff may also be seen in late winter and spring. Rarer waders, such as Wood Sandpiper and Pectoral Sandpiper, have also been recorded.

While relatively small in area, Ballycotton Bay supports an excellent diversity of wintering waterfowl and has nationally important populations of nine species, of which two, Golden Plover and Bar-tailed Godwit, are listed on Annex I of the E.U. Birds Directive. Bird populations have been well-monitored in recent years. (NPWS, 2004).

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4.5 Identification of potential impacts

4.5.1 Direct habitat loss or habitat degradation during construction

The proposed development site and immediately adjoining shoreline habitats, which will be affected by the construction of the proposed development, including the proposed beach nourishment works, do not lie within any designated Natura 2000 site.

Beach nourishment is a well-recognised coastal engineering solution worldwide. It is a soft solution and will not significantly affect the areas in the vicinity of the site. The net coastal sediment transport goes from south to north according to wind conditions and swell and, therefore, the material is likely to move towards the north in the medium and long term. The Cork Harbour Special Protection Area (SPA) is located to the south west of the site therefore the sacrificial material will not impact on the SPA.

Cork Harbour SPA

Although impacts during construction on estuarine mudflats of high value for wintering birds listed as qualifying interests for the Cork Harbour SPA are extremely unlikely, such impacts cannot be entirely discounted in the absence of mitigation.

Great Island Channel cSAC

Given the dilution provided in the harbour, the distance from qualifying habitats for the Great Island Channel cSAC and the robust nature of these habitats, any minor increases in silt in surface run-off, minor spills of hydrocarbons or other chemicals during construction or fire related impacts will have a negligible impacts on qualifying habitats for this cSAC.

Ballycotton Bay SPA and Sovereign Islands SPA

No potential impacts on the Ballycotton Bay SPA or Sovereign Islands SPA during the construction phase have been identified due to their distance from the proposed

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development site and the absence of potential ecological pathways by which impacts could occur.

4.5.2 Disturbance or displacement of birds during construction, operation and cumulative impacts

Cork Harbour SPA

Construction and beach nourishment works will generate additional noise and activity which could lead to the short-term disturbance/displacement of birds. During operation there will be increased traffic and human activity associated with the site. There could also be in-combination impacts due to the presence of other developments in Cork Harbour.

The shoreline habitats in proximity to the proposed development site are not considered of high value for birds listed as qualifying interests for the Cork Harbour SPA. However some of these species were noted overflying the channel that separates the site from Spike Island or were recorded feeding along shoreline habitats. Whilst direct disturbance of qualifying species within the SPA boundary are extremely unlikely, disturbance of such birds where they occur outside the SPA boundary cannot be entirely discounted without more detailed consideration.

Great Island Channel cSAC, Ballycotton Bay SPA and Sovereign Islands SPA

No potential impact on the Ballycotton Bay SPA or Sovereign Islands SPA have been identified due to their distance from the proposed development site. Disturbance of birds is not relevant to the Great Island Channel cSAC which was designated on the basis of habitats.

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4.5.3 Bird collision risk during operation and cumulative impacts

Cork Harbour SPA

Structures adjacent to the estuarine environment have the potential to create a collision risk under certain circumstances. The highest buildings at the site of the proposed development will be the main process building (between 23.7-50.7m AOD) and the stack (75 m AOD). Buildings at the site of the proposed development could potentially affect birds via increased collision risk. Bird collisions, if of sufficient magnitude, could potentially impact on the Cork Harbour SPA. There are a number of tall structures within the wider Cork Harbour area including wind turbines, other stacks etc. and, potentially, cumulative impacts could occur which, in turn, could impact on the Cork Harbour SPA.

Great Island Channel cSAC, Ballycotton Bay SPA and Sovereign Islands SPA

No potential impacts on the Ballycotton Bay SPA, or Sovereign Islands SPA have been identified due to their distance from the proposed development site and there is no evidence to indicate that the proposed development site lies within a migration route to these sites. Collision is not relevant to the Great Island Channel cSAC which was designated on the basis of habitats.

4.5.4 Emissions to water during operation

Cork Harbour SPA and Great Island Channel cSAC

In respect of the possible impacts from emissions of pollutants from the facility, it is noted that no significant aqueous discharge into the marine environment is proposed from the resource recovery facility during operation. Any process effluent will be recycled for use in the process and will not be discharged off site. Storm water will be monitored and

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discharged off site only if monitoring determines that it is uncontaminated. Given the dilution provided in the marine environment and the distance from the facility to the Cork Harbour SPA and Great Island Channel cSAC, adverse impacts from the discharge of storm water on Natura 2000 sites can be ruled out. Given the distance involved no impact on the Ballycotton Bay SPA and Sovereign Islands SPA will occur.

Wastes, fuel and liquid and solid process materials will be delivered to site by truck via the N28 and the L2545. All Trucks carrying solid waste will be covered. Aqueous waste will come in tankers. All trucks will have to comply with the road transport legislation and regulations. The closest part of the Cork Harbour SPA to the N28 is Monkstown Creek. The N28 is several hundred metres from Monkstown Creek. The L2545 is nearly 1km from the Cork Harbour SPA at Loughbeg. A release from a truck, which is on the road network and conveying material to the site, will not reach the Cork Harbour SPA or other Natura 2000 sites, so no impact on Natura 2000 sites will occur.

4.5.5 Emissions to air.

Cork Harbour SPA

The impacts on air quality from emissions are specifically addressed in **Appendix 11** to this NIS**.** It is concluded that, based on the results of air dispersion modelling of process emissions, the air quality impact of the proposed facility will be insignificant. This appraisal incorporated all significant potential cumulative impacts.

Notwithstanding the low risk created by emissions, a theoretical pathway, which could impact on ecology, is the aerial deposition of chemicals with ecotoxicological properties such as dioxin or mercury onto marine sediments. Bioaccumulation of such deleterious chemicals could then potentially occur. Generally the impacts, if any, would affect fauna higher up the food chain such as piscivorous birds, some of which are listed as qualifying interests for the Cork Harbour SPA (Common Tern, Cormorant, Red Breasted Merganser, Little Grebe, Great Crested Grebe and Grey Heron). Impacts on the Cork Harbour SPA as a result of air emissions and bioaccumulation, although highly unlikely, could potentially occur.

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Great Island Channel cSAC, Ballycotton Bay SPA and Sovereign Islands SPA

As set out in **Appendix 11,** in relation to spatial impacts, the modelling results, using both the USEPA regulatory model AERMOD and the more advanced CALPUFF model, indicate that the maximum ambient ground level concentration occurs at or near the facility's northern and north-eastern boundaries. The spatial impact of the facility is limited with concentrations falling off rapidly away from the maximum peak. Therefore, no potential impact from emissions, or subsequently from bio-accumulation, on the Ballycotton Bay SPA or Sovereign Islands SPA can occur due to their distances (18.4km and 19.7km respectively) from the proposed development site and the low level of emissions proposed. The Great Island Channel cSAC is located approximately 5km from the proposed development and is designated on the basis of habitats rather than species. Thus direct impacts via bioaccumulation do not arise and potential impact from direct emissions on these designated sites can be ruled out.

4.5.6 Potential Accidental Releases from fire during operation

Cork Harbour SPA

A Hazard Identification and Risk Assessment Study (**Appendix 13**), examined the operation of the proposed Ringaskiddy resource recovery centre in the context of the Directive 2012/18/EU of the European Parliament and of the Council of 4 July 2012 on the control of major-accident hazards involving dangerous substances, amending and subsequently repealing Council Directive 96/82/EC [the the 'Seveso III Directive']. This directive is

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implemented in Ireland by the Chemicals Act (Control Of Major Accident Hazards Involving Dangerous Substances) Regulations, 2015 [S.I. 205 of 2015]. The study concluded that the proposed Ringaskiddy Resource Recovery Centre will not be a major accident establishment and that the Seveso III Directive and Regulations will not apply to the centre.

Notwithstanding the fact that the proposed development will not be a major accident establishment, a number of accident scenarios which could arise during the operation of the facility, were assessed in the study to determine the risk each posed to human health and the environment. Following industry best practice, five risk ratings of increasing significance, based on the probability of occurrence and the hazard posed, were assigned to the scenarios. The risk ratings were trivial, minor, moderate, substantial and priority. No priority risks were identified and one substantial risk was identified. The substantial risk was a fire in the bunker. A fire in the bunker will result in the emissions to air of the products of the combustion and thermal radiation. Contamination by fire water will not occur as the bunker and the recovery tanks will be designed as water retaining structures.

Whilst impacts on the Cork Harbour SPA are considered unlikely, they cannot be entirely discounted due to the relative proximity of the proposed development site.

Great Island Channel cSAC, Ballycotton Bay SPA and Sovereign Islands SPA

No potential impact on the Ballycotton Bay SPA or Sovereign Islands SPA will occur due to their distance from of the proposed development site and the low levels of proposed emissions. The Great Island Channel cSAC is located approximately 5km from the proposed development site and is designated on the basis of robust estuarine habitats. No appreciable impact on the qualifying interests of this designated site will occur.

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4.5.7 Disposal of bottom ash

Circa 52,664 tonnes per annum of bottom ash will be produced in the waste-to-energy plant. The bottom ash will consist of silicates, minerals and glass compounds. All trucks leaving the facility, carrying bottom ash, will be securely covered. From experience of operating similar facilities in Meath, Ireland and Flanders, Belgium, it is anticipated that the bottom ash will be non-hazardous for handling and for transport.

Bottom ash from waste incineration in EU countries, including Belgium, is used in road construction or as railway ballast. Although there is no Irish or European legislation or standards governing the quality of ash for use in roads, if the ash is to be used for road construction, it must generally be of better quality than if it were to be disposed of in a landfill. This improvement in quality can be achieved by treating the ash in an ash recovery plant. If an ash recovery plant is constructed in Ireland it would be the intention of Indaver Ireland to proactively identify potential uses for the bottom ash. If no market can be found for the bottom ash, it will be disposed of to a suitably licensed landfill site for non-hazardous waste. The bottom ash, produced in Indaver's Carranstown, Co Meath facility has been tested. The bottom ash from the Meath waste-to-energy facility has been classified as non hazardous and non toxic to the aquatic environment according to EPA methodology and Commission Regulation (EU) No. 135/2014.and Commission Decision 2014/955/EU. The bottom ash has been tested since 2011 and to date there has been no change in the classification.

Fifty-five loads per week of bottom ash will be removed from the site via standard covered trucks. The bottom ash will pose no risk to the Cork Harbour SPA during transport from the site as it is transported on the L2545, the N28 and onwards to its final destination on the road network. The closest part of the Cork Harbour SPA to the N28 is Monkstown Creek. The N28 is several hundred metres from Monkstown Creek. The L2545 is nearly 1km from the Cork Harbour SPA at Loughbeg. A release from a truck, which is on the road network and conveying bottom ash from the site, will not reach the SPA or have a negative effect on

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it. The bottom ash will be disposed of in a licensed facility or reused in road or rail construction. The EPA can only license the disposal of bottom ash in a facility, if the activity will not have a significant effect on the environment. As noted above the bottom ash from the Meath waste-to-energy facility has been classified as non hazardous and non toxic to the aquatic environment and a similar classification will pertain to the bottom ash producted at the Cork Facility. In this context no potential adverse impacts on Natura 2000 sites from the disposal of bottom ash have been identified.

4.5.8 Disposal of Boiler Ash and Flue Gas Cleaning Residues

Circa 2,000 tonnes per annum of boiler ash and circa 9,104 tonnes per annum of flue gas cleaning residues will be produced in the waste-to-energy plant. The boiler ash and flue gas cleaning residues will be in the form of fine particles and will contain heavy metals.

These residues will be disposed of to a landfill for hazardous waste after treatment if necessary or recovered to a salt mine, either in Ireland, if one is available, or abroad. The shipping containers used for such transport are designed and operated in line with international standards. The regulation of the transport of the ash would be subject to Trans Frontier Shipment (TFS) licence which is a licence which must be approved by the origin/destination/transit authorities consenting to the movement/transit and acceptance of wastes between EU member states. The regulation governing this is EU Regulation 1013/2006. This licence tracks waste from origin to destination and ensures that each authority is aware of the status of the waste until final recovery when the individual TFS notification annex consigned with each shipment is signed off as having been received and treated by the receiver. This completed licence is then circulated back to Indaver as the producer as well as all relevant authorities.

Similar residues from Indaver's Meath facility are currently being shipped to salt mines in Germany where the residues are solidified and used to back-fill the mine instead of using other raw materials. There are no hazardous landfills or salt mines in Ireland at present. The residues will be collected on the site in sealed silos (See **Photo 1** below). The silos are emptied into a tanker via a sealed connection. This will ensure there are no fugitive releases on the site.

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Photo 1 Sealed silos

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Photo 2 Loading area and tanker

Two container truck loads per week of boiler ash and seven to eight container truck loads per week of flue gas cleaning residues will be removed from the site. The ash and residue containers will be taken to a port, loaded onto a ship and shipped to Rotterdam, or another container port in Europe. From the port of entry the containers will be transported by road to the final destination.

If the residues are disposed of in Ireland, then the residues may be pre-treated on site prior to dispatch. The pre-treatment process will consist of a simple batch mixer which will mix water with the residues. They will be discharged into 1m^3 FIBC bags to solidify prior to dispatch off-site. The equipment will be located close to the flue gas residue silos within the main process building on the south side. The solidification process will take between 4 and 6 hours.

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It is noted that the accident risk during shipping of the boiler ash and residues is low. Van Den Bosch are the preferred international logistic services provider which transports such residues for Indaver. They note that in the 51 years of their history no container has ever fallen overboard and no ship has sunk with their containers on board.

As noted above the addition of water leads to the residues solidifying. Thus, in event of a shipping accident and if the transport container were to loose integrity, the residues would solidify on contact with water and solidified residues will be salvaged from the sea bed.

Given the extremely low risk of an accident, the low risk of leakage from the transport containers, the fact that the residues will solidify on contact with water, no appreciable impacts on Natura 2000 sites along the shipping route from the disposal of this material will occur.

4.5.9 Potential Trans-boundary effects - Flue gas cleaning residues disposal and boiler ash in salt mine or landfill in Europe

As noted above, the transport and disposal and recovery of flue gas cleaning residues disposal and boiler ash does not constitute a risk to any designated Natura 2000 sites during transport. The final destination is likely to be a salt mine in Germany, in which the boiler ash and flue gas cleaning residues will be used as backfill. Such an operation must be approved by the relevant competent authorities. The German authorities are subject to current EU legislation including the Habitats Directive, which requires the consent authority for any project which has the potential to have a negative effect on a Natura 2000 site, and which is

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not directly connected with or necessary to the management of the site, to undertake an appropriate assessment. The Hattorf facility, which is the proposed final destination of the flue gas residues from Ringaskiddy, has been approved by the relevant competent authority. The letter of confirmation is attached as **Appendix 19.** There will be no appreciable impacts on Natura 2000 sites from disposal of these residues.

4.5.10 Potential Impact from increased predator density or activity or changes in predator behaviour.

Cork Harbour SPA, Great Island Channel cSAC, Ballycotton Bay SPA and Sovereign Islands SPA

Local ecological impacts could arise due to increased predator activity if species such as rats or gull species were attracted into the local area due to the presence of waste. Both species can predate on nests for ground nesting birds such as common tern. It is noted that trucks with organic waste discharge their loads within a sealed building and that there will no storage of waste in outside spaces. Trucks are inspected on arrival to ensure that there is no waste adhering to wheels. A standard pest control programme will be implemented at the site. It is also noted that the closest nesting colony of high conservation value (common terns) is located approximately 750m away from the Indaver site. This colony is not located within a Natura 2000 site. There will be no ledges suitable for predatory species on the proposed stack. Under these circumstances, any impact on birds listed as special conservation interests for the Cork Harbour SPA from increased predator density or increased predator activity is predicted to be negligible. There will be no appreciable impacts on the Cork Harbour SPA, Ballycotton Bay SPA, Great Island Channel cSAC or Sovereign Islands SPA due to the absence of a risk to bird species listed as special conservation interests for the Cork Harbour SPA.

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4.5.11 Impact from flooding and erosion and possible impacts from climate change

Flooding of the site could introduce deleterious chemical substances into surface water with the potential impacts on the marine environment. Coastal erosion could lead to structural damage. The project has been specifically designed to minimise such risks and resilience to climate change has been built into the project design as follows.

Site levels within the Indaver site

The ground levels of the Indaver site will be raised to alleviate localised flooding issues. Based on the precautionary principle, climate change scenarios have been considered in the modification of levels and the site design. The minimum levels of the site will be raised to 4.55m OD. This level will offer a very high standard of flood protection to the site. For climate change, the OPW Draft Guidance on the “Assessment of potential future scenarios for Flood Risk Management” suggests the use of two scenarios; a mid-range future scenario (MRFS) and a high end future scenario (HEFS). The MRFS represents a likely future scenario which is within the bounds of the widely accepted projections. The HEFS is a more extreme, but plausible future event, and is within the upper bounds of the widely accepted projections. The proposed 1.05m allowance for climate change allows for the high end future scenario. It was decided to use an even more conservative site flood defence level of 4.55m OD given that that a number of recent developments close to the site in Ringaskiddy (Beaufort Research Laboratory and IMERC) have already utilised this level. The 4.55m OD level will offer a very high standard of flood protection to the site. The ground floor level of most of the waste-to-energy plant will be at 5mOD. The floor level of the bunker will be 0mOD. The bunker, and any tanks constructed below 5mOD, will be of watertight concrete construction and will be impermeable.

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Coastal Protection The coastline, which forms the eastern boundary of the site, was found to have eroded over the past 100 years at varying rates. Rates identified from historical datasets have been extrapolated to give future conservative retreat rates of up to 36 or 55m over 100 years.

The proposed waste-to energy facility, with a design life of 25 to 30 years, has been located far enough away from the edge of the cliff to ensure that the development will not be impacted by the predicted retreat rates over the 25 – 30 design life. The possibility of impact in a further 30 year period would need to be assessed at the time of considering any application to extend the life of the facility. Never the less, it is proposed that approximately 1,100m^3 of sacrificial material, comprising shingle of appropriate size and rounded shape, will be deposited on the beach in the area extending from the car park at the north-eastern corner to the southern boundary of the Indaver site.

The sacrificial material has been designed to remain on site and help lower the natural erosion rate over a number of years. However, the length of time that the material remains in place will depend on the occurrence of extreme wave events which are impossible to forecast. The sacrificial material and the cliff face will be monitored and the sacrificial material will be replenished as required

The proposed protection measures are a soft solution and will not significantly affect the adjoining areas of coastline in the vicinity of the site. The net coastal sediment transport will go from south to north according to wind conditions and swell. Therefore the material is likely to move towards the north in the medium and long term. The Cork Harbour Special Protection Area (SPA) is located to the south west of the site. The sacrificial material will not impact on the SPA.

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L2545 Road Upgrade

The principal design objective for the upgrade of the L2545 road is to improve the surface water drainage so that the road does not flood after prolonged rainfall and to raise the level of the road above the 1:200 year tidal event and to allow for climate change. The proposed road drainage network upgrade will extend along the entire northern boundary of the Indaver site. It has been designed to cater for the 6.5 hours when the storm water outfall is tide locked and a 1 in 100 year rainfall event plus an allowance for climate change. The increased storage will be in the form of oversized pipes placed underneath the road.

Grid Connection

The proposed development will be connected to the 38kV substation, which is located on the eastern side of the Hammond Lane premises, adjacent to the Indaver site. The connection will be via an underground trench.

Raising the level of the Western Field

The levels of a portion of the western field, i.e. the field which lies to the west of the entrance Hammond Lane premises, will be raised above the one in 200 year flood level.

Conclusions Impact from flooding and erosion and possible impacts from climate change

There will be no significant potential impact due to flooding or coastal erosion for the Cork Harbour SPA, Ballycotton Bay SPA, Great Island Channel cSAC or Sovereign Islands SPA due to their distance from the proposed development site and the absence of significant predicted impacts. It is noted that that measures have been put in place to prevent erosion and flooding. Thus the proposed development will prevent erosion and flooding that would otherwise occur.

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4.5.12 Potential Cumulative impacts

The potential for in-combination impacts to occur needs to be taken into account. Plans and projects which are considered relevant, for the purposes of assessing cumulative impacts, include the following:

- **Hammond Lane Metal Company**

The existing Hammond Lane Metal Company is accessed from the N28 and is surrounded by the Indaver site. There is existing noise and activity associated with the site.

- **Wind turbines within the Lower Cork Harbour**

Currently in the Cork Lower Harbour there are three existing wind turbines and a further turbine has planning permission. Each turbine has a maximum rotor tip height of 150m. The closest turbine is located approximately 400m south of the proposed stack for the Ringaskiddy Resource Recovery centre at the DePuy facility (Loughbeg). The other constructed wind turbines are located at GlaxoSmithKline (Curraghbinny) and at Janssen (Barnahely), located 1.7km and 2.5km from the proposed Indaver stack, respectively. The fourth turbine, for which Novartis site has planning permission, is similar to the three existing turbines. DePuy Synthes has announced its intention to apply for planning permission to erect a turbine at Loughbeg, on the site which formerly was the Pfizer tableting plant. This turbine is expected to be similar to the three turbines existing turbines in Ringaskiddy. The proposed turbine will be located to the south of the existing turbine, and is expected to be at least 1km from the proposed stack on the Indaver site. It is expected that a planning application for the proposed wind turbine will be submitted to Cork County Council in December 2015.

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- **Power Station Stack, at Whitegate**

Approximately 5km east of the proposed development is the ESB Power Station Stack, at Whitegate, with a height of 152m.

- **The Port of Cork redevelopment**

The Port of Cork redevelopment will be located approximately 700m from the proposed development. Increased noise and disturbance are likely to occur during development and operation of this facility.

- **Haulbowline Development and Masterplan**

Remediation works and the subsequent redevelopment of Haulbowline Island, which is located 870m north of the proposed development, could potentially increase traffic levels along local roads.

- **Spike Island Masterplan**

Increased boat traffic to Spike Island and increased activity on the island, which is separated from the Indaver site by a 770m marine channel, could potentially impact on bird populations.

- **M28 Cork to Ringaskiddy Upgrade Scheme**

Increased noise and activity levels could arise due to the proposed M28 scheme, particularly during construction.

- **IMERC Campus Masterplan area**

A Masterplan for the Irish Maritime and Energy Resource Cluster (IMERC) adjacent to the National Maritime College of Ireland (NMCI) aims to deliver research and enterprise campus in Ringaskiddy,Cork. Construction of the Beaufort Building was completed by UCC in 2015.

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It is proposed to expand the campus and to develop a marine and energy cluster focussing on research, development, commercialisation and innovation.

Although unlikely to occur, in-combination impacts could potentially impact on the Cork Harbour SPA due to its relative proximity to these proposed and existing developments.

There will be no likely significant cumulative or in-combination impacts on the Ballycotton Bay SPA or Sovereign Islands SPA due to their distance from the proposed development site and the absence of ecological pathways.

The Great Island Channel cSAC is located approximately 5km from the proposed development and is designated on the basis of habitats rather than species. There will be no potential cumulative or in-combination impacts on this designated site.

4.6 Screening Conclusion

Theproposed project is not directly connected with or necessary to the management of any Natura 2000 site. It is, accordingly, necessary for the competent authority to assess whether the proposed development, either individually or in combination with other plans or projects, would be likely to have significant effects on any Natura 2000 site.

As set out in detail in this Stage One Screening Report the likely significant impacts on Natura 2000 sites within a 20km radius of the proposed development have been considered. The use of a 20km radius was adopted as a precautionary measure as impacts at or beyond this distance are extremely unlikely.

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Four Natura 2000 sites are located within 20km of the proposed development site namely Cork Harbour SPA (0.5km to the south), Great Island Channel SAC (5km to the north) and the Ballycotton Bay SPA 18.4km east and Sovereign Islands SPA 19.7km southwest.

A precautionary approach has also been adopted in relation to the appraisal of whether the proposed development is likely to have significant impacts on these four sites. Any significant potential impacts were identified and, unless such impacts could be discounted with certainty, it has been determined that a Stage 2 appropriate assessment should be carried out.

The conclusions in respect of each site are as follows.

4.6.1 Potential impacts on the Ballycotton Bay SPA and Sovereign Islands SPA.

Given the low levels of emissions from the proposed development and the distance of these Natura 2000 sites from the proposed development site, no significant potential impacts, whether direct, indirect or cumulative, will occur.

4.6.2 Potential impacts on the Great Island Channel cSAC.

The Great Island Channel SAC (0.5km from the proposed development site) is designated on the basis of two qualifying Annex 1 habitats namely Mudflats and sandflats not covered by seawater at low tide and Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*). No faunal species are listed as qualifying interests for this site and thus potential impacts from collision risk or bioaccumulation to higher trophic levels do not apply. These estuarine

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habitats are robust and any impacts from minor accidental discharges of silt or hydrocarbons during construction or emissions during operation will have a negligible impact. Therefore no appreciable impacts from operational emissions, construction or direct removal of habitat, or disturbance will arise. Similarly no significant potential impacts from accidents such as fires during construction or operation or from shipping accidents whilst transporting ash and flue gas residues will occur.

4.6.3 Potential impacts on the Cork Harbour SPA

Although it is considered improbable that significant impacts will occur, the likelihood of significant potential impacts on the Cork Harbour SPA with respect to the following, cannot be entirely discounted without further analysis.

1. **Disturbance/displacement of birds listed as qualifying interests for the Cork Harbour SPA where they occur outside the SPA boundary including potential cumulative impacts**
2. **Potential for collision risk for birds listed as qualifying interests for the Cork Harbour SPA where they occur outside the SPA boundary including potential cumulative impacts**
3. **Potential Accidental Releases from the Site During the Construction Phase including cumulative impacts**
4. **Potential Accidental Releases from fire during operation including cumulative impacts**
5. **Potential for bioaccumulation and impacts on piscivorous birds from air emissions of mercury and dioxins**

Therefore in line with a precautionary approach, a Stage 2 Appropriate Assessment of the proposed development is considered necessary in respect of the Cork Harbour SPA. It is also noted that during consultation with the NPWS queries were raised in relation to particular aspects of the development (**See Section 3.3).** These queries are further addressed within the Stage 2 of this NIS.

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5. Stage 2 – Appropriate Assessment

In carrying out an appropriate assessment under Article 6(3) and section 177V, the competent authority (i.e., the Board) is obliged to make a determination as to whether or not the proposed development would adversely affect the integrity of the relevant European site (i.e., the Cork Harbour SPA) in view of its conservation objectives. Accordingly, an appropriate assessment of the implications for the Cork Harbour SPA of the proposed development implies that, prior to its approval, all the aspects of the proposed development which can, by themselves or in combination with other plans or projects, affect the Cork Harbour SPAs conservation objectives must be identified in the light of the best scientific knowledge in the field.

5.1 Cork Harbour SPA Conservation objectives

As concluded in Section 4, and adopting a precautionary approach, the only Natura 2000 site in respect for which it is considered that a Stage 2 Appropriate Assessment is required is the Cork Harbour SPA (Site code 004030). A site synopsis (NPWS, 2008) and conservation objectives (NPWS, 2014) are provided below.

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Conservation objectives

The overall aim of the Habitats Directive is to maintain or restore the favourable conservation status of habitats and species of community interest. These habitats and species are listed in the Habitats and Birds Directives and Special Areas of Conservation and Special Protection Areas are designated to afford protection to the most vulnerable of them. These two designations are collectively known as the Natura 2000 network.

A site-specific conservation objective aims to define favourable conservation condition for a particular habitat or species at that site. The maintenance of habitats and species within Natura 2000 sites at favourable conservation condition will contribute to the overall maintenance of favourable conservation status of those habitats and species at a national level.

The favourable conservation status of a species is achieved when:

- population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and
- the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and
- there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

The qualifying interests and specific conservation objectives for the Cork Harbour SPA are detailed in *NPWS (2014) Conservation Objectives: Cork Harbour SPA 004030*. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht. These are listed in **Table 7.**

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Table 7. Cork Harbour SPA – Special Conservation Interests for Cork Harbour SPA and species specific conservation objectives.

Cork Harbour SPA [IE0004030] SCIs		Season	Conservation Objectives (2014)
Little Grebe	*Tachybaptus ruficollis*	Wintering	Maintain population
Great Crested Grebe	*Podiceps cristatus*	Wintering	Maintain population
Cormorant	*Phalacrocorax carbo*	Wintering	Maintain population
Grey Heron	*Ardea cinerea*	Wintering	Maintain population
Shelduck	*Tadorna tadorna*	Wintering	Maintain population
Wigeon	*Anas penelope*	Wintering	Maintain population
Teal	*Anas crecca*	Wintering	Maintain population
Pintail	*Anas acuta*	Wintering	Maintain population
Shoveler	*Anas cylpeata*	Wintering	Maintain population
Red-breasted Merganser	*Mergus serrator*	Wintering	Maintain population
Oystercatcher	*Haematopus ostralegus*	Wintering	Maintain population
Golden Plover	*Pluvialis apricaria*	Wintering	Maintain population
Grey Plover	*Pluvialis squatarola*	Wintering	Maintain population
Lapwing	*Vanellus vanellus*	Wintering	Maintain population
Dunlin	*Calidris alpina*	Wintering	Maintain population
Black-tailed Godwit	*Limosa limosa*	Wintering	Maintain population
Bar-tailed Godwit	*Limosa lapponica*	Wintering	Maintain population
Curlew	*Numenius arquata*	Wintering	Maintain population
Redshank	*Tringa totanus*	Wintering	Maintain population

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Black-headed Gull	*Larus ridibundus*	Wintering	Maintain population
Common Gull	*Larus canus*	Wintering	Maintain population
Lesser Black-backed Gull	*Larus fuscus*	Wintering	Maintain population
Common Tern	*Sterna hirundo*	Breeding	Maintain population
Wetlands & Waterbirds			Maintain population

* Indicates a priority species under the Habitats Directive.

5.2 Appraisal of Potential Significant Impacts - Disturbance/displacement of birds listed as qualifying interests for the Cork Harbour SPA where they occur outside the SPA boundary including potential cumulative impacts

5.2.1 Potential noise/disturbance impacts during construction

The schedule for the construction and commissioning of the resource recovery centre is approximately 31 months and thus works will occur during the main wintering season for birds in Cork Harbour (October to March inclusive). Night-time works are likely to take place over a period of 6 to 8 weeks. The likely construction activities during this period will involve concrete pours for foundations, retaining walls etc.

The road upgrade will take circa 8 weeks to complete and it is anticipated that the upgrade of the road and the upgrade of the road drainage system will proceed in advance of the construction of the resource recovery facility.

The placement of sacrificial beach material will take approximately three weeks to complete and it is envisaged that it will be undertaken towards the end of the construction phase. Deliveries of shingle (sacrificial material) for the coastal protection works will take place over a period of two weeks. Placing of sacrificial beach material will take place outside the main wintering season for birds (October to March).

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Due to the nature of the activities undertaken on a large construction site, there is potential for the generation of high levels of noise to the surrounding environment. A variety of items of plant will be in use depending on the construction phasing. There will also be vehicular movements to and from the site that will make use of existing roads.

The potential for vibration will be limited to vibration as a result of excavation works, rock breaking, piling operations and lorry movements on uneven road surfaces. The most potentially significant of these will be the vibration associated with rock breaking and piling operations. No blasting is proposed.

Disturbance stimuli can divert time and energy from other fitness-enhancing activities such as feeding, parental care, or mating displays. In other words, disturbance signifies a deviation in an animal's behaviour from patterns occurring without human influences. It is generally accepted that disturbance can cause temporary changes in behaviour of migratory and wintering waterfowl. However birds can and often do compensate for this disturbance by altering their behaviour or habituating to human activities.

The closest part of the Cork Harbour SPA is located approximately 0.5 km south of the proposed development area and no impacts on birds within the SPA from increased noise and activity during construction are predicted. A total of thirteen species listed as qualifying interests for the Cork Harbour SPA were recorded, namely, Cormorant, Oystercatcher, Dunlin, Curlew, Redshank, Greenshank, Great Crested Grebe, Grey Heron, Teal, Black headed Gull, Common Gull, Lesser Blackbacked Gull and Common Tern. However, none of these species were recorded in nationally significant numbers in proximity to the site, with relatively small numbers recorded feeding along the rocky shoreline or overflying the

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channel. The shoreline in proximity to the proposed development site consists primarily of rocky shore/shingle habitat and lacks the large estuarine mudflats which are of high value for wintering birds. A breeding colony of Common tern and a colony of tree roosting cormorants are located 750m and 1km from the Indaver site respectively.

Notwithstanding the lack of high quality feeding habitat, recreational usage may already be impacting on bird usage of Gobby Beach, which is the shoreline adjacent to the site eastern boundary. It is noted that this beach is subject to high levels of disturbance from recreational users with or without dogs during daylight hours.

5.2.2 Mitigation Measures during construction

Mitigation Measures – Noise & Vibration

The following mitigation is proposed with respect to noise during construction.

During out of hours construction periods or other construction scenarios with high potential for noise and vibration generating activities, best practice noise and vibration control measures will be employed by the contractor. The best practice measures set out in BS 5228 (2009) Parts 1 and 2 will be complied with. This includes guidance on several aspects of construction site mitigation measures, including, but not limited to the following:

Selection of quiet plant

This practice will be in relation to static plant such as compressors and generators. Units will be supplied with manufacturers' proprietary acoustic enclosures. The potential for any item of plant to generate noise will be assessed prior to the item being brought onto the site. The least noisy item should be selected.

Noise control at source

If replacing a noisy item of plant is not a viable or practical option, consideration will be given to noise control "at source". This refers to the modification of an item of plant or the application of improved sound reduction methods in consultation with the supplier.

- For example, resonance effects in panel work or cover plates can be reduced through stiffening or application of damping compounds; rattling and grinding noises can often be controlled by fixing resilient materials in between the surfaces in contact.
- For mobile plant items such as cranes, dump trucks, excavators and loaders, the installation of an acoustic exhaust and or maintaining enclosure panels closed during operation can reduce noise levels by up to 10dB. Mobile plant will be switched off when not in use and not left idling.
- For piling plant, noise reduction will be achieved by enclosing the driving system in an acoustic shroud, where necessary. For steady continuous noise, such as that generated by diesel engines, it is possible to reduce the noise emitted by fitting a more effective exhaust silencer system or utilising an acoustic canopy to replace the normal engine cover.
- For percussive tools such as pneumatic concrete breakers, rock drills and tools a number of noise control measures include fitting muffler or sound reducing equipment to the breaker 'tool' and ensure any leaks in the air lines are sealed. Further reductions in noise levels will be achieved by erecting localised screens around breakers or drill bits when in operation in close proximity to noise sensitive boundaries.

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- For concrete mixers, control measures will be employed during cleaning to ensure no impulsive hammering is undertaken at the mixer drum.
- For all materials handling, materials will not be dropped from excessive heights. Drops chutes and dump trucks will be lined with resilient materials.
- For compressors, generators and pumps, these will be surrounded by acoustic lagging or enclosed within acoustic enclosures providing air ventilation, where required.
- All items of plant will be subject to regular maintenance. Such maintenance can prevent unnecessary increases in plant noise and can serve to prolong the effectiveness of noise control measures.

Screening

Screening is an effective method of reducing the noise level at a receiver location and can be used successfully as an additional measure to all other forms of noise control. It has been assumed for the purposes of this assessment that a standard construction site hoarding will be erected around the site boundaries. The site hoarding will be constructed of a material with a mass per unit of surface area greater than 7 kg/m^2 to provide adequate sound insulation.

In addition, careful planning of the site layout will also be considered. Where feasible, site buildings such as offices and stores will be placed between the source and receiver to provide noise screening.

Monitoring

Prior to the construction works commencing on site, environmental noise and vibration monitors will be installed at the selected monitoring locations. The monitoring programme during the constructions works will ensure the effective implementation of the mitigation measures described in the preceding sections.

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5.2.3 Residual construction impacts on the Cork Harbour SPA and special conservation interests for the Cork Habour SPA where they occur in proximity to the Indaver site.

The application of noise limits, monitoring, and controlled working hours, along with implementation of appropriate noise and vibration mitigation measures as set out above, will ensure that noise and vibration impact is sufficiently controlled to within the relevant criteria. The noise assessment presented in **Appendix 12** notes that noise levels associated with of the Resource Recovery Centre for the worst case construction scenarios assessed are calculated to be less than 35dB L_{Aeq} at the closest areas of the Cork Harbour SPA to the south of the development site. This particular area of the SPA is located in close proximity to a number of existing industrial facilities (i.e. GSK, De Puy and Hovione) with operational noise limits of 55dB L_{Aeq} during daytime periods and 45dB L_{Aeq} during night-time periods. Given that predicted construction noise levels at this location are significantly below the permitted operational noise levels from adjacent facilities, the impact noise impact from construction activities at the closest area of the SPA is insignificant.

All other areas of the Cork Harbour SPA are located at distances beyond 1.5km from the proposed site with lower construction noise levels predicted at these distances, (less than 30dB L_{Aeq}) which is well below typical baseline noise levels in the surrounding environment. Taking the above into consideration, the construction phase of the RRC is determined to have no significant impact to the existing noise environment at any of the designated Cork Harbour SPA's.

The breeding colony of common tern is located 750m from the Indaver site and the large night-time roost of Cormorants is located approximately 1km from the Indaver site. Given

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that the noise impact during construction will be insignificant at these distances, no adverse impact on the Cork Harbour SPA has been identified.

It is noted that the shoreline habitats in proximity to the Indaver site are not of high value for birds listed as special conservation interests for the this SPA, although some of these species do occur. Disturbance from the proposed development is likely to arise during the construction phase due to increased noise levels. With the exception of limited amount of night-time activity, works will take place during the day when recreational usage of the beach is more likely to be a greater limiting factor for bird usage of the beach.

Night-time works are likely to take place over a period of 6 to 8 weeks. The likely construction activities during this period will involve concrete pours for foundations, retaining walls etc. This short-term night time activity is likely to have a greater impact, as birds feeding during this period may be less habituated to increased noise, activity and lighting, which could lead to some short-term disturbance/displacement of birds during such works. However, as such an impact will be localised and short-term, and given the low value of the shoreline habitats adjoining the site for SPA species, no significant adverse impact on birds listed as qualifying interests for the Cork Harbour SPA, where they occur in proximity to the Indaver site, will occur will occur.

5.2.4 Potential noise impacts during operation

Once coastal protection works, road works and building construction works are complete, the main noise sources during the operational phase relate to the operation of the main process building.

There are four key sources associated with the operational phase as follows:

- process and building services plant (fixed installations);
- vehicle movements on site (mobile plant);
- car parking on site, and;
- additional vehicles on public roads.

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5.2.5 Mitigation measures-operation

The following mitigation is proposed with respect to noise during operation.

Practicable noise control measures will be employed to ensure that noise from process and building services plant do not exceed the specified operational noise levels. Moreover, an acoustic attenuator will be included in the aero condenser structure. In addition to the measures outlined above, the following forms of noise control techniques will be employed as standard to ensure operational plant noise levels are kept to a minimum:

- plant will be sited as far away from noise-sensitive locations as is practicable;
- duct mounted attenuators will be installed on the atmosphere side of all air moving plant;
- splitter attenuators will be installed providing free ventilation to internal plant areas;
- anti-vibration mounts will be installed on all reciprocating plant.

5.2.6 Residual operational impacts on the Cork Harbour SPA and special conservation interests for the Cork Harbour SPA where they occur in proximity to the Indaver site.

The noise assessment presented in **Appendix 12** notes that noise levels associated with the operation of the resource recovery centre are calculated to be imperceptible at distances beyond 400 to 500m from the development site. The Indaver site is located 0.5km from the closest point of the Cork Harbour SPA. The breeding colony of common tern is located 750m

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from the Indaver site and the large night-time roost of Cormorants is located approximately 1km from the Indaver site. Given that the noise impact during operation will be imperceptible at the relevant distances, no adverse impact on the Cork Harbour SPA has been identified.

The overall noise and vibration impact of the proposed facility during operation is expected to be insignificant in the long term, taking account of the existing noise environment and the predicted impact of the proposal. There will no adverse effect on any bird species listed as special conservation interests for the Cork Harbour SPA, where they occur in proximity to the Indaver site, during the operational phase of the proposed development.

5.2.7 Cumulative impacts from noise

The noise assessment presented in **Appendix 12** assessed potential cumulative impacts on the Cork Harbour SPA. It concluded that noise levels associated with the operation of the resource recovery centre are calculated to be imperceptible at distances beyond 400 to 500m from the development site. The closest area of the Cork Harbour SPA is located some 500m to the south of the development site. This particular area of the SPA is located in close proximity to a number of existing industrial facilities (i.e. GSK, De Puy and Hovione) and hence the operation of the resource recovery centre will have no impact on noise levels at this area considering the contribution of these adjacent facilities to the existing noise environment. All other areas of the Cork Harbour SPA are located at distances beyond 1.5km from the proposed site and hence the operation of the resource recovery centre is determined to have no measurable or perceptible change to the existing noise environment at any of the designated Cork Harbour SPA's.

The Indaver site is located 0.5km from the closest point of the Cork Harbour SPA. It is noted that the shoreline habitats in proximity to the Indaver site are not of high value for birds listed as special conservation interests for the this SPA. The nesting colony of Common Tern is located approximately 750m from the proposed Indaver site. The large night-time roost of Cormorants is located approximately 1km from the Indaver site.

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Any predicted noise impacts associated with the proposed resource recovery centre are well below those associated with the existing noise environment, and those noise impacts associated with the proposed N28 Link road and the Port of Cork development and other planned projects. Hence, once operational, the proposed resource recovery centre is expected to be imperceptible in terms of noise to its surrounding environment. Potential construction in-combination impacts are not predicted to be significant given the background noise environment at the Indaver site. Based on the above, there will be no adverse effect on the bird species listed as special conservation interests for the Cork Harbour SPA.

5.3 Appraisal of Potential Significant Impacts - Potential for collision risk for birds listed as qualifying interests for the Cork Harbour SPA where they occur outside the SPA boundary including potential cumulative impacts

A literature review assessment of the potential for a collision risk for birds created by the type of stack proposed is included as **Appendix 4.** This information is considered in relation to the proposed 75m OD stack below.

Although collisions may occur there are a number of factors, such as total population size, natural mortality levels, and other human related influences, to be considered in order to put the collision mortality factor in proper perspective. Modelling by some authors has found that vulnerability to collision with buildings and towers varied over more than four orders of magnitude among species. Species that migrated long distances or at night, were much more likely to be affected by collisions than year-round residents or diurnal migrants. However, no correlation has been established between relative collision mortality and long-term population trends for these same species.

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5.3.1 Factors affecting risk of collision

Factors affecting risk of collision which were identified by the literature include the following**:**

Building height

There is some evidence to suggest that towers in the lower range (60 m to 150 m) pose a lower risk to migrating birds. The Indaver stack, which will have a height of 75m OD (circa 70m above the ground), will be within this lower range.

Lighting

Apart from size, often the most important structural factor related to collision probability is the use of lighting. There are no detailed studies of the different risks posed by different lighting systems, though several studies show that changes in the type of lighting used, particularly the replacement of continuous red or white lights with intermittent lighting, has, in some circumstances, reduced the trapping effect and thus mortality of nocturnal migrants.

The literature review indicates that, while any light source has the potential to attract birds and therefore increase collision risk, flashing lights are involved in significantly fewer collisions that continuous lights. There is also some indication that white lights are less attractive than red lights, although the results to date are inconclusive. While bird vision does differ from human, on the lower ultraviolet end of the spectrum, infrared light is also invisible to birds. The Indaver facility will have white flashing lights the least risk option for bird collision.

Location of structure

The location of a structure can dramatically affect the likelihood of collision mortality. Clearly, structures present a greater risk of collision if placed on or near areas regularly used by large numbers of feeding, breeding, or roosting birds, or on migratory flyways or local flight paths, such as those between foraging and nesting or roosting areas. A recent radar study, which was commissioned by the Cork Lower Harbour Energy Group in order to identify nocturnal bird movement and interconnectivity within the Cork Harbour SPA, indicated that the proposed Indaver stack will not be located on or near any migratory route.

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Differing Species Susceptibility

Not all bird species are equally susceptible to collision. Gregarious species that form flocks during the autumn and winter appear prone to collision. Flight height is clearly an important factor in collision and varies greatly, depending not only on species and behaviour, but also on topography, season, time of day and weather conditions. Flight distance also affects flight height, with local movements, such as between feeding and nesting or roosting areas, tending to be at low altitude.

Seasonality

There appears to be some correlation between seasonality and bird-strikes. This relates mainly to the seasonal movements of birds, with increased incidence of mortality events often occurring during peak migration periods. Higher mortality at this time is perhaps also due to the lack of familiarity of migrant and over-wintering birds with the locations of obstacles, compared with resident individuals. Determining risk based on migrant versus resident status is not straightforward, and mitigating factors, such as familiarity with the presence of structures, must be weighed against factors, such as period of exposure and species (or individual) susceptibility. However, as indicated previously the proposed Indaver stack will not be located on or near any migratory route.

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Flight characteristics

Commuting flights between foraging grounds generally take place at a lower altitude (i.e. 0-5 metres) and thus could potentially encounter the buildings of the proposed development. At Ringaskiddy, this is likely to include Cormorants, ducks, some wader species and gulls. However flights such as this are likely to take place within the estuarine habitats (i.e. the open water or mudflats) and not over the landward site of the proposed development.

Some attempts have been made to quantify the risk of wind turbine collision. While this is not entirely comparable to collision risk with static buildings, such as stacks, it does give some indication of relative species risk. **Table 8** lists the bird species of qualifying interest and conservation concern located within Cork Harbour SPA. The vulnerability to collision of each of these species, according the European Commission Guidelines on Windfarms (2010) is also listed. It is most notably the flocking species of Dunlin, Lapwing and Golden Plover which are at potential risk of impact. The higher risk identified for Common Tern is probably associated with their foraging behaviour during breeding seasons.

Table 8. Bird species of qualifying interest and conservation concern within Cork Harbour SPA

	Common Name	*Scientific Name*	Annex of EU Birds Directive	Vulnerability to Collision
Qualifying interests	Cormorant	*Phalacrocorax carbo*	n/a	1
	Shelduck	*Tadorna tadorna*	n/a	0
	Oystercatcher	*Haematopus ostralegus*	n/a	0
	Golden Plover	*Pluvialis apricaria*	Annex I	2
	Lapwing	*Vanellus vanellus*	n/a	2
	Dunlin	*Calidris alpine*	n/a	2
	Black-tailed godwit	*Limosa limosa*	n/a	1
	Bar-tailed godwit	*Limosa laponica*	n/a	0
	Curlew	*Numenius aquata*	n/a	0
	Redshank	*Tringa tetanus*	n/a	0
	Common tern	*Sterna hirundo*	Annex I	3
Special Conservation Interest	Little grebe	*Tachybaptus ruficollis*	n/a	0
	Great crested grebe	*Podiceps cristatus*	n/a	2
	Grey heron	*Ardea cinerea*	n/a	0
	Wigeon	*Anas Penelope*	n/a	0
	Teal	*Anas crecca*	n/a	0
	Pintail	*Anas acuta*	n/a	0
	Shoveler	*Anas clypeata*	n/a	0
	Red-breasted merganser	*Mergus serrator*	n/a	0
	Grey plover	*Pluvialis squatarola*	n/a	0
	Black-headed gull	*Larus ribundus*	n/a	0
	Common gull	*Larus canus*	n/a	0
	Lesser black-backed gull	*Larus fuscus*	n/a	0

4 = Evidence on substantial risk of impact, 3 = Evidence or indications of risk or impact, 2 = Potential risk or impact, 1 = small or non-significant risk or impact, but still to be considered in assessments, 0 = no risk.

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5.3.2 Mitigation measures

The top of the stack will be indicated by white strobe (flashing) obstacle warning lights. The lights will be incandescent or of a type visible to Night Vision Equipment. The lights will emit light at the near infra-red (IR) range of the electromagnetic spectrum specifically at or near

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850 nanometres (nm) of wavelength. Light intensity to be of similar value to that emitted in the visible spectrum of light.

5.3.3 Conclusions

In determining the potential collision risk the following points were taken into consideration:

- A recent radar study was commissioned by the Cork Lower Harbour Energy Group, in order to identify nocturnal bird movement and interconnectivity within the Cork Harbour SPA. A number of significant nocturnal flight corridors were identified, particularly connecting Lough Beg to the Owenboy River Estuary at incoming and outgoing tide periods. This is located to the south of the proposed Ringaskiddy Resource Recovery Centre. No widespread distinct patterns were observed between Monkstown Creek and Lough Beg, although minor patterns were observed from birds flying northwards from Lough Beg over the Martello tower area, to the west of the proposed Ringaskiddy Resource Recovery Centre. No distinct flight patterns were observed over the proposed development site. The location of the proposed stack at Ringaskiddy Resource Recovery centre although 500m from the Cork Harbour SPA, is not a roosting area, or on a significant flightline or migratory path for the birds using the SPA.
- The coastal areas adjacent to the proposed development are not of high value for bird species listed as special conservation interests for the Cork Harbour SPA.
- The nesting colony of Common Tern is located approximately 750m from the proposed Indaver stack. The large night-time roost of Cormorants is located approximately 1km from the Indaver site. The surveys carried out do not indicate that either species have significant flight lines through the Indaver site.
- The proposed stack height is relatively low, at just 75m OD (circa 70m above the ground), a height which has been shown to pose less collision risk than higher wind turbines and communication towers. Migratory flights over the area, would generally occur at a much greater height that 75m OD, thus eliminating or very substantially reducing the collision risk to migratory birds overflying the site of the proposed development.
- The static nature of the stack, compared to wind turbines, means it will create a significantly lower risk of collision.
- The literature review indicates that flashing lights are involved in significantly fewer collisions that continuous lights. There is also some indication that white lights are less attractive than red lights. While bird vision does differ from human, on the lower ultraviolet end of the spectrum, infrared light is also invisible to birds. Therefore the proposal for a combination of white flashing and IR lights on the stack, is the most favourable choice and is unlikely to pose a significant collision risk to birds.
- The potential cumulative impacts of this development, in combination with other developments in the vicinity, are not predicted to result in any adverse effects on the conservation objectives of the Cork Harbour SPA as the stack in the proposed development is located at a sufficient distance from other developments. The closest wind turbine is 400m away and, following radar studies conducted during the planning process for these turbines, no significant cumulative collision risk is predicted. No additional impact is predicted from the new planned turbine at the De Puy site, which will be at least 1km from the Indaver stack.

Based on the above and given the fact that the stack is a static structure, which is relatively low in height and which is not located on or in proximity to significant roosting areas, nesting areas, flight lines or migratory paths for birds, there will not be adverse effects on the constitutive characteristics (i.e., the thirteen bird species) of the Cork Harbour SPA.

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Specifically, in light of the best available scientific knowledge, the stack as proposed will not create a collision risk of a magnitude sufficient to adversely impact on the integrity of any of the special conservation interests and/or conservation objectives for the Cork Harbour SPA. Given the distance of the stack from other tall structures including wind turbines, no adverse cumulative effects to the integrity, special conservation interests and conservation objectives for the Cork Harbour SPA will occur.

5.4 Appraisal of Potential Significant Impacts - Potential Accidental Releases from the Site During the Construction Phase

Potential accidental releases with a higher risk of occurrence during construction would include the release of silt or mud or a spill of fuel onto the L2545 road or onto Gobby Beach.

5.4.1 Mitigation during construction

A range of easily implemented control measures, will ensure that any risks are minimised as follows:

- To prevent incidental damage by machinery or by the deposition of spoil during the site clearance stage, any trees /habitats earmarked for retention will be securely fenced early in the construction phase. The fencing will be clearly visible to machine operators.
- A dedicated holding tank for storage of construction foul effluent will be constructed prior to commencement of the main construction activities. The effluent will be regularly disposed of off-site by tanker by a licensed contractor to an approved licenced facility
- Storm water will be managed carefully during construction. In general, storm water will be infiltrated to ground via silt traps and managed soakaways. The laydown areas will be suitably drained and any areas which will involve the storage of fuel and refuelling will be paved and bunded and hydrocarbon interceptors will be installed to ensure that no spillages will get into the surface water or groundwater.
- The construction management of the site will take account of the recommendations of the CIRIA guide *Control of Water Pollution from Construction Sites 2001*. Construction mitigation measures are outlined in **Appendix 9**.
- Construction activities have the potential to generate dust emissions, particularly during the site clearance and excavation stages. The potential for dust to be emitted depends on the type of construction activity being carried out in conjunction with ambient conditions, including rainfall, wind speed, wind direction and on the distance to potentially sensitive locations. Most of the dust would be deposited close to the potential source and any impacts from dust deposition would typically be within 100 metres or so of the construction area.
- The following avoidance, remedial or reductive measures will be implemented as part of the dust minimisation plan:
    - During very dry periods when dust generation is likely, construction areas will be sprayed with water.
    - Exhaust emissions from vehicles operating within the site, including trucks, excavators, diesel generators or other plant equipment, will be controlled by the contractor through regular servicing of machinery.
    - Vehicle speeds will be limited in the construction site.

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- Surrounding roads used by trucks for access to and egress from the site will be cleaned regularly using an approved mechanical road sweeper. Roads will be cleaned subject to local authority requirements. Site roads will be cleaned on a daily basis, or more regularly, as required.
- Wheel-wash facilities will be provided with rumble grids to remove excess mud from wheels. These facilities will be located at the exit from the site and away from sensitive receptors, where possible.
- Internal haul roads will be paved at the earliest possible opportunity and inspected regularly for cleanliness.
- Materials carried on vehicles to site will be enclosed or covered with tarpaulins.
- Daily visual inspections will be carried out at locations around the site boundary as required. These inspections will monitor the effectiveness of dust mitigation measures.
- Material handling systems and site stockpiling of materials will be designed and laid out to minimise exposure to wind.
- Wheel wash facilities will be provided for vehicles exiting the project site. Wheel wash run off will be stored in an onsite storage tank and will be disposed of by permitted waste haulage company at a permitted or licensed facility.

- Waste generated during the construction phase will be carefully managed according to the accepted waste hierarchy which gives precedence to prevention, minimisation, reuse and recycling over disposal with energy recovery and finally disposal to landfill.
- All waste removed from the site will be collected only by contractors with valid waste collection permits, under the Waste Management (Collection Permit) Regulations 2007 and 2008. All facilities to which waste will be taken will be audited in advance, to ensure that they have appropriate waste licences or permits, under the Waste Management Act 1996, as amended, and the regulations thereunder, allowing them to accept the type of waste that is to be sent there. Hazardous waste generation will be minimised, and such waste will be recovered where feasible, and only disposed of if recovery is not feasible. Hazardous waste will be managed in accordance with the relevant legislation.
- The employment of good construction management practices will minimise the risk of pollution of soil, storm water run-off, seawater or groundwater. The Construction Industry Research and Information Association (CIRIA) in the UK has issued a guidance note on the control and management of water pollution from construction sites, *Control of Water Pollution from Construction Sites, guidance for consultants and contractors* (Masters-Williams et al 2001). Additional guidance is provided in the CIRIA technical guidance on *Control of Water Pollution from Linear Construction Projects* (Murnane *et al* 2006).
    - Measures, as recommended in the guidance above, that will be implemented to minimise the risk of spills and contamination of soils and waters, include:
    - Training of site managers, foremen and workforce, including all subcontractors, in pollution risks and preventative measures,
    - Careful consideration will be given to the location of any fuel storage facilities. These will be designed in accordance with guidelines produced by CIRIA, and will be fully bunded.

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- All vehicles and plant will be regularly inspected for fuel, oil and hydraulic fluid leaks. Suitable equipment to deal with spills will be maintained on site.
- Where feasible, soil excavation will be completed during dry periods and undertaken with excavators and dump trucks. Topsoil and subsoil will not be mixed together.
- All areas where liquids are stored or cleaning is carried out will be located within a designated impermeable area that is isolated from the surrounding area, e.g. by a roll-over bund, raised kerb, ramps or stepped access.
- Use collection systems to prevent any contaminated drainage entering surface water drains, watercourses or groundwater, or draining onto the land.
- Minimise the use of cleaning chemicals.
- Use trigger-operated spray guns, with automatic water-supply cut-off.
- Use settlement lagoons or suitable absorbent material such as flocculent to remove suspended solids such as mud and silt.
- Ensure that all staff are trained and follow vehicle cleaning procedures.
- Post details of the procedures in the work area for easy reference.

5.4.2 Conclusions - Potential Accidental Releases from the Site During the Construction Phase

In the unlikely event that construction does result in small scale spillages of hydrocarbons or increased silt levels in surface water run-off, the impacts on the marine environment would be limited and localised. Given the dilution provided in the marine environment and the distance of the Cork Harbour SPA from the proposed development such spillages would not have an adverse impact on the integrity of the Cork Harbour SPA or the conservation objectives for qualifying bird species.

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The only accidental release from the site during construction, which would have the potential to have a negative effect on the SPA, would be a fire. In such a scenario, combustion products would be released during a fire. It is noted that the risk of fire during construction is low and the impact is also likely to be low as thethis development is industrial in nature with a predominance of steel, concrete and other non-combustible materials in the main process building. Fuel storage on site will be limited to small diesel tanks to supply earth moving plant. Moreover, it is also noted that the Cork Harbour SPA is located 0.5km from the Indaver site and thus any impact on the SPA from a construction fire is predicted to be negligible. Given the dilution provided in the marine environment and the distance of the Cork Harbour SPA from the proposed development, run-off of fire water would not have an adverse impact on the integrity of the Cork Harbour SPA or the conservation objectives for qualifying bird species.

Overall, whilst minor localised impacts on water quality could occur, there will not be an adverse effect on the integrity, special conservation interests and conservation objectives for the Cork Harbour SPA, even in the event of a highly unlikely accidental release from the site during the construction period.

5.5 Appraisal of Potential Significant Impacts - Potential Accidental Releases from fire during operation

5.5.1 Hazard Identification and Risk Assessment study

Notwithstanding the fact that the proposed development will not be a major accident establishment, a number of accident scenarios which could potentially arise during the operation of the facility, were assessed in the Hazard Identification and Risk Assessment

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study to determine the risk each posed to human health and the environment. The only risk identified as substantial was a fire in the bunker.

5.5.2 Consequence of Fire in the Bunker

Byrne Ó Cléirigh (Appendix 13) modelled the effects of a fully developed fire in the bunker, which was the only substantial risk identified. The report concluded the following:

Calculations show that "*there is a very wide margin of safety between the expected dioxin intake to people at receptors close to the Indaver site when compared with the WHO's Tolerable Daily Intake (TDI) for lifetime exposure of 1-4 pg/kg/day (taken as 1 pg/kg/day for the purposes of this calculation). As such the overall exposure to dioxins in the surrounding area as a result of the Indaver facility would be very low (over three orders of magnitude less than the overall TDI established by WHO)".*

"The closest Protected Site to the Indaver facility is Lough Beg, which is part of the Cork Harbour SPA and is also a pNHA. This is located c.500 m from the facility. Applying the same calculations the resulting factor of safety works out as 4,390, based on the WHO criteria for human health." It is predicted that the dioxin intake level at the closest point of the SPA would be negligible and would not have have an adverse impact on the integrity of the Cork Harbour SPA or the conservation objectives for qualifying bird species.

The thermal radiation from a fully developed fire in the bunker was also modelled. A thermal dose end point of 4kW/m^2 is the level sufficient to cause pain to persons exposed if unable to reach cover within 20 seconds. The distance to this thermal dose was 52m. The closest point of the Cork Harbour SPA is approximately 0.5km from the site and well beyond this distance. Accordingly, the thermal dose at the nearest point of the SPA would be well below a level which would affect any of the species identified as the qualifying interests for this SPA.

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5.5.3 Control Measures to Prevent a Fire in the Bunker

The measures will be put in place to protect against a fire in the bunker, either by reducing the likelihood of occurrence or mitigating the impacts if it did occur:

5.5.4 Prevention Measures

- Visual inspection of waste as it is unloaded at the reception hall/tipping hall, to check for any irregularities.
- Hot work permitting system – control on ignition sources in area.
- Trained operators.
- Lower explosive limit (LEL) monitoring in bunker.
- Where practicable, equipment is taken outside of the bunker for maintenance works to protect against risk of fire from maintenance activities.
- Due to the manner in which the activity is carried out, there is a quick throughput at the bunker which means that waste is not left in situ for a long period of time.
- Bunker Management Programme - once or twice per year the level in the bunker is lowered (as far as practicable) in the course of a lead in to plant shut down.
- Barrier in place at waste receipt area, to protect against scenario in which a trailer falls into the bunker.

5.5.5. Control Measures if a fire occurs

- In the event of a fire in the bunker, the fire damper will close and air to boiler will be taken from elsewhere.
- The control room is a manned area that has visibility on the bunker at all times via a large window that looks out onto it; this would facilitate rapid detection of smoke formation.

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- Negative pressure at waste reception area.
- ultraviolet/infrared detectors in the bunker.
- If smouldering waste is detected it is loaded directly to hopper and more waste is then dumped on top to smother it.
- 4 x fixed water cannons in place to douse spot fires.
- Sprinkler system on roof as back up to the water cannons.
- Bunker is concrete structure.
- Fire wrapping of cables to ensure continued function during fire event.

5.5.6 Fire Water Containment

Fire water retention, for the retention and control of contaminated water generated when fighting a fire on site, will be provided to the waste-to-energy plant.

In the event of a fire in the bunker, the water used to fight the fire will be captured in the bunker where it will be stored for disposal. The bunker will have more than adequate capacity for the volume of water used to fight the fire as well as the waste which will be in it. If there is a fire in any other part of the waste-to-energy plant, the water used to fight the fire will be captured by the recovery water and clean water tanks which will be located below the building floor. The bunker and the recovery tanks will be designed as water retaining structures. The fire-fighting water from any fire anywhere else on site will be captured in the storm water drainage system and will be collected in the holding tank, where it can be stored for disposal. The outlet valve from the holding tank will close if there is a fire alarm. If the holding tank has insufficient capacity, the water will overflow to the attenuation tank, in which it can be retained pending testing and disposal.

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5.5.7 Conclusions - Potential Accidental Releases from fire during operation

A range of mitigation measures will be implemented to prevent a fire in the bunker. Even in the event of a bunker fire the dioxin intake level at the closest point of the SPA would be negligible. Moreover, in the extremely unlikely event of a fire occurring, the thermal dose at the nearest point of the SPA would be well below a level which would affect the any of the species identified as the qualifying interests of the SPA. In the event of a fire in the bunker, the water used to fight the fire will be captured in the bunker, which will have sufficient capacity, where it will be stored for disposal. If a fire occurs in another part of the waste-to-energy building, the water used to fight the fire would be captured in the recovered water and clean water tanks which will be located under the floor. If a fire occurred in an external area, the potentially contaminated water used to fight the fire would drain to the storm water drainage system and be collected in the holding tank. If the holding tank has insufficient capacity, the water will overflow to the attenuation tank, in which it can be retained pending testing and disposal. Accordingly, there will no release of water used to fight the fire to the aquatic environment and no adverse effects on the conservation objectives of the Cork Harbour SPA can occur.

In light of the above evaluation, including the effective implementation of measures to prevent a fire, even if a fire did occur at the facility, such a fire would not have an adverse impact on the integrity of the Cork Harbour SPA site and its conservation objectives. No potential in-combination impacts, in relation to a fire on site, have been identified, which could have an adverse impact on the integrity of the Cork Harbour SPA or the conservation objectives for qualifying bird species.

5.6 Appraisal of Potential Significant Impacts - Potential Accidental Releases from fire during operation Potential impacts on piscivorous birds from air emissions and possible bioaccumulation

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5.6.1 Assessment of potential air and sediment impacts

Appendix 11 of this NIS provides a detailed assessment of the potential impacts on air. It is noted that due to the localised nature of possible impacts from dust generation during construction, the limited nature of potential impacts and the distance from the Cork Harbour SPA (0.5km) no significant potential impact from dust has been identified. Thus this section is concerned with possible emissions from the operation of the facility.

The Ringaskiddy Resource Recovery Centre will have one furnace and flue gas cleaning line. The line will have a moving grate furnace with a state-of-the-art flue gas cleaning system The combustion of waste produces a number of emissions, the discharges of which are regulated by the EU Directive on Industrial Emissions (IED) (2010/75/EU). The emissions to atmosphere which have been considered are: Nitrogen Dioxide (NO_2), Nitrous Oxides (NO_x) Sulphur Dioxide (SO_2), Total Dust (as PM_{10} and $PM_{2.5}$), Carbon Monoxide (CO), Total Organic Carbon (TOC), Hydrogen Fluoride (HF) and Hydrogen Chloride (HCl), Dioxins/Furans (PCDD/PCDFs), Cadmium (Cd) and Thallium (Tl), Mercury (Hg) and the sum of Antimony (Sb), Arsenic (As), Lead (Pb), Chromium (Cr), Cobalt (Co), Copper (Cu), Manganese (Mn), Nickel (Ni) and Vanadium (V). In addition, Polycyclic Aromatic Hydrocarbons (PAHs) have been assessed as incineration is a potential emission source for this group of compounds.

The scope of the study consists of the following components:

- Review of maximum emission levels and other relevant information needed for the modelling study;
- Identification of the significant substances which are released from the facility;
- Review of background ambient air quality in the vicinity of the facility;
- Air dispersion modelling of significant substances released from the facility;
- Particulate deposition modelling of Dioxins and Furans, Polycyclic Aromatic Hydrocarbons (PAHs) and heavy metals released from the facility;
- Identification of predicted ground level concentrations of released substances at the facility boundary and at sensitive receptors in the immediate environment;
- Evaluation of the significance of these predicted concentrations, including consideration of whether these ground level concentrations are likely to exceed the most stringent ambient air quality standards and guidelines.

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5.6.1.1 Modelling Under Maximum & Abnormal Operating Conditions

In order to assess the potential impact from the proposed facility under maximum and abnormal operations, a conservative approach was adopted that is designed to over-predict ground level concentrations. This cautious approach will ensure that an over-estimation of impacts will occur and that the resultant emission standards adopted are protective of ambient air quality. The approach incorporated several conservative assumptions regarding operating conditions at the proposed facility. This approach incorporated the following features:

- For the maximum operating scenario, it has been assumed that the emission point is continuously operating at its maximum operating volume flow. This will over-estimate the actual mass emissions from the facility.
- For the maximum operating scenario, it has been assumed that the emission point is operating at maximum capacity for 24-hrs/day over the course of the full year.

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- Abnormal operating emissions were obtained from the process engineer and are pessimistically assumed to occur.
- As a result of these conservative assumptions, there will be an over-estimation of the emissions from the facility and the impact of the proposed facility on the surrounding environment.

5.6.1.2 Modelling Study Methodology

The air dispersion modelling input data consists of detailed information on the physical environment (including building dimensions and terrain features), design details from all emission points on-site and a full year of worst-case meteorological data. The worst-case ambient concentration was then compared with the relevant ambient air quality standard to assess the significance of potential releases from the site. In the absence of detailed guidance from the Irish EPA, the selection of appropriate modelling methodology has followed the guidance from the USEPA which has issued detailed and comprehensive guidance on the selection and use of air quality models. Based on guidance from the USEPA, the most appropriate regulatory model for the current application is the AERMOD model (Version 14134). The selection of the appropriate meteorological data has followed the guidance issued by the USEPA.

5.6.1.3 Background Concentrations

The ambient concentrations detailed in the following sections include both the emissions from the site and the ambient background concentration for that substance. Background concentrations have been derived from a worst-case analysis of the cumulative sources in the region in the absence of the development. A detailed baseline air quality assessment was carried out to assess background levels of those pollutants, which are likely to be significant releases from the site.

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5.6.1.4 Cumulative Assessment

As the region around Ringaskiddy is partly industrialised and thus has several other potentially significant sources of pollutants, a detailed cumulative assessment has been carried out using the methodology outlined by the USEPA. The impact of nearby sources should be examined where interactions between the plume of the point source under consideration and those of nearby sources can occur. These include the area of maximum impact of the point source, the area of maximum impact of nearby sources and the area where all sources combine to cause maximum impact on air quality. Background concentrations for the area, based on natural, minor and distant major sources need also to be taken into account in the modelling procedure. A major baseline monitoring programme was undertaken over several months which, in conjunction with other available baseline data, was used to determine worst-case background concentrations in the region. Full detail of the cumulative impact assessment and associated results can be seen in **Appendix 11.**

5.6.1.5 Ambient Air Quality Standards

Ambient air quality legislation designed to protect human health and the environment is generally based on assessing ambient air quality at locations where the exposure of the population is significant relevant to the averaging time of the pollutant. However, in the current appraisal, ambient air quality legislation has been applied to all locations within a 10km radius of the facility regardless of whether any sensitive receptors (such as residential locations) are present for significant periods of time. This represents a worst-case approach and an examination of the corresponding concentrations at the nearest sensitive receptors relative to the actual quoted maximum concentration indicates that these receptors generally

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experience ambient concentrations significantly lower than that reported for the maximum value.

5.6.1.6 Receiving Environment

An extensive baseline survey was carried out in the region of the proposed Ringaskiddy Resource Recovery Centre facility over the period August 2014 to July 2015. This supplements the extensive baseline survey undertaken in November 2006 to February 2007 and from April 2008 to July 2008. The surveys focused on the significant pollutants likely to be emitted from the facility and which have been regulated in Council Directive 2010/75/EU. The updated extensive baseline survey which was carried out in the region of the proposed Ringaskiddy Resource Recovery Centre facility over the period August 2014 to July 2015 focused on NO_2, PM_{10}, benzene, SO_2 and heavy metals over a year long period in order to capture any possible seasonal factors.

5.6.1.7 *AERMOD dispersion model*

Council Directive 2010/75/EU on Industrial Emissions (IED) has outlined air emission limit values. The Directive has also outlined stringent operating conditions in order to ensure sufficient combustion of waste thus ensuring that dioxin formation is minimised. Specifically, the combustion gases must be maintained at a temperature of 850°C for at least two seconds under normal operating conditions for non-hazardous waste whilst for hazardous waste containing more than 1% halogenated organic substances, the temperature should be raised to 1100°C for at least two seconds. These measures will ensure that dioxins/furans, polychlorinated biphenyls (PCBs) and PAHs are minimised through complete combustion of waste.

Emissions from the proposed facility have been modelled using the AERMOD dispersion model which is the USEPA's regulatory model used to assess pollutant concentrations associated with industrial sources[1]. Emissions have been assessed, firstly under maximum emissions limits of the EU Directive 2010/75/EU and secondly under abnormal operating conditions.

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The Ringaksiddy Resource Recovery Centre facility has one main process emission point (flue). In order to assess the possible impact from the proposed facility under maximum and abnormal operations, a conservative approach was adopted that is designed to over-predict ground level concentrations. This cautious approach will ensure that an over-estimation of impacts will occur and that the resultant emission standards adopted are protective of ambient air quality. The approach incorporated several conservative assumptions regarding operating conditions at the proposed facility.

- **NO_2 & NO_X**

NO_2 modelling results indicate that the ambient ground level concentrations will be below the relevant air quality standards for nitrogen dioxide under maximum and abnormal operation of the facility. Thus, no adverse impact on the environment is predicted under these conditions at or beyond the facility boundary.

The annual average NO_X concentration (including background concentration) in the Cork Harbour SPA will also be below the limit value for the protection of vegetation. Thus, no adverse impact on the environment, including the conservation objectives of the Cork Harbour SPA will occur.

- **SO_2, CO, PM_{10} & $PM_{2.5}$**

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Modelling results indicate that ambient ground level concentrations will be below the relevant air quality standards for sulphur dioxide, carbon monoxide and PM_{10} under maximum and abnormal operation of the facility. Results will also be below the air quality standard for $PM_{2.5}$ under maximum and abnormal operation of the facility. Thus, no adverse impact on the environment, including the conservation objectives of the Cork Harbour SPA will occur.

TOC, HCl & HF

Modelling results indicate that the ambient ground level concentrations will be below the relevant air quality guidelines for the protection for TOC (assumed pessimistically to consist solely of benzene), HCl and HF under maximum and abnormal operation of the facility. Thus, no adverse impact on the environment, including the conservation objectives of the Cork Harbour SPA, will occur.

- **PCDD / PCDFs (Dioxins/Furans)**

Currently, no internationally recognised ambient air quality concentration or deposition standards exist for PCDD/PCDFs (Dioxins/Furans). Both the USEPA and WHO recommended approach to assessing the risk from Dioxins/Furans entails a detailed risk assessment analysis involving the determination of the impact of Dioxins/Furans in terms of the TDI (Tolerable Daily Intake) approach. The WHO currently proposes a maximum TDI of between 1-4 pgTEQ/kg of body weight per day. Background levels of Dioxins/Furans occur everywhere and existing levels in the surrounding area have been extensively monitored as part of this study. Monitoring results indicate that the existing levels are similar to rural areas in the UK and Ireland. The contribution from the facility in this context is minor, with levels at the worst-case receptor to the north-west of the facility (at a distance of approximately 400 metres from the nearest point of the Cork Harbour SPA), under maximum and abnormal operation, accounting for less than 6% of the ambient air quality standards under maximum operating conditions.

There will be no adverse effects on the conservation objectives of the Cork Harbour SPA from Dioxins or Furans.

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- **PAHs**

PAHs modelling results indicate that the ambient ground level concentrations will be below the relevant air quality target value under maximum and abnormal operation of the facility. Thus, no adverse impact on the environment, including the conservation objectives of the Cork Harbour SPA, will occur.

- **Hg**

Hg modelling results indicate that the ambient ground level concentrations will be below the relevant air quality standards under maximum and abnormal operation of the facility. Thus, no adverse impact on the environment, including the conservation objectives of the Cork Harbour SPA, will occur. Emissions at maximum operations equate to ambient mercury concentrations (including background concentrations) which are only 0.2% of the annual average limit value at the worst-case receptor.

- **Cd and Tl**

Modelling results indicate that the ambient ground level concentrations will be below the relevant air quality standard for cadmium under maximum and abnormal operation from the facility. There will be no adverse effects on the conservation objectives of the Cork Harbour SPA from cadmium or thalium.

- **Sum of As, Sb, Pb, Cr, Co, Cu, Ni, Mn and V**

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Modelling results indicate that the ambient ground level concentrations will be below the relevant air quality standards for arsenic (As) and vanadium (V) (the metals with the most stringent limit values) under maximum and even abnormal operation emissions from the facility (based on the ratio of metals measured at a Waste to Energy facility in Belgium). Thus, no adverse impact on the environment, including the conservation objectives of the Cork Harbour SPA, will occur under these conditions.

5.6.1.7 AERMOD Modelling Summary

Modelling results indicate that the ambient ground level concentrations will be below the relevant air quality standards or guidelines for all parameters under maximum and abnormal operation of the facility. The modelling results indicate that this maximum occurs in the region between the northern and north-eastern boundaries of the facility. Maximum operations are based on the emission concentrations outlined in EU Directive 2010/75/EU.

An appropriate stack height has been selected to ensure that ambient air quality standards will not be approached even under abnormal operating scenarios. The stack height determined by air dispersion modelling which will lead to adequate dispersion was 70 metres.

The spatial impact of the facility is limited with concentrations falling off rapidly away from the maximum peak. For example, the short-term concentrations due to process emissions at the nearest residential receptor will be less than 17% of the short-term ambient air quality limit values. The annual average concentration has an even more dramatic decrease in maximum concentration away from the facility with concentrations from emissions at the proposed facility accounting for less than 1% of the limit value (not including background concentrations) at worst case sensitive receptors near the facility.

5.6.1.8 CALPUFF Modelling Assessment

The CALPUFF modelling system has been recommended by the USEPA as a Guideline Model for source-receptor distances of greater than 50km and for use on a case-by-case basis in complex flow situations within 50km. CALPUFF has some important advantages over steady-state Gaussian models such as AERMOD in areas of complex meteorology.

- **NO_2**

NO_2 modelling results indicate that the ambient ground level concentrations will be below the relevant air quality standards for nitrogen dioxide under maximum and abnormal operation of the facility. Thus, no adverse impact on the environment, including the conservation objectives of the Cork Harbour SPA, will occur under these conditions at or beyond the facility boundary.

- **SO_2, CO, PM_{10} & $PM_{2.5}$**

Modelling results indicate that ambient ground level concentrations will be below the relevant air quality standards for sulphur dioxide, carbon monoxide and PM_{10} under maximum and abnormal operation of the facility. Results will also be below the air quality standard for $PM_{2.5}$ under maximum and abnormal operation of the facility. Thus, no adverse impact on the conservation objectives of the Cork Harbour SPA will occur under these conditions at or beyond the facility boundary.

- **TOC, HCl & HF**

Modelling results indicate that the ambient ground level concentrations will be below the relevant air quality guidelines for TOC (assumed pessimistically to consist solely of benzene), HCl and HF under maximum and abnormal operation of the facility. Thus, no adverse impact on the environment, including the conservation objectives of the Cork Harbour SPA, will occur.

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- **PCDD / PCDFs (Dioxins/Furans)**

Background levels of Dioxins/Furans occur everywhere and existing levels in the surrounding area have been extensively monitored as part of this study. Monitoring results indicate that the existing levels are similar to rural areas in the UK and Ireland. The contribution from the facility in this context is minor, with levels at the worst-case receptor to the north-west of the facility (approximately 400 metres from the nearest point of the SPA), under maximum and abnormal operation, accounting for less than 6% of the ambient air quality standards under maximum operating conditions.

Thus, no adverse impact on the environment, including the conservation objectives of the Cork Harbour SPA, will occur.

- **PAHs**

PAHs modelling results indicate that the ambient ground level concentrations will be below the relevant air quality target value under maximum and abnormal operation of the facility. Thus, no adverse impact on the environment, including the conservation objectives of the Cork Harbour SPA, will occur.

- **Hg**

Hg modelling results indicate that the ambient ground level concentrations will be below the relevant air quality standards under maximum and abnormal operation of the facility. Thus, no adverse impact on the environment, including the conservation objectives of the Cork Harbour SPA, will occur.

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- **Cd and Tl**

Modelling results indicate that the ambient ground level concentrations will be below the relevant air quality standard for cadmium under maximum and abnormal operation from the facility. Thus, no adverse impact on the environment, including the conservation objectives of the Cork Harbour SPA, will occur.

- **Sum of As, Sb, Pb, Cr, Co, Cu, Ni, Mn and V**

Modelling results indicate that the ambient ground level concentrations will be below the relevant air quality standards for for arsenic (As) and vanadium (V) (the metals with the most stringent limit values) under maximum and abnormal operation emissions from the facility (based on the ratio of metals measured at a Waste to Energy facility in Belgium).

Thus, no adverse impact on the environment, including the conservation objectives of the Cork Harbour SPA, will occur.

5.6.1.9 Conclusion on modelling results

Based on the emission guidelines outlined in Council Directive 2010/75/EU, detailed air dispersion modelling has shown that the most stringent ambient air quality standards are not exceeded as a result of operating under either maximum or abnormal operating conditions.

The modelling results, using both the USEPA regulatory model AERMOD and the more advanced CALPUFF model, indicate that the maximum ambient GLC occurs at or near the facility's northern and north-eastern boundaries. The spatial impact of the facility is limited with concentrations falling off rapidly away from the maximum peak. The annual average concentration has a dramatic decrease in maximum concentration away from the facility with concentrations from emissions at the proposed facility accounting for less than 2% of the limit value (not including background concentrations) at worst case sensitive receptors near the facility.

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In the Cork Harbour SPA, levels are significantly lower than most background sources. The concentrations from emissions at the proposed facility accounting for less than 2% of the annual limit values for all pollutants under maximum operations of the facility.

5.6.2 Mitigation by Design

A number of measures have been incorporated into the design of the resource recovery centre to ensure that emissions from the plant do not exceed regulatory emission limit values as outlined in Industrial Emissions Directive 2010/75/EU. Air modelling predictions indicate that ambient air quality due to emissions from the proposed facility will be within the air quality standards at all locations beyond the site boundary, based on maximum and abnormal operating conditions. Thus no specific additional mitigation measures are required during the operational phase of the facility. Based on the results of air dispersion modelling of process emissions, there will be no adverse effects on the conservation objectives of the Cork Harbour SPA during the operational phase of the proposed development.

5.6.3 Summary of Sediment and soil Survey

The report Sampling and analysis of soil and sediment samples for PCDDs, PCDFs and PCBs at various locations around Cork Habour (AWN, 2015) is attached as **Appendix 14** of this report.

Soil and sediment sampling was conducted at 12 locations in the Cork Harbour Area and at EPA Iniscarra, with the aim of determining background concentrations of PCDD, PCDF and dioxin-like PCBs in the vicinity. Three of these sites are within the Cork Habour SPA. Samples were analysed for dioxins and furans with results compared to previous data recorded by AWN and EPA sampling in 2000.

The primary aims of the sampling programme carried out by AWN were as follows (where site refers to the proposed Resource Recovery Centre):

- Establish the current concentrations of PCDDs, PCDFs and dioxin-like PCBs in soil and sediments in the vicinity of the site;

- Discuss the relevance of recorded concentrations of PCDDs, PCDFs and dioxin-like PCBs; and

- Compare recorded concentrations in this round with soil and sediment dioxin and furan concentrations obtained for the site by AWN in 2001, 2008, 2009 and historically by the EPA and Cork County Council. As this report is concerned primarily with potential impacts on the Cork Harbour SPA, the sediment sampling programme is relevant. The sediment sampling sites are indicated in the full report **(Appendix14)** and, as far as the Cork Harbour SPA is concerned, were located as follows:

  - Beach 1A, Strand at Whitegate Village (more than 3km east of the proposed development) within the Cork Harbour SPA
  - Beach 2A, Ringaskiddy – Gobby Beach adjacent to road to Haulbowline Island
  - Beach 3A Mud Flats at Buncoille (Monkstown) (circa 2.5km northwest of the proposed development) within the Cork Harbour SPA
  - Beach 4A Mud flats in bay west of Hovione plant at Loughbeg, (circa 900m southwest of the proposed development) within the Cork Harbour SPA.

By sampling in these areas, PCDD/F concentrations in the sediment of these designated areas can be determined and used to whether there will be any adverse impacts on species which may breed, feed, roost or winter in the SPA. In addition, all sediment sampling sites chosen were in areas of muddy sediment which can provide bird feeding habitats and which

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are known, or which have an apparent potential, to accumulate contaminants. Details on the sampling methodology and assumptions which were required when assessing results are included in **Appendix 14.**

The results of sediment sampling shows that PCDD/F concentrations in beach sediments were generally higher in the 2015 sampling event than in the 2009 event, with the exception of levels at location Beach 2A which reduced from 0.035 ng/kg to 0.015 ng/kg. The concentration at Beach 1A in Whitegate Village was significantly higher in 2015 with an increase in concentration of more than ten times that of 2009.

There is no Irish statutory threshold values for PCDD/F or dioxin-like PCBs in soils or sediments. However, there are Dutch Target and Intervention values assigned to sum value of the EC7 PCB congeners and in the absence of Irish guidance, these values are typically used. The Dutch Government have set a national target value of 20 µg/kg PCB in soil and a threshold value (the concentration above which remedial action should be considered) of 1000 µg/kg. The highest measured concentration in soil in the Cork Harbour area in the 2015 sampling round was 0.113 ng/kg at Location 3A (Martello Tower) which is well below even the target value, therefore the recorded concentrations can be considered as insignificant.

The UK EA published a document in 2004 entitled "UK Proposed Environmental Quality Guidelines for Dioxins and Furans in Water and Sediments" which applies the concept of using a 2000 ng/kg as a TEQ x fraction of organic carbon to determine an appropriate limit value for dioxin concentration in sediments. When the measured concentrations are compared against the limit value they are all shown to be less than the assigned limits.

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The AWN 2015 report concluded as follows:

> *"Background concentrations of PCDD/Fs in soil samples were found to be reduced from samples measured at similar locations in 2001 and 2008. The concentration at Martello Tower (Location 3A) continues to be elevated above locations and in this recent round, the total PCDD/F concentration at Roche's Point Lighthouse (Location 7A) was found to be highest with a TEQ of 0.802 ng/kg. Dioxin-like PCB concentrations were typically similar to recorded concentrations in 2008 and remain well below Dutch limit value concentrations. TEQ PCDD/F concentrations in beach sediment samples were shown to be slightly higher at three out of the four sampling locations in 2015 with the most elevated concentration (0.485 ng/kg) recorded at the strand in Whitegate Village to the east of the site (Beach 1A). PCDD/F concentrations in sediments were still well below UK EA limit values, however. TOC and pH values were within expected ranges with slight alkalinity in the sediment samples as expected in marine conditions. Heavy metal concentrations were recorded at each of the twelve locations with highest lead (110 mg/kg) and zinc (140 mg/kg) concentrations recorded at Locations 4A and 2A, respectively."*

5.6.4 Ecological Risk Assessment

An ecological risk assessment report was prepared by AWN which specifically considers the risk to piscivorous birds and otter within Cork Harbour. (Ecological Risk Assessment for PCDD/F for Indaver Ringaskiddy Resource Recovery Centre (AWN, 2015). This report is attached as **Appendix 15.**

The risk assessment approach taken was that presented by the US EPA in the documents: Framework for the Application of the Toxic Equivalency Methodology, Polychlorinated Dioxins, Furans and BiPhenyls in Ecological Risk Assessment, US EPA 2003 1 and Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities, US EPA, 1999 2.

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The approach taken was as follows:

- Model baseline impact of existing background dioxin with respect to predicted concentration in bird egg and concentration in forage fish in otter diet. The bird species focused on were cormorant and common tern.
- Model worst case theoretical increase due to PCDD/F emissions from the waste-to-energy facility,
- Model impact of predicted sediment concentration on selected species
- The receptor location for sediment concentration was in front of Whitegate Village (Beach 1A), which had the highest background levels.
- The baseline calculation for both gull eggs and otters follows the relevant equations from the Framework Application Document above as follows:

  C (fish eating bird egg) = (Cs/Foc) x BSAF (egg) x fl(egg)

  Where

  C (fish eating bird egg) is dioxin concentration (pg/g)

  Cs is dioxin concentration in sediment (pg/g)

  Foc is fraction of organic carbon in sediment

  BSAF is the Biota-sediment accumulation factor

- The increase in dioxin concentration in sediment resulting from airborne dioxin deposition was estimated using a very conservative approach, which was to assume that the maximum dioxin deposition rate from the waste-to-energy facility facility, which is predicted to be close to the boundary of the facility, would, for the purposes of the model, impact on the chosen sample point (beach B1A, which in reality is more than 3 km to the east of the waste-to-energy facility site), so deposition is likely to be many times lower than that modelled. It was also assumed that the sediment in question was permanently exposed to the atmosphere, whereas in reality the sediments will be covered by the tide for much of the day. The modelled increase was determined using deposition data modelled by AWN and the MARI model for soil dioxin.

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The ecological risk assessment report concluded the following:

- Baseline dioxin concentrations in the eggs of fish eating birds and in otters considered to be low and well within limit values for the eggs of fish eating birds.
- The predicted change in dioxin concentrations is considered to be insignificant for both fish eating birds' eggs and otters, based on exposure to forage fish.

5.6.5 Summary of literature review on possible impacts on the environment from emissions of dioxin and mercury with a particular emphasis on bio-accumulation in piscivorous birds (Appendix 3)

5.6.5.1 History of dioxin and mercury emissions from incineration

- In 1989, for the first time the EU adopted legislation to reduce dioxin emissions from municipal waste incineration by setting up so-called operational conditions, leading to a significant reduction of dioxin emissions. Emission Limit Values (ELV) were set at Community level in the Waste Incineration Directive 2000/76/EC. It is estimated that industrial sources of dioxin and furan emissions in the EU have reduced by almost

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80% over the last 20 years. Currently the main sources of dioxin emissions in the EU 25 member states, including Ireland, are from non-industrial activities.

- Since 1995, the Irish EPA have regularly monitored dioxin levels in cow's milk. Levels of dioxins in cow's milk have been consistently low since the surveys began. The levels of dioxins found in the most recent surveys (2012) are well below the EU limit in milk and milk products of 2.5 pg WHO-TEQ/g for dioxins only, and 5.5 pg WHOTEQ/ g for dioxins and PCBs combined. The EPA results are in line with the dioxin results from the latest report from the Cork County Council animal health surveillance programme, which has been operating in the Cork Harbour Region since 1991.The Cork Harbour report found dioxin, furan and PCB levels were significantly less than the applicable limits. This study, which began in 2005, found dioxins and furan levels remained generally stable at values considered as low background levels in European terms.
- In 1995, the US EPA adopted new emissions standards for waste-to-energy facilities pursuant to the Clean Air Act. These so-called MACT (maximum available control technology) regulations dictated that waste-to-energy facilities with large units (i.e., >227 tonnes per day) should comply with new Clean Air Act standards by December 19, 2000. Waste-to-energy facilities now represent less than 1% of the US emissions of dioxins and mercury.

5.6.5.2 Impact of dioxins on wildlife

- In animal studies, tetrachlorodibenzo-p-dioxin TCDD and dioxin-like chemicals demonstrate many effects. Laboratory studies on birds have shown a variety of effects from dioxins including lethality, chick oedema, decreased growth rates decreases in locomotary responses, deficits in body motions and balance, aggressive behaviour and changes in brain neurotransmitters. Fish eating birds which inhabit areas contaminated with TCDD are chronically exposed during embryonic development via the yolk and this has anti-oestrogenic effects. *In ovo* exposure to these compounds during the perinatal period may be responsible for certain behavioural characteristics and reproductive dysfunction.

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5.6.5.3 Dioxins in birds and incineration

- A number of studies have attempted to examine the direct links between dioxin contaminated sites and morbidity effects in birds occupying habitats adjacent to them including studies of Anhingas (*Anhinga anhinga*) and White Ibises (*Eudocimus albus*) collected from a colony next to a Florida municipal solid-waste (MSW) combustor and ash landfill and eggs of the Common Tern (*Sterna hirundo*) from the highly polluted colonies, located in the main sedimentation area of the Rhine and Meuse rivers. In the study of Anhingas, most of the measured residues, including TCDD, TCDF, arsenic, beryllium, cadmium and nickel, remained at pre-operational levels during the first five years of facility operation. In the study on Common terns the toxicity of a mixture of dioxins and dioxin-like compounds can be expressed in a single number - the toxic equivalency (TEQ) and this was used as a metric to examine the residual yolk sacs of the hatchlings. Highly polluted colonies, located in the main sedimentation area of the Rhine and Meuse rivers, contained on average 16ng TEQ per gram lipid, which was fivefold higher than the concentrations in the reference colony. These studies were carried out prior to the implementation of the Waste Incineration Directive in the EU and the Clean Air Act in the US, which has led to substantial reductions in incinerator emissions.

5.6.5.4 Impacts of mercury in ecosystems

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- Because mercury can be methylated and therefore become bioavailable in aquatic systems, it has historically been considered a problem for species directly associated with aquatic ecosystems, such as piscivorous birds. Studies indicate that there is background uniformity of mercury contamination in the North Atlantic which provides evidence of global pollution by mercury due to atmospheric deposition at long distance from emission sources.
- Birds, such as Heron (*Ardea cinerea*), that consume large fish as their prey, are predicted to be at greater risk of methylmercury poisoning than birds that consume smaller fish. When the quantities of fish consumed on a body weight basis is also considered for smaller birds such as the Kingfisher (*Alcedo atthis*), there is an elevated risk of methylmercury poisoning.
- High concentrations of mercury have been associated with developmental and behavioral abnormalities, impaired reproduction and survival, and in some cases with direct mortality.
- Several estimates exist in the published literature on mercury concentrations in soft tissues (liver, kidney, brain) that are associated with mercury poisoning in bird species. Estimates for extreme hazard and neurological impacts were in the region of 20µg/g fresh weight in soft tissues, brain mercury concentrations of 15 µg/g (fresh weight), or liver or kidney mercury concentrations of 30 µg/g (fresh weight).
- It was observed that significant reproductive impairment due to methylmercury occurred at about one-fifth the tissue concentrations required to produce overt neurotoxicity. Such effects include decreased hatchability of eggs. Dietary methylmercury also reduces the appetite and growth rates of baby birds.

5.6.5.5 Waste incineration and mercury in birds

- This subject was intensively studied in the Everglades in south Florida. The Everglades system was historically highly contaminated with mercury which had been linked to local waste incineration. Some results supported the hypothesis that nestlings are protected from the harmful effects of mercury through deposition of mercury in growing feathers. The implementation of the Clean Air Act in 2000 led the significant decreases in local mercury inputs. Studies concluded that the Everglades has undergone a biologically significant decline in mercury availability in the wetland food web, possibly because of decreased local inputs.

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5.6.5.6 Conclusions of literature review on possible impacts on the environment from emissions of dioxin and mercury with a particular emphasis on bio-accumulation in piscivorous birds (Appendix 3)

- Historically dioxin and mercury emissions from incinerators have been the cause of much public concern. However, the implementation of the EU Waste Incineration Directive 2000/76/EC and the Clean Air Act in the US has led to large reductions in incinerator emissions across the developed world. In Germany, for example, incinerator dioxin emissions have fallen from 400 grams to less than 0.5 grams a year, since the year 2000. Incinerators now represent less than 1% of total dioxin emissions in Germany. In Ireland dioxin levels are currently significantly less than applicable limits and are considered as low background levels in European terms.
- Laboratory studies on birds and mammals have found an array of negative effects from dioxins and heavy metals. While a number of studies have attempted to replicate these effects in the wild, in areas which are heavy polluted, the results have been inconclusive. In one study, uptake of dioxins in the bird population resident near a waste incinerator were not increased in the ten years following the facility's opening. One complication of feeding animals diets containing fish collected from contaminated waters, appears to be that other unaccounted for contaminants can

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influence the overall toxicity of the mixture. While gaps in the research exist, between lab and field based studies, it does appear that the impact of polluted sediments on animals is complex. The complexities of examining individual and combination effects of dioxins, PCBs and heavy metals in the field seem, at present, to be beyond the reach of researchers. However, it does appear that the contribution of waste incineration to these pollutants has decreased significantly. In the years since strict legislation governing waste incineration has been implemented, mercury concentrations in bird feathers has dropped significantly alongside declines in mercury inputs from industrial sources.

5.6.6 Additional information requested by the NPWS during consultation in relation to possible emission impacts (See section 3.3)

During consultation with the NPWS, information was sought in relation to particular issues that relate to the possible impacts of emissions from the proposed facility on Natura 2000 sites. These are addressed in **Appendix 2** and the responses are summarised below. The NPWS information requirements are as follows:

- Comparative data from similar waste-to-energy incinerator facilities (Point 3 of DAU letter).
- Information on plant start-up and shut-down procedures including frequency of start-up and shut-down, and emergency response procedures (Requested at the NPWS meeting, May 2015).
- Review of potential bio-monitoring programmes (Requested at the NPWS meeting, May 2015).
- Information on air emission monitoring data from Indaver's plant at Carranstown, Co Meath. (Requested at the NPWS meeting, May 2015).
- Effects of hazardous compounds (Point 8 of DAU letter).

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5.6.7 Conclusions - Impacts on piscivorous birds from air emissions and possible bioaccumulation

In determining the potential impact from emissions and bioaccumulation, the following points were taken into consideration:

- In line with the Industrial Emissions Directive, Directive 2010/75/EC, best available techniques (BAT) are required to be used in pollution prevention and control. BAT have been incorporated into all aspects of the design of this project.
- The facility will be operated under an industrial emission licence. Indaver must implement an environmental management system to manage and control all aspects of the operation.
- Within the incineration process, a hazardous substance that is fed into the furnace does not come out unchanged as the same hazardous substance, either in the residues or in the exhaust gases. In the furnace the hazardous substance is oxidised which means it under goes a chemical reaction and is converted into one or more different substances with different properties. These different substances are removed in the ash or flue gas cleaning residues and a very small quantity is discharged to the air in the exhaust gases. Compounds such as dioxins which form

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after combustion is complete (and at lower temperature windows in the boiler of around 450°C) are removed by the injection of activated carbon/clay.

- Potential impacts on air quality have been comprehensively addressed. This appraisal reviewed background information on ambient air quality, potential cumulative impacts, identified significant substances which could arise from the facility, identified suitable models and used the two most appropriate models to predict the concentrations at ground level by reference to stringent air quality standards. Modelling was based on conservative assumptions which overestimate the impact of the facility. Notwithstanding these conservative assumptions it was concluded that '*Air modelling predictions indicate that ambient air quality levels from the proposed facility will be within the ambient air quality standards at all locations beyond the site boundary, based on maximum and abnormal operating conditions.*'
- Soil and sediment sampling was conducted at 12 locations in the Cork Harbour Area with the aim of determining background concentrations of PCDD, PCDF and dioxin-like PCBs in the vicinity. Samples were obtained from areas of muddy sediments where birds will feed and 3. Sediment sampling locations were located within the Cork Harbour Special Protection Area (SPA). Background concentrations were found to be below the Dutch limit value concentrations and UK Environment Agency limit values.
- A literature review concluded that dioxins and mercury can impact on birds and mammals. However, the implementation of the EU Waste Incineration Directive 2000/76/EC and the Clean Air Act in the US has led to large reductions in incinerator emissions across the developed world. In the years since strict legislation governing waste incineration has been implemented, mercury concentrations in bird feathers has dropped significantly alongside declines in mercury inputs from industrial sources.
- Since 1995, the Irish EPA have regularly monitored dioxin levels in cow's milk. Levels of dioxins in cow's milk have been consistently low since the surveys began. The levels of dioxins found in the most recent surveys (2012) are well below the EU limit in milk and milk products of 2.5 pg WHO-TEQ/g for dioxins only, and 5.5 pg WHOTEQ/ g for dioxins and PCBs combined (Concannon, 2014). The 2013 report from Cork County Council animal health surveillance programme, which addresses the years 2005 – 2010, found dioxin, furan and PCB levels were significantly less than the applicable limits.
- An Ecological Risk Assessment concluded that the baseline dioxin concentrations in the eggs of fish eating birds and in otters considered to be low and well within limit values for the eggs of fish eating birds. The predicted change in dioxin concentrations is considered to be insignificant for both fish-eating, bird's eggs and otters, based on exposure to forage fish.
- A review of the start-up and shut down processes and procedures has concluded that the risk of poor performance with respect to dioxins during start-up and shut down of the furnace will be effectively prevented.
- The waste-to-energy plant at the Ringaskiddy Resource Recovery Centre will be very similar to the Indaver Carranstown, Co Meath, plant. Air emission monitoring data from the Carranstown facility show that the concentration of dioxins in emissions from the plant, in the years 2012, 2013 and 2014, were substantially less than one tenth of the licensed emission limit value. For the year 2014, the daily average emissions of dust, metals, acid gases, carbon monoxide, sulphur dioxide and nitrous oxides from the facility complied with the licensed emission limit values.

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- In Belgium, France and the UK examples of incinerators can be found located within less than 0.5km of an SPA and the results suggest that proximity to an SPA does not, in general, create a significant barrier to permission being granted to incinerators in proximity to SPAs.
- The closest part of the Cork Harbour SPA is located 0.5km from the site boundary and the area of shoreline which adjoins the site boundary is not of high value for birds listed as special conservation interests for this SPA.
- Based on the above, and taking possible cumulative impacts into consideration, there will be no adverse effects on the conservation objectives of the Cork Harbour SPA arising from any emission from the proposed waste-to-energy facility. Similarly, given the low background levels and the low concentrations of toxic substances in emissions, the risk that significant bioaccumulation will occur is considered negligible. Therefore, there will be no adverse effect on the integrity, special conservation interests and conservation objectives for the Cork Harbour SPA from emissions, including cumulative emissions and possible bioaccumulation.

5.7 Implementation of Mitigation measures

5.7.1 Implementation of mitigation measures - evidence of how these will be secured and implemented and by whom and evidence of how measures will be monitored and should mitigation failure be identified how that failure will be rectified.

Indaver will appoint a construction management team for the duration of the construction phase. The construction management team will be based on site. The team will supervise the construction of the project, including monitoring the performance of the contractors to ensure that the proposed construction phase mitigation measures are implemented and that construction impacts and nuisance are minimised.

The team will monitor the implementation of the construction mitigation measures. If a mitigation measure is not implemented or if it fails the construction management team will require the relevant contractor to immediately rectify the situation.

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5.7.2 Implementation of mitigation measures - evidence of degree of confidence in their likely success.

The proposed mitigation measures are tried and tested on many construction projects and their efficacy is proven. The likely success of the proposed mitigation measures is high, either in their current form or as they will be adapted on-site to achieve the desired result. The measures incorporated into the project design and mitigation measures have been drawn up in line with current best practice and include an avoidance of sensitive habitats at the design stage. It is clear in what the mitigation measures are designed to achieve in lowering or reducing the risk of impact to acceptable levels. Whilst the proposed methods of mitigation may be amended and supplemented the risk that the mitigation measures will not function effectively in preventing adverse impacts on designated sites is low.

5.7.3 Implementation of mitigation measures - timescale, relative to plan or project for their implementation or completion.

The timescale for implementation of the mitigation measures will be dependent on the construction programme of the proposed project. However, based on evidence from other projects, the mitigation measures can only commence in tandem with other site operations as staff, machinery and other resources are necessary to implement the measures. Certain mitigation measures will have to be undertaken in advance of certain construction works, while others can proceed in parallel and others will only be necessary following completion of the main site works.

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5.8 Biomonitoring

The NPWS requested that the potential benefits and practicality of a bio-monitoring programme for mercury and dioxin levels within birds in Cork Harbour during operation of the facility be assessed. Specifically the use of bird feathers and eggs of piscivorous birds was considered as a potential mechanism for assessing possible bioaccumulation. A review including a literature review was carried out to assess the viability of such a bio-monitoring programme (**Appendix 6).**

5.8.1 Conclusion of bio-monitoring review

A notable method for examining the impact of pollutants in the wild is bio-monitoring. While studies on heavy metals, in particular mercury, are well established, non-invasive bio-monitoring for dioxins is still relatively new. Bird feathers and eggs have been successfully used to monitor mercury levels in birds for many years. In the case of dioxins, bird livers and muscle are commonly used, although a number of studies have successfully used eggs to monitor contamination levels. However, other factors, including age, sex, time of year, migratory status and, in the case of eggs, laying sequence, will affect the levels of mercury or dioxins detected. Therefore using such techniques to monitor mercury patterns in a single area, or from a single source (in this case the proposed Indaver facility) appears very difficult if not impossible.

Indaver contacted representatives of the waste-to-energy industry in the UK, Ireland, Germany, Belgium and The Netherlands but found no evidence for a biomonitoring programme instigated by a specific incinerator. The general consensus was that such programmes are not required due to the low emission levels and the low potential for impacts.

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The predicted levels of dioxins and mercury generated by the facility will be low and no significant impact on piscivorous bird species is predicted. Given the difficulties inherent in determining the source of dioxins and mercury in piscivorous birds and the difficulties in ascribing levels to any particular source, the use of cows' milk is considered an adequate means of determining if problematic levels of dioxins are entering the food chain via atmospheric deposition. The EPA conducts such monitoring of dioxin in cows milk in Ireland, including in the Ringaskiddy area.

5.9 Conclusions of the Natura Impact Statement

The Stage One Screening appraisal contained in this report considered the potential for significant impacts arising from the proposed development on Natura 2000 sites within a 20km radius. Following screening, the only Natura 2000 site for which potential significant impacts have been identified is the Cork Harbour SPA, which is located approximately 0.5km from the proposed development site at its closest point.

Impacts which were considered to have the potential to impact on the Cork Harbour SPA related to disturbance during construction and operation, a possible fire in the bunker during operation, impacts on the marine environment during construction and operation, the collision risk to birds created by the stack during operation and the potential for emissions of substances with eco-toxicological effects and possible bioaccumulation through the food chain. Potential cumulative impacts were also considered.

A range of precautionary measures have been incorporated into the project design, and other mitigation measures have been developed and proposed, with the purpose of avoiding or minimising impacts on the qualifying interests and conservation objectives of the Cork Harbour SPA, which is located 0.5km from the Indaver site. The likely success of these

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measures was also considered and no particular difficulties in their effective implementation were identified.

The provisions of Article 6 of the 'Habitats' Directive 92/43/EC (2000) defines 'integrity' as the 'coherence of the site's ecological structure and function, across its whole area, or the habitats, complex of habitats and / or population of species for which the site is or will be classified'. *The draft documents Managing Natura 2000 Sites: the provisions of Article 6 of the 'Habitats' Directive 92/43/EEC (Draft)* (EC, 2015) states that the integrity of the site can be usefully defined as the coherent sum of the site's ecological structure, function and ecological processes, across its whole area, which enables it to sustain the habitats, complex of habitats and/or populations of species for which the site is designated"

Following a comprehensive evaluation of the potential direct, indirect and cumulative impacts on the qualifying interests and conservation objectives for the Cork Harbour SPA, it has been concluded that the proposed development will not have an adverse effect on the integrity of the Cork Harbour SPA.

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Appendix 1

Site Location and Site Layout Figures

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ARUP

INDAVER

Site Location

Natura Impact Statement - Ringaskiddy Resource Recovery Centre

238129-00 | January 2016 | Figure 1

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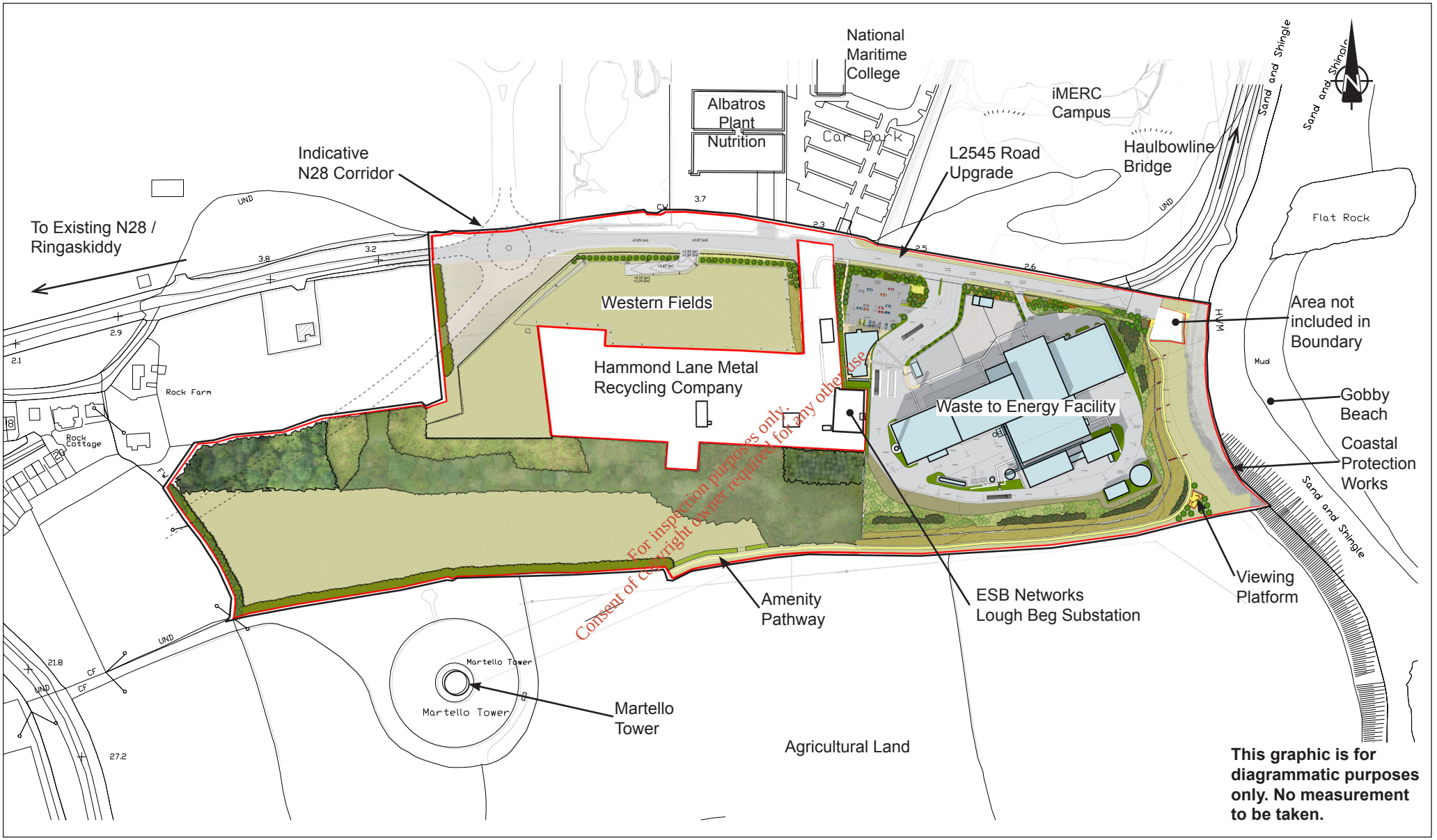

ARUP

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Overview of Proposed Development

Natura Impact Statement - Ringaskiddy Resource Recovery Centre

238129-00 | January 2016 | Figure 2

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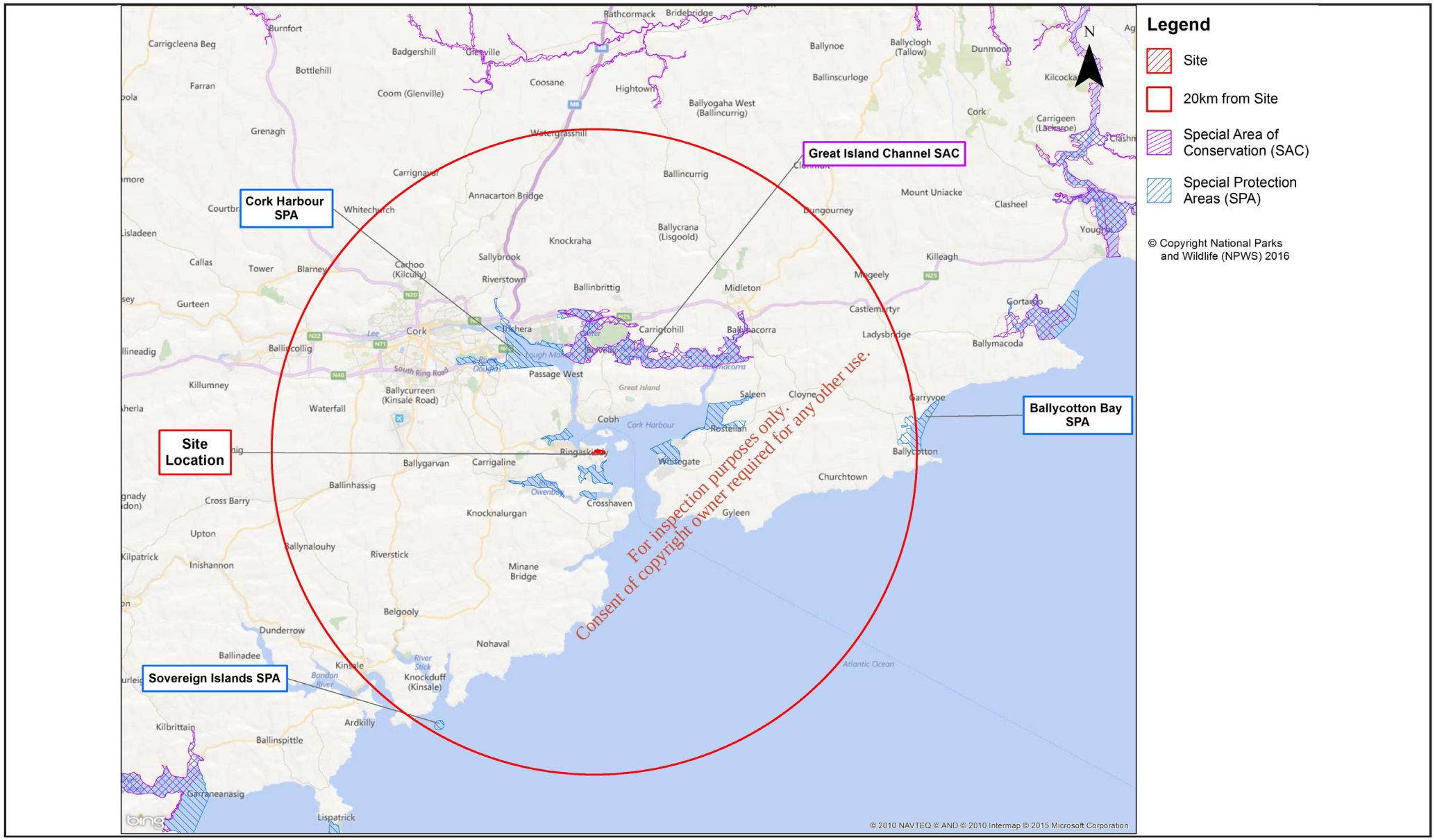

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Natura 2000 Sites 20km from Site

Natura Impact Statement - Ringaskiddy Resource Recovery Centre

238129-00 | January 2016 | Figure 3

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Appendix 2

Letter from the Development Applications Unit

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An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht

Our Ref: **G Pre00050/2015**
ABP Ref: **PL04 .PC0151 according to ABP website: Pre-Application Consultation**

11 September 2015

Fiona Patterson
Senior Engineer
Ove Arup & Partners (Ireland)
15 Oliver Plunkett St.
Cork.

Via email fiona.patterson@arup.com
Cc: sids@pleanala.ie

Re: **Pre-planning enquiry - Proposed waste management facility, Ringaskiddy**

A Chara,

On behalf of the Department of Arts, Heritage and the Gaeltacht, I refer to your consultation letter of 18 February 2015 with regard to the above proposed development, and to the preliminary documents presented at meetings (on 23 April and 9 September 2015) between Indaver, Arup, Dixon-Brosnan and regional staff of the National Parks and Wildlife Service (NPWS) of this Department. It is noted that the proposal does not now include a hazardous waste facility.

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Outlined below are heritage-related observations/recommendations of the Department under the stated heading(s).

Nature Conservation

In the context of the provisions of the Planning and Development Act, 2000, as amended, the Department understands that An Bord Pleanála will be carrying out the appropriate assessment and environmental impact assessment of this proposed development, and they should be consulted in the first instance. The Department has therefore copied the Board with this letter. The observations below *are not comprehensive*, and are without prejudice to any recommendations, decisions or actions by either the Board or the Minister for Arts, Heritage and the Gaeltacht relating to this planning application or to further pre-planning consultations.

The proposed municipal waste incinerator facility is located within the Lower Harbour area, parts of which includes Cork Harbour Special Protection Area (SPA) (4030), designated under the European Communities (Conservation of Wild Birds (Cork Harbour Special Protection Area 004030) Regulations 2010 (S.I. No. 237 of 2010). A site synopsis, conservation objectives, and the conservation objectives supporting document, for this site are available at www.npws.ie. Although the proposed development is not located within, or adjacent to, the above SPA, nevertheless both stack emissions and flue-treatment ash transport could indirectly affect the SPA. In addition, species to which conservation objectives (e.g. cormorant, common tern, red-breasted merganser) apply feed within the Lower Harbour area, and also migrating and dispersing birds could be at risk of collision with the stack.

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Information on the legislative requirements for Habitats Directive appropriate assessment and Environmental Impact Assessment can be found on the websites of the Departments of Arts, Heritage and the Gaeltacht (DAHG) and the Department of the Environment, Community and Local Government (DECLG), respectively. Your attention is drawn to the requirement for the Habitats Directive appropriate assessment to be "clear, precise and definitive" (Court of Justice of the European Union Case C-521/12).

Although the emissions from the facility will be subject to an EPA licence, nevertheless, the Department considers that their assessment is necessary as part of the planning process, to ensure that the decision concerning location (near to a SPA) is properly made.

NIS - Cork Harbour SPA

The following potential conservation issues, discussed at the above pre-planning meetings, will need to be addressed in the Natura Impact Statement (NIS), concerning the conservation objectives of the SPA:

(1) *Effects of air emissions*

Due to their ecotoxicological effects, emissions of polychlorinated dibenzo-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), thallium (Tl), mercury (Hg), and cadmium (Cd) are of particular concern. These compounds and metals also bioaccumulate, affecting species such as piscivorous (fish-eating) birds and otter which are high in the food web. Elevated concentrations of these pollutants have been reported associated with municipal waste incinerators. Baseline data on piscivorous bird species in Cork Harbour, to which the conservation objectives of the SPA apply, should be provided. This should form part of the basis for the interpretation of emission modelling of effects of emissions on the SPA.

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Pollutant monitoring and operation performance data for similar processes under similar management (especially re start-up frequencies) (e.g. from the Indaver facility in Co. Meath) should be provided, where an argument is being proposed that modern facilities have less emissions than those reported in the scientific literature more than ten years ago.

(2) *Dioxins and furans*

As mentioned above, dioxins and furans can be produced by the incineration process, and these contaminants have been recorded as having very low toxicity thresholds to some piscivorous birds, as well as accumulating through the food chain to top predators.

The ability of the incinerator process to control temperature above that predicted to lead to dioxin and furan formation, and the efficacy of the quenching process to rapidly reduce temperature to avoid temperatures lingering between 500 and 800°C, needs to be assessed.

The following is cited from Teaf *et al.* (1999: 33[1]): "Temperatures between 500 and 800°C are observed to promote PCDD [polychlorinated dibenzo-dioxin] formation, while destruction of PCDDs is expected only at temperatures above 800°C. Combustion temperature is a function of fuel Btu content, available oxygen content, and fuel processing operations. Thus, the conditions of municipal waste incinerator combustion (low temperatures, high moisture content, low Btu-value fuel, lack of supplemental fuel, and poor

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waste mixing during combustion) are conducive to and are considered a significant source of PCDD formation."

The following is the part of the DEHLG submission to the Oral Hearing for the previous Indaver application, referring to toxicity thresholds for common tern, as requested at the pre-planning meeting:

"In the related Forster's tern, embryotoxicity occurred at 90-339 pg/g of TCDD-TEQ (toxic equivalents) (Hoffman *et al.*, 1996; cited in Mierzykowski *et al.*, 2008[2]). A common tern egg hatchability effect threshold of 600 pg/g TCDD-TEQ was suggested by Kubiak (2007; cited in Mierzykowski *et al.*, 2008), and a feminization threshold of 3000 pg/g lipid was suggested by Hart (1998; cited in Mierzykowski *et al.*, 2008). A toxicity reference value of 90pg TCDD-TEQ/g can be taken from this data for common tern."

(3) Comparative data from similar waste-to-energy incinerator facilities

A number of similar incinerators operate close to Special Protection Areas in other parts of Europe. Examples are:

(a) Runcorn municipal waste incinerator (Cheshire, UK), within 300m of the Mersey Estuary SPA;
(b) Marchwood Energy from Waste Facility (Southampton, UK), within 1km of the Solent and Southampton Water SPA;
(c) Exeter Energy from Waste facility (Devon, UK), within 2km of the Exe River SPA;
(d) La Collete non-hazardous waste incinerator facility (Jersey, UK), near to the South East coast of Jersey Ramsar site[3].

Comparative ecological data on the impact of operating incinerators, where these data are available and preferably accredited, should be collated to support the conclusion of the appropriate assessment, as to whether there is reasonable scientific doubt concerning the absence of adverse effects of the proposed incinerator on Cork Harbour SPA.

In addition, the thresholds of sub-lethal and lethal effects of dioxins and furans on the above or similar bird species, documented from areas like the Great Lakes in North America and from Tokyo Bay, should be considered in relation to the model predictions for the proposed development. For instance, Tsuchiya *et al.* (2003)[4] made the following observations in relation to food chain accumulation:

"The major source of dioxin impurities in Japan in the past years was agrochemical formulations; more recently, it has been exhaust from waste incinerators.

The elevated dioxin concentration with polychlorinated dibenzo-p-dioxins, polychlorinated dibenzofurans and coplanar PCBs found in the fishermen may be due to the frequent consumption of fish.

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[1] Teaf, C.M., Stabile, I.K. and Moffat, P.A. (1999) Characterization of potential emissions from hazardous waste incinerators and related facilities. Pp. 23-50. In: Roberts, S.M., Teaf, C.M. and Bean, J.A. (eds.) *Hazardous waste incineration*. Lewis Publishers, Boca Raton.
[2] Mierzykowski, S.E., Welch, L.J., Hall, C.S., Kress, S.W. and Allen, R.B. (2008) *Contaminant assessment of common terns in the Gulf of Maine*. USFWS Special Project Report FY07-MEFO-2-EC. Maine Field Office, Old Town, Maine, U.S.
[3] A 'Ramsar site' is a site designated under the Ramsar Convention on Wetlands (Part of Cork Harbour is also designated as a Ramsar site (837)).
[4] Tsuchiya, Y., Nakai, S., Nakamura, K., Hayashi, K., Nakanishi, K. and Yamamoto, M. (2003) Effects of dietary habits and CYP1A1 polymorphisms on blood dioxin concentrations in Japanese men. *Chemosphere* **52**: 213-219.

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Thus, it is probable that the primary route of dioxin exposure in the Japanese population is through the food chain, via fish consumption …"

However, Senthikumar *et al.* (2002)[5] pointed out that several studies indicated elevated exposure of birds to PCDD/Fs in the mid- to late 1990s, but that "efforts have been taken to reduce emission of dioxin in Japan in the late 1990s. As an example, increase of temperature and reduction of carbon sources and substitution of oxygen reduced PCDD/DF emissions."

Any up-to-date indication that such improvements in process control have been successful would be useful.

(4) *Flue gas treatment residue and filter ash transport in Cork Harbour*
Flue gas treatment residue and filter ash can contain high concentrations of the pollutants mentioned above. If it is proposed to ship this material to continental Europe through Cork Harbour, then the risk of an accidental release of this material into Cork Harbour (and including the SPA-designated mudflats) should be thoroughly assessed.

(5) *Flue gas treatment residue and filter ash transport in the Elbe Estuary*
At the pre-planning meeting on 9 September 2015 it was mentioned that the flue gas treatment residue and filter ash may be shipped to Hamburg. The Elbe Estuary leading to Hamburg includes the Ramsar-Gebiet S-H Wattenmeer und angrenzende Küstengebiete SPA (DE0916491), the Niedersächsisches Wattenmeer und angrenzendes Küstenmeer SPA (DE2210401), the Unterelbe SPA (DE2121401), the Vorland St. Margarethen SPA (DE2121402), the Unterelbe bis Wedel SPA (DE2323401), the Mühlenberger Loch SPA (DE2424401), the Hamburgisches Wattenmeer SAC (DE2016301), the Unterelbe SAC (DE2018331) and the Schleswig-Holsteinisches Elbästuar und angrenzende Flächen SAC (DE2323392), It should be confirmed with An Bord Pleanála as to whether a similar assessment for these sites, as recommended above for Cork Harbour SPA in relation to ecological risks of residue and ash shipping, is necessary. The Board may also be able to advise if the EIS and/or NIS need to be sent to the German authorities (e.g. under Articles 124-129 of the Planning and Development Regulations 2000 – 2014).

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(6) *Bird collision risk with stack*
There is a potential for collisions between birds dispersing between various parts of Cork Harbour SPA and the proposed stack, with the potential for lighting of the stack to exacerbate this during poor weather conditions (e.g. fog). This issue should be thoroughly assessed, especially in relation to the type of lighting proposed.

(7) *Increased predator attraction*
The potential for the facility to encourage a higher population of nest predators (e.g. hooded crows, brown rats) in the Ringaskiddy area, due to the potential availability of waste, should be assessed.

(8) *Effects of hazardous components in waste*
The potential for ecotoxicological effects of the residues of the hazardous wastes to be burned as part of the waste feed (e.g. solvents, etc.) should be thoroughly assessed.

[5] Senthikumar, K., Iseki, N., Hayama, S., Nakanishi, J. and Masunaga, S. (2002) Polychlorinated dibenzo-p-dioxins, dibenzofurans, and dioxin-like polychlorinated biphenyls in livers of birds from Japan. *Archives of Environmental Contamination and Toxicology* **42**: 244-255.

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EIS – protected species

The following potential conservation issues, in addition to those mentioned above, will particularly need to be addressed in the Environmental Impact Statement (NIS), concerning protected species and strictly protected species (under the Birds and Habitats Directives and the Wildlife Acts):

(1) Effects on otters (including coastal protection measures and bioaccumulation of pollutants (as with piscivorous birds above));
(2) Effects on Annex I bird species and regularly occurring migratory birds, to which the conservation objectives of the SPA do not apply, e.g. little egret (a piscivorous species), whimbrel (in terms of collision risk), etc.
(3) Effects on red-listed and amber-listed bird species (e.g. yellow-hammer (habitat removal), barn owl (rodenticide use), etc.).
(4) Effects of any blasting or pile-driving on marine mammals occurring in the Lower Harbour;
(5) Effects of rock-armouring on the fauna and flora of the shingle beach; a survey for protected flora should be undertaken.

You are requested to send further communications to Development Applications Unit (DAU) via email to manager.dau@ahg.gov.ie; if emailing is not possible, correspondence may alternatively be sent to:

The Manager
Development Applications Unit
Department of Arts, Heritage and the Gaeltacht
Newtown Road
Wexford
Y35 AP90

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Finally, the above observations and recommendations are based on the papers submitted to this Department on a pre-planning basis and are made without prejudice to any observations the Minister may make in the context of any consultation arising on foot of any development application referred to the Minister, by the planning authority, in her role as statutory consultee under the Planning and Development Act 2000, as amended.

Is mise, le meas

Patricia O'Leary

Patricia O'Leary
Development Applications Unit
Tel: (053) 911 7482

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Appendix 3

Literature Review:

The Potential Ecological Effects of Mercury, Dioxins, Thalium and Cadmium on Bird Receptors and Otter

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Appendix 3. Literature review of potential ecological effects of mercury, dioxins, thalium and cadmium on bird receptors and otter.

1. Introduction

There is considerable public, scientific and regulatory concern over the possible adverse health effects of chronic exposure to trace levels of persistent organic pollutants and heavy metals. In particular the class of compounds made up of the polychlorinated dibenzo-p-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF), often collectively known as dioxins, has received widespread attention and attracted a great deal of research. The following report attempts to examine this research in the light of the proposed Ringaskiddy Resource Recovery Centre, with a view to determining potential environmental impacts of the Waste-to-Energy (WtE) plant. The main focus of this literature review will be on impacts to wildlife, particularly those species which are similar to those occupying the designated areas adjacent the proposed development site i.e. Cork Harbour SPA and Great Island Channel SAC. This will help to inform the Natura Impact Statement (NIS) for the proposed development.

2. History of dioxin and heavy metal emissions from incineration

Waste incineration has a long history in the EU, with the first dedicated waste incinerators dating back to 1876 in the UK (Bontoux 1999). In the past, many US cities had thousands of residential incinerators in the city without any air pollution controls. At one time New York City had an estimated 18,000 residential incinerators and 32 municipal incinerators (Psomopoulos *et al.* 2009), the environmental impacts of which can still be detected in deep lying cores of the Central Park soil. Activities such as these have understandably left a lasting bad impression of waste incineration. During this time, when the effects of emissions on health and the environment were not well understood, all high temperature processes, including metal smelting, cement production, coal-fired power plants and incinerators, were the sources of enormous emissions to the atmosphere. In particular, incinerators were the major sources of toxic organic compounds (dioxins and furans) and heavy metals such as mercury. However, legislation on emissions over the last two decades has led to huge reductions in waste incineration emissions.

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In 1989, for the first time the EU adopted legislation to reduce dioxin emissions from municipal waste incineration by setting up operational conditions. These Emission Limit Values (ELV) were set at Community level in the Waste Incineration Directive 2000/76/EC, leading to significant reductions in dioxin emissions. While difficult to quantify overall dioxin trends in the EU due to differences between the EU Member States, it is estimated that industrial sources of dioxin and furan emissions in the EU have reduced by almost 80% over the last 20 years (EC, 2006). Individual member states have also published reports supporting this trend. In Germany, for example, incinerator dioxin emissions have fallen from 400g to less than 0.5g per annum and now represent less than 1% of total dioxin emissions (German Federal Ministry, 2005). In a long term study of a Portuguese Municipal Solid Waste (MSW) incinerator operational post 2000, no significant differences were recorded in the levels of dioxins and furans found in breast milk and human blood, before and after the opening of the facility (Coutinho 2012). Similar trends have been observed in the US. In 1995, the US EPA adopted new emissions standards for WtE facilities pursuant to the Clean Air Act. These regulations dictated that WtE facilities with large units (i.e., >227 tonnes per day) should

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comply with new Clean Air Act standards by December 2000. WtE facilities now represent less than 1% of the US emissions of dioxins and mercury (US EPA, 2003; Millrath *et al.* 2004; Psomopoulos et al. 2009).

Currently the main sources of dioxin emissions in the EU 25 member states are from non-industrial sources, with 30% from residential combustion and 15% from backyard burning (EC, 2006). Similarly in the US backyard burning emits close to 600g of dioxins annually, accounting for the majority of dioxin emissions (Deriziotis, 2004).

Similar trends in reducing incineration dioxin emissions have been observed in other developed countries, particularly Japan, whose main method of waste management is incineration. According to United Nations Environment Programme (UNEP) data, Japan generated almost 40% of the total worldwide dioxin emissions in 1995 (UNEP, 1999). Other reports from the same period concluded that while previously the largest source of dioxin-like compounds was from agricultural sources, municipal waste incineration had then become the largest source of dioxin emissions in Japan (Masunaga and Nakanishi, 1999; Masunaga *et al.*, 2001). Following these reports, an intensive programme of measures was implemented to reduce dioxin-like emissions. This has led to a 95% reduction in the amount of dioxins emitted between 1997 and 2003 (Yoshida *et al*. 2009).

In line with the rest of the EU, the dominant sources of dioxin emission in Ireland are from non-industrial activities (Concannon, 2014). Since 1995, the Irish EPA have regularly monitored dioxin levels in cow's milk. The primary mechanism for dioxins entering the food chain is through atmospheric deposition. Therefore cow's milk is seen as a suitable means of assessing the presence of dioxins in the environment, since cows tend to graze over relatively large areas and these compounds will, if present, concentrate in the fat content of the milk. Levels of dioxins in cow's milk have been consistently low since the surveys began. The levels of dioxins found in the most recent surveys (2012) are well below the EU limit in milk and milk products of 2.5pg WHO-TEQ/g for dioxins only, and 5.5pg WHOTEQ/ g for dioxins and PCBs combined (Concannon, 2014). The EPA results are in line with results from Cork County Council's animal health surveillance programme, which has been operating in the Cork Harbour Region since 1991 (Buckley *et al.*, 2013). The Cork Harbour report found dioxin, furan and PCB levels were significantly less than the applicable limits. This study, which began in 2005, found dioxins and furan levels remained generally stable at values considered as low background levels in European terms.

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3. Dioxins and Furans

3.1 Impact of dioxins on wildlife

After the Second World War, scientists began to recognise that certain chemical pollutants were capable of persisting in the environment for long time, migrating in air, water, soil and sediments and accumulating to levels that could harm wildlife and human health. These chemical pollutants were labelled persistent organic pollutants (POPs) (Manahan 2000). Because they can be transported by wind and water, most POPs generated in one country can and do affect people and wildlife far from where they are used and released. They persist for long periods of time in the environment and can accumulate and pass from one species to the next through the food chain. Many POPs were widely used during the boom in industrial production after World War II, when thousands of synthetic chemicals were introduced into commercial use. Many of these

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chemicals proved beneficial in pest and disease control, crop production, and industry. These same chemicals, however, have had unforeseen effects on human health and the environment. POP's include Polychlorinated Biphenyls (PCBs), DDT and dioxins. While some POPs are intentionally produced for pest control (e.g. DDT) or for industrial processes (PCBs), others are unintentional by-products of industrial processes or combustion (e.g. dioxins and furans).

"Dioxins" is a collective term for the category of 75 polychlorinated dibenzo-para-dioxin compounds (PCDDs) and 135 polychlorinated dibenzofuran compounds (PCDFs). Seventeen PCDD and PCDF compounds are considered to be of toxicological significance. The most toxic of these is 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD). The toxic responses include skin effects, immunotoxicity and carcinogenicity, as well as reproductive and developmental toxicity. These compounds, or congeners, arise mainly as unintentional bi-products of incomplete or poorly controlled combustion and from certain chemical processes.

In animal studies, TCDD and dioxin-like chemicals demonstrate many effects including: altered transcription of genes; induction of various enzymes; wasting syndrome; hepatotoxicity; altered immune function; testicular atrophy; altered thyroid function; chloracne; porphyria; neurotoxicity; teratogenicity; and carcinogenicity (EPA, 2004). Laboratory studies on birds have shown a variety of effects from dioxins including lethality, chick oedema, decreased growth rates (Hoffman *et al.* 1996) decreases in locomotary responses, deficits in body motions and balance, aggressive behaviour (Dahlgren and Linder 1974, Kreitzer and Heinz 1974) and changes in brain neurotransmitters (Sharma *et al.* 1976). Fish eating birds which inhabit areas contaminated with TCDD are chronically exposed during embryonic development via the yolk and this has anti-oestrogenic effects (Janz and Bellward 1996). *In ovo* exposure to these compounds during the perinatal period may also be responsible for certain behavioural characteristics and reproductive dysfunction.

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Hart *et al.* (1991) examined the relationship between concentrations of PCDDs and PCDFs in Great Blue Heron (*Ardea herodias*) eggs and the effects on chicks. Eggs were collected from sites of low, intermediate and high contamination. Levels of TCDD in eggs were 10 ng/kg (wet weight), 135 ng/kg and 211 ng/kg, respectively. There was little difference in mortality of chicks from eggs collected from the various sites, suggesting no effect on survival at levels of PCDD/PCDFs seen in the eggs. Effects of contamination included decreased growth with increased TCDD level, depression of skeletal growth with increased TCDD levels and subcutaneous oedema which increased with increasing PCDD and PCDF contamination. Also observed were shortened beaks and a scarcity of down follicles in the chicks from the more contaminated sites.

Uptake of PCDD and PCDF in laying ducks was determined at different degrees of feed contamination (Shun-I Shih *et al.* 2009). To observe the extent of the transfer of 17 PCDD/Fs from feed to the duck eggs and duck meat, 18 ducks were divided into three groups (six in each group) and fed feed with two different levels of PCDD/Fs. As a control, one group of ducks was fed with the non-contaminated feed for comparison, while the other two groups were exposed to the feed mixed with fly ash. The experiment lasted for 60 days, with an exposure duration of 41 days and the subsequent non-contaminated feed being given for an additional 19 days. PCDD/F levels in the eggs of the all three groups were observed to increase significantly on the 15th day. For the low contaminated group, PCDD/F levels reached 2.61pg WHO-TEQ/g lipid at day 41,

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whereas those of the high contaminated group accounted exceeded 3pg/g lipid on the 15th day. Furthermore, PCDD/Fs levels in the duck meat were analysed before and after exposure duration, and at the end of the experiment. The results showed that the level of PCDD/F in the duck eggs and the duck meat may reach unacceptable levels due to the effect of accumulation, although the PCDD/Fs in the duck feed were at acceptable levels.

3.2 Dioxins in birds and incineration

A number of studies have attempted to examine the direct links between dioxin contaminated sites and morbidity effects in birds occupying adjacent habitats. Rumbold *et al.* (1997) examined levels of TCDD, tetrachlorodibenzofuran (TCDF) and selected metal concentrations in eggs and nestlings of Anhingas (*Anhinga anhinga*) and White Ibises (*Eudocimus albus*) collected from a colony next to a Florida municipal solid-waste (MSW) combustor and ash landfill. Most of the measured residues, including TCDD, TCDF, arsenic, beryllium, cadmium and nickel, remained at pre-operational levels during the first five years of facility operation. Selenium (in Anhingas) and mercury (in both Anhingas and Ibises) occurred at their lowest concentrations in samples collected during the fifth year of facility operation (Year-5). Concentrations of lead in Ibis nestlings were highest in Year-1 and Year-5 compared to Year-0. The MSW combustor could neither be ruled out nor confirmed as the source of this lead. In a follow on study at the same facility Rumbold and Mihalik (2002) found that concentrations of most residues, including TCDD, TCDF, arsenic, beryllium, cadmium and lead, were at levels comparable to those found during previous survey prior to facility start-up. Nickel residues were detected only sporadically in Anhingas and in eggs from Ibises, and decreased significantly in concentration in Ibis nestlings in 1999 compared to 1989. While concentrations of mercury in Anhinga nestlings and in eggs of both species were comparable to 1989 levels, its concentration was significantly greater in Ibis nestlings in 1999. However, levels of mercury in the Ibises remained relatively low when compared to birds from other areas of Florida and did not appear to represent a health threat. While lead did not increase in 1999, its concentration in Ibis nestlings remained a concern. The most notable temporal trend observed in birds at this site was a general monotonic decrease in levels of selenium residues during the 10-year monitoring period.

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In 1991, eggs of the Common Tern (*Sterna hirundo*) were collected at eight different locations and incubated artificially (Bosveld *et al.* 1995). The toxicity of a mixture of dioxins and dioxin-like compounds can be expressed in a single number - the toxic equivalency (TEQ) and this was used as a metric to examine the residual yolk sacs of the hatchlings. Highly polluted colonies, located in the main sedimentation area of the Rhine and Meuse rivers, contained on average 16ng TEQ per gram lipid, which was fivefold higher than the concentrations in the reference colony. The hepatic EROD activity (a highly sensitive indicator of contaminant uptake) was induced fourfold compared to the reference colony ($p < 0.005$). At the individual level, a significant relationship was found between log TEQ and EROD levels. Average TEQ concentration in chicks that hatched after 23 d of incubation were twice the concentration of those that hatched after 21 d ($p < 0.05$). No concentration-related effects on morphology and physiology were found. The non-ortho- and mono-ortho-PCBs were predominant regarding the total TEQ, while the PCDDs and PCDFs contributed less than 10%. The PCB patterns were highly similar among the individual birds and among different locations. In contrast, PCDD and PCDF patterns were not similar at all locations, and two distinct patterns could be recognised and related to sediments that were deposited during different time periods.

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Naito and Murato (2009) carried out a population-level assessment of the ecological risks of dioxin-like PCB exposure to piscivorous birds in Tokyo Bay, Japan. Egg mortality risk and changes in the population growth rate in relation to the contamination levels of dioxin-like PCBs in eggs of Grey Heron (*Ardea cinerea*), Great Cormorant (*Phalacrocorax carbo*), Osprey (*Pandion halieaetus*), and Kingfisher (*Alcedo atthis*) were determined by integrating the results of exposure analysis, effect analysis, and a life-history model for each species. The results concluded that the levels of dioxin-like PCBs observed in the Tokyo Bay area alone would not have significant population-level effects on the fish-eating bird populations. This study follows a 95% reduction in Japanese incinerator dioxin emissions between 1997 and 2003 (Yoshida *et al.* 2009).

It should be noted that the majority of the studies referred to above were carried out prior to the implementation of the Waste Incineration Directive in the EU and the Clean Air Act in the US, which as discussed in **Section 2** of this review, has led to substantial reductions in incinerator emissions. This author was unable to find any studies examining post 2000 dioxin levels in birds adjacent to incinerators in the EU or US. However, a number of studies have found significant reductions in mercury levels after the year 2000. These are discussed in detail in **Section 4.2** of this report.

4. Heavy metals

4.1 Impacts of mercury in ecosystems

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Mercury is a well-studied environmental contaminant, with wide-ranging impacts on the health of various taxa (Scheuhammer *et al.* 2007). Because mercury can be methylated and therefore become bioavailable in aquatic systems, it has historically been considered a problem for species directly associated with aquatic ecosystems, such as piscivorous birds (Wolfe *et al.* 1998).

There is a huge scientific literature on the distribution of mercury in ecosystems. Mercury has been measured in aquatic and terrestrial invertebrates, in a variety of plants, and in many higher organisms including humans. High concentrations of mercury have been associated with developmental and behavioral abnormalities, impaired reproduction and survival, and in some cases with direct mortality.

During the decades when seed grains were treated with organo-mercurial fungicides, huge numbers of wild birds were poisoned fatally with mercury. In the 1970s, declining use of organo-mercurial fungicides greatly reduced the severity of mercury exposure. However, mercury residues either through natural or anthropogenic sources remain. Several reports of mercury concentrations in avian species have been published in the peer-reviewed literature (Bowerman *et al*. 1994; Spalding *et al*. 1994; Langlois and Langis 1995). Based on historical and recent information, mercury is a common contaminant of avian tissues from diverse geographic locations. The feeding habits of particular avian species have been major predictors of risk of mercury toxicity. When seed grains were treated with organo-mercurial fungicides, herbivorous, omnivorous, and carnivorous species were all at risk of mercury toxicity. Because of the bio-magnification of methylmercury in the aquatic foodweb, birds which feed on fish, crayfish or shellfish now have higher exposures to methylmercury than do non-fish eating birds. Birds, such as Grey Heron, that consume large fish as their prey, are predicted to be at

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greater risk of methylmercury poisoning than birds that consume smaller fish (Spalding *et al*. 1994; Sundlof *et al*. 1994). When the quantities of fish consumed on a body weight basis is also considered for smaller birds such as the Kingfisher, there is an elevated risk of methylmercury poisoning. Senthilkumar *et al.* (2002) found that as well as feeding habits, specific elimination and metabolism influenced differing contamination patterns between species.

Several estimates exist on mercury concentrations in soft tissues (liver, kidney, brain) that are associated with mercury poisoning in bird species. Experimental studies of survival and reproductive success of Black Ducks (*Anas rubripes*) indicated that adult ducks would tolerate liver mercury concentrations of 23 ppm and appear in good health (Findley and Stendell 1978). However, it was found that although the Black Ducks fed methylmercury in their diet appeared in good health, they had impaired reproductive success as indicated by reduced hatchability of eggs and high duckling mortality. Findley *et al.* (1979) concluded that concentrations of mercury in excess of 20 µg/g fresh weight in soft tissues should be considered extremely hazardous to avian species. Scheuhammer (1991) indicated that the major effects of methylmercury in avian species were neurological, developmental and reproductive. The neurological changes included weakness, walking or flying difficulties and incoordination that were associated with brain mercury concentrations of 15 µg/g (fresh weight), or liver or kidney mercury concentrations of 30 µg/g (fresh weight). Schuehammer (1991) observed that significant reproductive impairment due to methylmercury occurred at about one-fifth the tissue concentrations required to produce overt neurotoxicity. Liver mercury concentrations of 2 to 12 µg/g (fresh weight) in adult breeding Pheasants (*Phasianus colchicus*) and Mallard (*Anas platyrhynchos*) were linked to decreased hatchability of eggs (Schuehammer 1991). Barr (1986) noted that clinical signs of mercury poisoning, such as impaired vision and ataxia in loons. Barr (1986) also noted that impairment of vision or ataxia in a visual hunter such as loon would be likely to reduce its chances of procuring adequate food and defending a territory.

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Mercury concentrations in the livers of wading birds in Southern Florida (Sundlof *et al.* 1994; Spalding *et al.* 1994) and the merganser in northern Quebec (Lanlois and Langis 1995) are in the range associated with adverse reproductive and neurological effects in other species of birds. Sundlof *et al.* (1994) reported that four Great Blue Heron collected from the central Everglades contained liver mercury at concentrations typically associated with overt neurological signs (>30 µg mercury/g fresh weight). Furthermore, these investigators found between 30% and 80% of the potential breeding-age birds collected in an area encompassing the central Everglades contained liver mercury at concentrations associated with reproductive impairment in ducks and Pheasants. In a parallel study, Spalding *et al*. (1994) determined the magnitude of mercury contamination associated with death of Great White Herons (*Ardea herodias occidentalis*). Birds that died of acute causes (e.g., trauma from collision with power lines or vehicles) had much lower liver mercury concentrations (geometric mean 1.8 µg/g fresh weight, range 0.6 to 4.0 µg/g fresh weight) than did birds that died of chronic diseases (geometric mean 9.8 µg/g fresh weight, range 2.9 to 59.4 µg/g fresh weight).

Dietary methylmercury reduces the appetite and growth rates of baby birds. In the baby birds fed methylmercury (Spalding *et al.* 2000a) at 0.5 mg/kg body weight (comparable to doses encountered in the wild) anemia, feather abnormalities, neurological changes, and immunology damage occurred. At higher doses birds showed gait disturbances.

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Birds in the wild died at lower doses than laboratory birds, presumably due to multiple stressors (Spalding *et al.* 2000b).

Although the hazards of environmental mercury were already well recognized by 1970, there was considerable speculation regarding the relative contribution of anthropogenic versus natural sources. Hammond (1971) questioned whether the magnitude of human releases was sufficient to alter the concentration of mercury in the marine ecosystem. Thompson *et al.* (1998) addressed this question by showing that the mercury content of seabird feathers had increased between 65% and 394% (or 1-4% per year) in five species of North Atlantic seabirds for which pre-1931 and post-1979 feather samples were available. Based on mercury levels in the feathers of museum specimens, mercury levels in carnivorous birds in Europe were low prior to the mid-20th century and then increased, reflecting the increased anthropogenic (both industrial and agricultural) contribution to the environment. Odsjö (1975) documented the dramatic jump in mercury concentration of Scandinavian Goshawk (*Accipiter gentilis*) feathers from < 5 µg/g prior to 1940 to about 20 µg/g after 1940. Peregrine Falcons (*Falco peregrinus*) averaged less than 3 µg/g prior to 1940, jumping to almost 38 µg/g (1964-1966) and declining to 7-17 µg/g in the 1970s (Lindberg and Odsko 1983) as agricultural uses and industrial pollution were curtailed. Smaller differences occur in non-predatory species, such as the Bar-tailed Godwit (*Limosa lapponica*) in the Netherlands where values increased from 0.4 µg/g (1904-1963) up to 2.0-4.9 µg/g (1979-1982).

Monteiro *et al.* (1999) examined mercury concentrations in egg and plumage samples of adults and chicks of seabirds from colonies in the Portuguese Atlantic. Species and tissues were selected to ensure varied levels of ecological (epipelagic vs mesopelagic), spatial (coastal vs pelagic) and temporal (short-to medium-term) integration of mercury contamination. Results show a four-fold increase in mercury bioaccumulation from the epipelagic to the mesopelagic areas. Such background uniformity of mercury contamination in the North Atlantic conveys further evidence of global pollution by mercury due to atmospheric deposition at long distance from emission sources.

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4.2 Waste incineration and mercury in birds

Probably no area with mercury pollution has been as extensively studied as the Everglades in south Florida. The Everglades system was historically highly contaminated with mercury, which had been linked to local waste incineration (Dvonch *et al.* 1999, Frederick, 2000). Elevated methylmercury concentrations were recorded in many species of wetland wildlife and have been extensively studied in Great Egrets (*Egretta alba*), one of the top trophic level piscivorous species.

However, the implementation of the Clean Air Act in 2000 led the significant decreases in local mercury inputs and Lange *et al.* (2000), found that the mercury levels in Everglades Egrets declined rapidly. Frederick *et al.* (2002) examined mercury contamination in piscivorous birds over six years in the Everglades. Species examined included Great Egret and White Ibises. Over the course of the study, Everglade's colonies maintained their mercury concentration rankings relative to one another, but all showed strongly declining mercury concentrations (mean of 73% averaged across colonies, between 1994 and 2000). The study concluded that the Everglades has undergone a biologically significant decline in mercury availability in the wetland food web, possibly because of decreased local inputs.

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Herring *et al.* (2008) attempted to link mercury contamination in the Florida Everglades with declines in the numbers of wading birds. Feather mercury levels in Great Egret and White Ibis nestlings were assessed. Nestlings were in better physiological condition when feather mercury levels were higher. These results support the hypothesis that nestlings are protected from the harmful effects of mercury through deposition of mercury in growing feathers. The study also found evidence to suggest shifts in diets of the two species, as a function of prey availability, thus altering their exposure profiles. However, no evidence was found to suggest that birds responded differently to mercury exposure.

Blanco *et al*. (2004) assessed whether levels of heavy metals in blood have detrimental effects on the health of pre-fledgling Black Kites (*Milvus migrans*) exposed to emissions from a solid waste incinerator near Madrid, central Spain. These results suggest that the participation of metallothioneins in detoxification and metal regulation may also indirectly enhance the adrenal stress response to contaminants, probably through a competition of Cd and Zn for Zn binding sites on metallothioneins, reducing the ability of Cd to stress the immune system.

4.3 Other Heavy Metals

Cadmium (Cd) occurs in association with zinc and is found in soils, mud, humus and organic matter. It is a significant anthropogenic contaminant, but soils derived from carboniferous black shales may contain up to 200 ppm. Major environmental sources of cadmium include electroplating, zinc and lead mining and smelting, paint and pigments, batteries, plastics, coal-fired power plants, and municipal wastewater and sewage sludge. Cadmium is a known teratogen and affects calcium metabolism causing excess calcium excretion, which negatively impacts both skeletal and cardiovascular systems (Eisler 1985). In addition, growth retardation, anemia, and testicular damage occur in cadmium-exposed wildlife (Eisler 1985). Cadmium is readily bio-accumulated and available data suggests that it is biomagnified through food chains (Larison *et al.* 2000). Cadmium is readily taken up from the soil (especially by leafy plants and under acid pH) but, although the initial rate of uptake can be linear relative to soil concentration, it tends to tail off with time (Vernet, 1992). Cadmium is relatively mobile and shows potential for accumulation through the lower terrestrial trophic levels, although leaf crops are more problematic than root or seed crops from a human perspective (Lepp 1981). It accumulates in the soft tissues of grazing animals where it is highly toxic, with pasture herbs being a more dangerous pathway of transmission than grasses. White-tailed ptarmigan (*Lagopus leucura*) in Colorado are at threat from cadmium poisoning due to bio-magnification in willow (*Salix* spp.), a primary food plant for these birds (Larison *et al.* 2000). Cadmium residues in vertebrate kidney or liver that are >10 ppm fresh weight or 2 ppm whole body fresh weight should be viewed as evidence of probable cadmium toxicity; residues of 200 ppm kidney (fresh weight), or >5 ppm whole animal fresh weight are indicative of cadmium poisoning. Wildlife, especially migratory birds, which feed on crops growing in fields fertilized with municipal sewage sludge, may be at considerable risk from cadmium toxicity (Eisler 1985).

Thallium (Th) is often chemically associated with arsenic, and may also be concentrated in soils derived from weathered limestone (Lepp 1981). The main anthropogenic source is flue gases, primarily from coal burning, non-ferrous smelting and cement production (Alloway 1995, Nriagu 1998). In this context, the contribution from MSW incineration seems negligible, but this may be understated since MSW and industrial wastes have

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been used to fuel cement kilns in France since 1986 (Porteus 1996). The forms of thallium found in flue gas are fairly soluble and affect both plants and animals (enzyme inhibitor), the toxicity to animals possibly being enhanced by microbial biomethylation (Lepp 1981). Although soil/plant exchange increases at acid pH, thallium mobility in the aquatic environment is largely independent of major water characteristics such as hardness. Aquatic food-source invertebrates such as Daphnia are affected at levels below the vertebrate toxicity threshold and therefore have indirect effects upon fish stocks (Nriagu 1998).

Cadmium may arise in air emissions of MSW incinerators due to its thermal mobility. Although some countries restrict applications of Cd, frequent sources in MSW incinerators are electronic devices (including accumulators), paints, Ni-Cd batteries, and cadmium-stabilised plastics. Under the conditions usually observed in the furnace, Cd is mainly converted into $CdCl_2$ (Quina *et al*. 2011). The air pollution control (APC) devices normally lead to a concentration of Cd in APC residues, and less than 1% is released to the atmosphere. The reported range is usually 0.0002-0.03 mg/Nm3 (11% of O2) (BREF, 2006). The thallium amount in municipal solid waste is virtually non-existent and very often below any detection limit (Quina *et al.* 2011).

5. Mammals

Piscivorous mammalian wildlife, such as Otter and Mink, are exposed to mercury in the same way as piscivorous birds i.e. via the consumption of contaminated fish. Concentrations of mercury in wildlife have been observed at concentrations causing adverse effects in laboratory studies using the same species (U.S. EPA 1997). Toxic effects from the consumption of contaminated fish have been observed in mammalian wildlife in areas with point sources of mercury emission (U.S. EPA 1997). The U.S. EPA (1997) investigated population impacts on piscivorous wildlife and estimated an adverse effect level for methylmercury in trophic level 3 fish (between 0.077 and 0.3 µg/g). This indicates that it is possible that individuals of some highly exposed wildlife subpopulations are experiencing adverse toxic effects due to mercury in the food chain. In a study of Mink and Otter, the U.S. EPA (1997) concluded that field data were insufficient to determine whether these species suffered adverse effects.

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Zwiernik *et al.* (2008) examined dioxin and furan levels in Mink at Tittabawassee River, Michigan, U.S. where sediments have been historically contaminated with dioxins, furans and PCBs. Significant concentrations of PCDF's and PCDD's have been recorded within the sediments, and the area is a major industrial and population centre along the river. However, the resident mink survey, including number of mink present, morphological measures, sex ratios, population age structure, and gross and histological tissue examination, indicated no observable adverse effects. Based on the lack of negative outcomes for any measurement endpoints examined in the study and direct measures of effects on individual mink and their population it was concluded that these high concentrations of PCDDs/PCDFs were not causing adverse effects on resident mink of the Tittabawassee River.

Otters are consistently fish eaters whose diet consist of at least 95% fish (Toweill and Tabor, 1982). Mercury concentrations in Otter tissues have been positively associated with mercury levels in prey (for example; fish, shellfish, crayfish) (Wren and Stokes, 1986; Foley *et al.* 1988; Langlois and Langis, 1995). Otter accumulated about ten times

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more mercury on a concentration basis than did predatory fishes from the same drainage areas (Kucera, 1983). These correlations were statistically significant (Foley *et al.* 1988) on the basis of mercury in the watershed because of the importance of fish, shellfish and crayfish in the diet of Otter. Case reports of clinical mercury poisoning exist for wild Otter (Wren, 1985). The magnitude of the concentration in one organ for Otter (for example, liver) is highly correlated with other organs (for example, kidney or brain) (Wren and Stokes 1986). The range of concentrations reported in different geographic locations is substantial. Consequently, broad generalisations are difficult regarding how close liver mercury concentrations of wildlife are to liver mercury concentrations of experimentally poisoned Mink. However, the upper range of liver mercury concentrations of Mink from northern Quebec (Langlois and Langis, 1995), Otters from Georgia (Hallbrook *et al.*, 1994) and Otters from Ontario (Wren *et al.* 1986) approximate those of clinically poisoned animals.

Lethal effects of mercury have also been recorded in the wild. Sleeman *et al.* (2010) reported a moribund 5-year-old female northern river otter (*Lontra canadensis*) was found on the bank of a river known to be extensively contaminated with mercury. It exhibited severe ataxia and scleral injection, made no attempt to flee, and died shortly thereafter of drowning. Tissue mercury levels were among the highest ever reported for a free-living terrestrial mammal: kidney, 353 µg/g; liver, 221 µg/g; muscle, 121 µg/g; brain (three replicates from cerebellum), 142, 151, 151 µg/g (all dry weights); and fur, 183 ug/g (fresh weight). Histopathologic findings including severe, diffuse, chronic glomerulosclerosis and moderate interstitial fibrosis were the presumptive cause of clinical signs and death. This is one of a few reports to document the death of a free-living mammal from presumed mercury poisoning.

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Sub-lethal effects can be projected to be more wide-spread with additional reports showing average liver mercury concentrations approximately one-third of those in moribund mink with experimental methylmercury poisoning. Liver mercury concentrations of river otters from the lower coastal plain in Georgia averaged 7.5 µg/g (Hallbrook *et al.* 1994); this is approximately 33% of the concentrations associated with severe intoxication and/or death in a closely related species, the Mink (Wobeser *et al.* 1976a,b). In many geographic regions [e.g. Georgia (Halbrook *et al.* 1994), New York State (Foley *et al.* 1988)], mercury concentrations in Mink and Otter tissues are 10-30% of the concentrations associated with severe, clinically evident methylmercury poisoning in Mink. For example, data showing Mink liver mercury concentrations averaging 2 µg/g or higher were reported in several regions of New York State (Foley *et al.* 1988), Ontario (Wren *et al.* 1986), and Manitoba (Kucera, 1983). Concentrations in excess of 20 µg/g occurred in Mink dying of methylmercury poisoning (Wobeser, 1973; Wobeser *et al.* 1976a, b). There may be other factors in addition to methylmercury concentration in the food supply of the mink and otter that are responsible for the association.

Another consideration is the combination effects of various contaminants on mammals. Polychlorinated biphenyls (PCB), DDT, dieldrin and mercury (Hg) are most often associated with the decline in Otter *Lutra lutra* populations in Europe (Norrgren and Levengood, 2012). However it is possible that the PPCB/PCDD/PCDF congener profile is influencing toxicity in a way that is not accounted for. One complication of feeding mink diets containing fish collected from contaminated waters is that it is probable that other unaccounted contaminants are influencing the overall toxicity of the mixture. This may explain why Heaton *et al.* (1995) reported effects on kit survival and growth at dietary tPCB and TEQ concentrations that were 2.5-fold and 3.4-fold less, respectively,

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than the No Observed Averse Effect Level (NOAEL) reported by Bursian *et al.* (2006a). Similarly, Bursian et al. (2006b) reported that diets containing 3.7 µg tPCB/g feed or 50.4 pg TEQ/g feed provided by carp collected from the Housatonic River, Massachusetts, caused reduced kit survivability, resulting in a LOAEL that is 5.6 and 3 times greater than the LOAEL reported by Heaton *et al.* (1995) when expressed on a tPCB and TEQ basis, respectively. There have been a few mink studies conducted with single PCB, PCDD and PCDF congeners that avoid the complexities associated with exposure to a mixture of congeners as well as other contaminants. Hochstein and associates conducted studies that involved exposure of mink to TCDD. The first study (Hochstein et al., 1988) established a 28-day LD50 of 4.2 µg TCDD/kg body weight. A 28-day LC50 of 4.8 ng TCDD/g feed and a 25-day LC50 of 0.85 ng TCDD/g feed was reported in the second study (Hochstein *et al.*, 1998). Beckett *et al.* (2008) reported that dietary concentrations of 24 and 2.4 ng 3,3',4,4',5-pentachlorobiphenyl (PCB 126)/g feed resulted in complete reproductive failure (2,400 and 240 pg TEQ/g feed, respectively), while a dietary concentration of 0.24 ng PCB 126/g feed (24 pg TEQ/g feed) was the NOAEL. Interestingly, Zwiernik *et al.* (2009) reported that an equivalent TEQ concentration (242 pg/g feed) provided by 2,3,7,8-tetrachlorodibenzofuran (TCDF) had no effect on reproduction and survivability of offspring.

6. Conclusions

Historically dioxin and mercury emissions from incinerators have been the cause of much public concern. However, the implementation of the EU Waste Incineration Directive 2000/76/EC and the Clean Air Act in the US has led to large reductions in incinerator emissions across the developed world. In Germany, for example, incinerator dioxin emissions have fallen from 400 grams to less than 0.5 grams a year, since the year 2000. Incinerators now represent less than 1% of total dioxin emissions in Germany. In Ireland dioxin levels are currently significantly less than applicable limits and are considered as low background levels in European terms.

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Laboratory studies on birds and mammals have found an array of negative effects from dioxins and heavy metals. While a number of studies have attempted to replicate these effects in the wild, in areas which are heavy polluted, the results have been inconclusive. In one study, uptake of dioxins in the bird population resident near a waste incinerator were not increased in the ten years following the facility's opening. One complication of feeding animals diets containing fish collected from contaminated waters, appears to be that other unaccounted for contaminants can influence the overall toxicity of the mixture. While gaps in the research exist, between lab and field based studies, it does appear that the impact of polluted sediments on animals is complex. The complexities of examining individual and combination effects of dioxins, PCBs and heavy metals in the field seem, at present, to be beyond the reach of researchers. However, it does appear that the contribution of waste incineration to these pollutants has decreased significantly. In the years since strict legislation governing waste incineration has been implemented, mercury concentrations in bird feathers has dropped significantly alongside declines in mercury inputs from industrial sources.

References.

Alloway, B.J. (ed.) (1995) Heavy metals in soils. (2nd Ed.) Blackie Academic & Professional: London.

EPA Export 20-07-2019:03:56:28

Barr, J. F. (1986). Population dynamics of the Common Loon (*Gavia immer*) associated with mercury-contaminated waters in northwestern Ontario. Occasional Paper No. 56, Canadian Wildlife Service, Ottawa.

Beckett, K.J., Yamini, B. and Bursian, S.J. 2008. The effects of 3,3',4,4',5-pentachlorobiphenyl (PCB 126) on mink (Mustela vison) reproduction and kit survivability and growth. In: Archives of Environmental Contamination and Toxicology, 54, pp. 123-129.

Blanco, Guillermo; Jimenez, Begona; Frias, Oscar; Millan, Javier; Davila, Jose A., 2004: Contamination with nonessential metals from a solid-waste incinerator correlates with nutritional and immunological stress in pre-fledgling black kites. Environmental Research. 94(1): 94-101

Bontoux, L. 1999. The Incineration of Waste in Europe: Issues and Perspectives. European Commission Joint Research Centre.

Bosveld, ATC, Gradener, J., Murk, AJ, Brouwer, A., Van Kampen, M. Evers, EHG and Van den Berg, M. 1995. Effects of PCDDs, PCDFs and PCBs in Common Tern (*Sterna hirundo*) breeding in estuarine and coastal colonies in the Netherlands and Belgium. Environ. Toxicol. Chem. 14; 99-115

Bowerman WW, Evans ED, Giesy JP, Postupalsky S. 1994. Using feathers to asssess risk of mercury and selenium to Bald Eagle reproduction in the Great Lakes region. Arch Environ Contam Toxicol 27:294–298

BREF (2006). Integrated Pollution Prevention and Control – Reference Document on the Best
Available Techniques for Waste Incineration, European Commission.

Buckley, J. Crowley, D., Keohane, C., Larkin, H., O'Farrell, K.J., Berry, D., Tlustos, C. and Sayers, R. 2013. Animal Health Surveillance of Dairy Herds in the Vincinity of Large Chemical Industrial Complex in the Cork Harbour Region 2005 – 2010. Cork County Council Report.

Burger, J. and M. Gochfeld 1997. Risk, mercury levels, and birds: relating adverse laboratory effects to field bio-monitoring. Environ. Research 75: 160-172.

Bursian, S.J., Beckett, K.J., Yamini, B., Martin, P.A., Kannan, K., Shields, K.L. and Mohr, F.C. 2006a. Assessment of effects in mink caused by consumption of carp collected from the Saginaw River, Michigan, USA. In: Archives of Environmental Contamination and Toxicology, 50, pp 614-623.

Bursian, S.J., Sharma, C., Aulerich, R.J., Yamini, B., Mitchell, R.R., Orazio, C., Moore, D., Sivirski, S. and Tillitt, D.E. 2006b. Dietary exposure of mink (*Mustela vison*) to fish from the Housatonic River, Berkshire County, Massachusetts, USA: Effects on reproduction and kit growth and survival. In: Environmental Toxicology and Chemistry, 25, pp. 1533-1540

Consent of copyright owner required for any other use.
For inspection purposes only.

EPA Export 20-07-2019:03:56:28

Concannon, C. 2013. Dioxin Levels in the Irish Environment 2012. EPA report.

Coutinho, M., Pereira, M., Silva, A., Ribeiro, C. and Borrega, C. 2012. Long-term monitoring of a waste to energy facility in Porto. In: IAIA Conference Proceedings: Energy Future, the role of impact assessment. The 32nd Annual Meeting of the International Association for the Impact Assessment, Porto, Portugal.

Deriziotis, P., 2004. Substance and Perceptions of Environmental Impacts of Dioxin Emissions. M.S. Thesis, Columbia University (data by US EPA).

Dvonch, J.T., Graney, J.R., Keeler, G.J., and Stevens, R.K. 1999, Use of elemental tracers to source apportion mercury in south Florida precipitation: Environmental Science Technology, 33; 4522-4527.

Eisler, R. 1985. Cadmium hazards to fish, wildlife and invertebrates a synoptic review: Biological report 85 (1,2). US Fish and Wildlife Service, Department of the Interior. Washington, D.C., USA

Eisler, R. 1987. Mercury Hazards to Fish, Wildlife and Invertebrates: A Synoptic Review. US Fish and Wildlife Service Biological Report. 85

European Commission 2006. Identification, assessment and prioritisation of EU measures to reduce releases of unintentionally produced/released Persistent Organic Pollutants. REFERENCE:O7.010401/2005/419391/MAR/D4

Foley, R.E., S.J. Jackling, R.J. Sloan and M.K. Brown. 1988. Organochlorine and mercury residues in wild Mink and Otter: Comparison with fish. Environ. Toxicol. Chem. 7:363-374.

Findley, MT and Stendell, RC. 1978. Survival and reproductive success in Black Ducks fed mercury. Environ. Pollut. 16;51-54

Findley, MT, Stickel, WH and Christensen, RE. 1979. Mercury residues in tissues of dead and surviving birds fed methylmercury. Bull. Environ. Contam. Toxicol, 21;105-110

Frederick, PC. 2000. Mercury contamination and its effects on the Everglades ecosystem. Reviews in Toxicology, 3; 213-256

Frederick PC, Spalding MG, Dusek R. 2002. Wading birds as bio-indicators of mercury contamination in Florida, USA: annual and geographic variation. Toxicol Chem 2002;21:163–7

Gochfeld, M. (1971) Pre-mature feather loss---a "new disease" of Common Terns on Long Island, New York. Kingbird 21:206-211.

German Ministry of Environment. 2005. Waste Incineration — A Potential Danger? The Contribution of Waste Management to sustainable development in Germany

Hammond, AL 1971. Mercury in the environment; natural and human factors. Science 171; 788-789

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 20-07-2019:03:56:28

Hart, L.E., K.M. Cheng, W.E. Whitehead, A.M. Shah, R.J. Lewis, S.R Ruscjkowski, R.W. Blair, D.C. Bennett, S.M. Bandiera, R.J. Norstrom and G.D.Bellward. 1991. Dioxin contamination and growth and development in Great Blue Heron embryos. J. Toxicol. Environ. Health 32:331-344.

Hays, H. and R.W. Risebrough 1971. The early warning of the terns. Natural History

Heaton, S.N., Bursian, S.J., Giesy, J.P., Tillitt, D.E., Render, J.A., Jones, P.D., Verbrugge, D.A., Kubiak, T.J. and Aulerich, R.J. 1995. Dietary exposure of mink to carp from Saginaw Bay, Michigan. I. Effects on reproduction and survival and the potential risks to wild mink populations. In: Archives of Environmental Contamination and Toxicology, 28, pp. 334-343.

Herring G. 2008. Constraints of landscape level prey availability on the physiological condition and productivity of great egrets and white ibises. Dissertation, Florida Atlantic University, Boca Raton, FL, 2008.

Hochstein, J.R., Bursian, S.J. and Aulerich, R.J. 1998. Effects of dietary exposure to 2,3,7,8-tetrachlorodibenzo-p-dioxin in adult female mink (*Mustela vison*). In: Archives of Environmental Contamination and Toxicology, 35, pp. 348-353.

Kucera, E. 1983. Mink and Otter as indicators of mercury in Manitoba waters. Canad. J Zool. 61:2250-2256.

Lange T, D. Richard, and H. Royals. 2000. Long-term trends of mercury bioaccumulation in Florida's Largemouth Bass, Annual Meeting South Florida Mercury Science Program, Tarpon Springs FL.

Langlois, C. and Langis, R. 1995 Presence of airborne contaminants in the wildlife of northern Québec. Sci. Total Environ 15;160-161; 391-402

Larison, J.R., G.E. Likens, J.W. Fitzpatrick, and J.G. Crock. 2000. Cadmium toxicity among wildlife in the Colorado Rocky Mountains. Nature 406:181-183.

Lepp, N.W. (Ed.) (1981) Effect of heavy metal pollution on plants-Volume 1: Effects of trace metals on plant function. Applied Science Publishers: London.

Lindberg, P. and T. OdsjO. 1983. Mercury levels in feathers of Peregrine Falcon *Falco peregrinus* compared with total mercury content in some of its prey species in Sweden. Environ. Pollut. 5: 297-318.

Manahan, S. 2000. Environmental Chemistry, 7th edn, Lewis Publishers/CRC Press LLC, London, 2000.

Masunaga, S., Nakanishi, J., 1999. Dioxin impurities in old Japanese agrochemical formulations. Organohalogen Compd. 41, 41–44.

Masunaga, S., Takasuga, T., Nakanishi, J., 2001. Dioxin and dioxin-like PCB impurities in some Japanese agrochemical formulations. Chemosphere 44, 873–885.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 20-07-2019:03:56:28

Millrath K., Roethel F.J., Kargbo D.V., 2004. Waste-to-energy residues – the search for beneficial uses. In: 12th North American Waste to Energy Conference (NAWTEC 12), Savannah, GA, May 17–19, pp. 1–812.

Monteiro LR, Granadeiro JP, Furness RW, Oliveira P. 1999. Contemporary patterns of mercury contamination in the Portuguese Atlantic inferred from mercury concentrations in seabird tissues. Mar Environ Res 47: 137–156

Naito, W. and Murato, M. 2009. Evaluation of population-level ecological risks of dioxin-like polychlorinated biphenyl exposure to fish-eating birds in Tokyo Bay and its vicinity. Integrated Environmental Assessment and Management, 3 (1); 68–78.

Norrgren, L., and Levengood, J.M. 2012. Ecology and Animal Health. Ecosystem Health and Sustainable Agriculture. v. 2. Uppsala, Sweden: The Baltic University Programme, Uppsala University, 2012. 380 pp., ill.-380 pp., ill. pp.

Nriagu, J.O. (Ed.) (1998) Thallium in the environment. Advances in Environmental Science and
Technology 29. J. Wiley: Chichester.

Odsjö, T. 1975. Toxic chemicals in sedentary and migratory birds in Fennoscandia and Baltic sea areas. Ornis. Fenn. 52; 74-82.

Porteus, A. (1996) Dictionary of environmental science and technology (2nd Ed.). J Wiley: Chichester

Psomopoulos, C.S.; Bourka, A.; Themelis, N.J. “Waste-to-Energy: A Review of the Status and Benefits in the USA, Waste Management; Vol. 29, January 2009; pp. 1718–1724.

Quina, M.J, Bordado, J.C.M, and Quinta-Ferreira, R.M, 2011. Air Pollution Control in Municipal Solid Waste Incinerators: The Impact of Air Pollution on Health, Economy, Environment and Agricultural Sources, 1st ed., University Campus STeP Ri, Slavka Krautzeka 83/A, 51000 Rijeka,
Croatia.

Rappe, A. (1973) Influence de la pollution par le mercure sur les populations d'oiseaux. L'Oiseau et R.F.O. 43: 196-204.

Rumbold DG, Bruner MC, Mihalik MB and Marti EA (1997) “Biomonitoring environmental contaminants near a municipal solid-waste combustor” Environmental Pollution 96(1) 99-105.

Rumbold, DG and Mihalik, MB (2002) Biomonitoring environmental contaminants near a municipal solid-waste combustor, a decade later. Environmental Pollution 117: 15-21

Scheuhammer, A. M. (1991). Effects of acidification on the availability of toxic metals and calcium to wild birds and mammals. Environ. Pollut., 71, 329-375.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 20-07-2019:03:56:28

Scheuhammer AM, Meyer MW, Sandheinrich MB, Murray MW (2007) Effects of environmental methylmercury on the health of wild birds, mammals, and fish. AMBIO: J Human Environ 36:12–19

Senthilkumar K1, Iseki N, Hayama S, Nakanishi J, Masunaga S. (2002). Polychlorinated dibenzo-p-dioxins, dibenzofurans, and dioxin-like polychlorinated biphenyls in livers of birds from Japan. Arch Environ Contam Toxicol. 2002 Feb;42(2):244-55.

Shun-I Shiha, I-Ching Wangbc, Kuen-Yuh Wud, Hsing-Wang Libc, Lin-Chi Wange & Guo-Ping Chang-Chiene. 2009. Uptake of polychlorinated dibenzo-p-dioxins and dibenzofurans in laying ducks Journal of Environmental Science and Health, Part A: Toxic/Hazardous Substances and Environmental Engineering, Volume 44, 8; 799-807

Sleeman J. M., Cristol, D. A., White, A. E., Evers, D. C., Gerhold, R. W. and Keel, M. K. 2010. Mercury poisoning in a freeliving northern river otter (Lontra canadensis). – J. Wildl. Dis. 46: 1035–1039

Spalding, M.G., P.C. Frederick, H.C. McGill, S.N. Bouton and L.R. McDowell (2000a) Methylmercury accumulation in tissues and its effects on growth and appetite in captive Great Egrets, J. Wildlife Diseases 36:411-422.

Spalding, M.G., P.C. Frederick, H.C. McGill, S.N. Bouton, L.J. Richey, I.M. Schumacher, C.G.M. Blackmore and J. Harrison (2000b) Histologic, neurologic, and immunologic effects of methylmercury in captive Great Egrets, J. Wildlife Diseases 36:423-435.

Sundlof, S.F., M.G. Spalding, J.D. Wentworth and C.K. Steible, 1994. Mercury in livers of wading birds (*Ciconiiformes*) in Southern Florida. Environ. Contam. Toxicol., 27: 299-305.

Themelis, N.J., Gregory, A., 2002. Mercury Emissions from high temperature sources in the NY/NJ Hudson Raritan Basin. In: Proceeding of NAWTEC 11. American Society of Mechanical Engineers, pp. 205–215.

Thompson, D. R., R. W. Furness, and L. R. Monteiro. 1998. Seabirds as bio-monitors of mercury inputs to epipelagic and mesopelagic marine food chains. Science of the Total Environment 213:299–305

Thompson DR, Furness RW (1989) Comparison of total and organic mercury in seabird feathers. Mar Pollut Bull 20. 577-5

Toweill, D.E. and J.E. Tabor. 1982. River otter. In: Wild Mammals of North America, J.A. Chapman and G.A. Feldhamer, Ed. Johns Hopkins University Press, Baltimore, MD. p. 688-703.

U.S. EPA 1997. Mercury Study Report to Congress c7o032-1-1 Office of Air Quality Planning & Standards and Office of Research and Development Volume VII: Characterization of Human Health and Wildlife Risks from Mercury Exposure in the United States

US Environmental Protection Agency, Letter to President of Integrated Waste Services Association, February 2003. <www.wte.org/docs/epaletter.pdf>.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 20-07-2019:03:56:29

United Nations Environment Programme (UNEP), 1999. Dioxin and furan inventories. UNEP Chemicals, pp. 82–87.

United States Environmental Protection Agency (U.S.EPA). Exposure and Human Health Reassessment of 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (TCDD) and Related Compounds National Academy Sciences (NAS) Review Draft. 2004. Available at URL: http://www.epa.gov/ncea/pdfs/dioxin/nas-review/External Web Site Icon. 3/15/13

Vernet, J.P. (1992) Trace metals in the environment 2: Impact of heavy metals on the environment. Elsevier: Amsterdam.

Wobeser, G., N.D. Nielsen and B. Schiefer. 1976a. Great Lakes Water Quality Initiative Criteria Documents for the Protection of Wildlife (PROPOSED). DDT; Mercury; 2,3,7,8-TCDD; PCBs. Office of Water, Office of Science and Technology, Washington DC. EPA-822-R-93-007. April.

Wobeser, G., N.D. Nielsen and B. Schiefer. 1976b. Mercury and mink II: Experimental methylmercury intoxication. Can. J. Comp. Med. 40:34-45.

Wolfe, M.F., Schwarzbach, S., Sulaiman, R.A., 1998. Effects of mercury on wildlife: a comprehensive review. Environmental Toxicology and Chemistry 17, 146-160

Wren, C.D. 1985. Probable case of mercury poisoning in a wild otter in northwestern Ontario. Can. Field-Nat. 99:112-114.

Wren, C.D., P.M. Stokes and K.L. Fischer. 1986. Mercury levels in Ontario mink and otter relative to food levels and environmental acidification. Canad. J Zool. 64:2854-2859.

Yoshida, H., Kazuaki Takahashi, Nobuo Takeda, Shin-ichi Sakai. 2009. Japan's waste management policies for dioxins and polychlorinated biphenyls. Journal of Mater. Cycles Waste Management 11: 229-243

Zwiernik MJ, Kay DP, Moore JN, Beckett KJ, Newsted JL, Roark S, Giesy JP. 2008. Exposure and effects assessment of resident mink exposed to polychlorinated dibenzofurans and other dioxin-like compounds in the Tittabawassee River Basin, Midland, MI, USA on wild mink (*Mustela vison*). Environ Toxicol Chem. 27:2076–2087.

Zwiernik, M.J., Beckett, K.J., Bursian, S., Kay, D.P., Holem, R.R., Moore, J.N., Yamini, B. and Giesy, J.P. 2009. Chronic effects of polychlorinated dibenzofurans on mink in laboratory and field conditions. In: Integrated Environmental Assessment and Management, 105, 291-301.

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Appendix 4. Literature Review - Bird Collision Risk.

1. Introduction

The following report uses published peer reviewed literature to examine the potential impact of the building and stack at the Ringaskiddy Resource Recovery Centre. This review will help to inform the conclusions of the Natura Impact Statement (NIS) which specifically addresses the impact of the proposed development on the Cork Harbour SPA. This literature review was prepared by Sorcha Sheehy PhD and Carl Dixon MSc.

A number of published reports have voiced concern over the potential of buildings to negatively impact on bird populations through collision mortality. Such impacts are of particular concern for sensitive species such as those which use the nearby Cork Harbour SPA. The highest buildings at the site of the proposed development will be the main process building (roof level is between 23.7-50.7m AOD, ground level 5mOD) and the stack (level of top is 75 m AOD, ground level 5mOD). Therefore, for the purposes of this report, the author assumes a total maximum building height of <75m AOD.

2. Impacts of bird collision

Birds have been colliding with manmade structures ever since humans started building them, with the earliest documented instances of collision mortality in the late 1800's (Coues 1876, Merriam 1885). There have been cases where large numbers of bird mortalities at stacks have been recorded. Daily searches of two stacks in Ontario, Canada over a 4-year period yielded 8,531 dead birds, the majority of which were passerine species (Weir 1976). However, the biological significance of collision mortality to any species is unknown. There are a number of factors, such as total population size, natural mortality levels, and other human related influences, for which insufficient data exist to be able to put the collision mortality factor in proper perspective. Although a wealth of literature exists on the subject of bird-strike with structures, much of it derives from one-off studies of individual installations, carried out or commissioned by developers or other interested and concerned parties.

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Hence, the majority of studies have been undertaken in circumstances where a problem has been recognised or anticipated, and, consequently, reported bird fatalities may reflect the distribution of observation effort more than the actual occurrence of bird collisions. The focus of such studies and reports has changed over the years, with attention from power lines to wind turbines, following changes in public interests and/or concerns. As a result, few data sets of bird-strike are based on long-term, standardised, and systematic assessments, and those that are available are often derived from a single structure or a small number of installations rather than a wider-scale study. Therefore, attempts to assess the overall levels of collision mortality caused by structures, at a local, regional, or national level, are generally based on small and biased samples which are unreliable or, at best, yield estimates with extremely wide ranges.

Putting such bird-strike mortality in context is crucial to understanding its impact on bird populations. Despite widespread public attention and more than five decades of research, measures of anthropogenic sources of mortality for birds remain speculative. Estimates of total collision mortality from communication towers in North America range from 0.94 to 50 million birds annually (Banks 1979; Drewitt & Langston 2006), while estimates of collision mortality with windows range from 3.5 million up to 5 billion birds annually (Banks 1979; Klem 1990; Hager *et al.* 2008). Arnold and Zink (2011) developed a model using comparative data, including species-specific measures of mortality, relative abundance, and long-term population trends. They found that vulnerability to collision with buildings and towers varied over more than four orders of magnitude among species. Species that migrated long distances or at night, were much more likely to be killed by collisions than year-round residents or diurnal migrants. However, they found no correlation between

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relative collision mortality and long-term population trends for these same species. Therefore they concluded, that although millions of North American birds are killed annually by collisions with manmade structures, this source of mortality has no discernible effect on populations.

It should be noted that relatively few studies have been carried out on stack collisions, and this may reflect the lower level of risk, or perceived risk, posed by such structures. While this literature review attempts where possible to focus on stacks, the relatively paucity of studies on this building type, means that the author has also examined other structures including communication towers, tall buildings and to a lesser extent wind turbines, in order to get a complete picture of the bird-strike risk posed by the proposed Ringaskiddy Resource Recovery Centre.

3. Factors affecting risk of collision

3.1 Building height

Reviewing the available literature, a number of trends have emerged, particularly linking building height to collision risk. Although there are few published studies of the effect of tower height, there is some evidence to suggest that towers lower than 60 m to 150 m pose a lower risk to migrating birds (Kerlinger 2000a, 2000b; Newton 2007). Observations from one study suggested that a change in tower height from 308 m to 90 m greatly reduced the number of fatalities (Crawford and Engstrom 2001). Building structure, size and dimensions clearly influence the risk of bird-strike, especially in conditions of poor visibility (Winkelman 1992a; Ogden 1996; Hotker *et al.* 2006). For example, there is evidence that taller communication towers present a greater risk to nocturnal migrants than shorter masts (Crawford and Engstrom 2001). Layout, orientation and spacing are also important factors influencing collision risk, most notably for wind turbines and power lines (Winkelman 1992a, 1992b; Bevanger 1994). In particular this may be a consideration when looking at cumulative impacts of the proposed Ringaskiddy Resource Recovery Centre alongside existing wind turbines in the Cork Harbour area (discussed in **Section 4**).

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3.2 Lighting

Apart from size, often the most important structural factor related to collision probability is the use of lighting. Many tall structures require warning lights for aircraft and/or shipping. Additional sources of light include floodlighting and the interior lighting of office blocks, which are often illuminated through the night. There are many observations, both incidental and systematic, of birds being attracted to and disoriented by lights, especially on (but not restricted to) overcast nights with drizzle or fog (Laskey 1954; Cochran and Graber 1958; Weir 1976; Verheijen 1985; Gauthreaux and Belser 2006). Birds attracted to light are not only at risk of death or injury due to collision, but also at risk of exhaustion, starvation, or predation (Ogden 1996; Huppop *et al.* 2006). Even if migrants successfully escape lit structures, the consequent increase in energy expenditure may reduce their chances of successfully completing their migration.

Various explanations have been put forward for the apparent attraction of birds, especially nocturnally migrating passerines, to artificial lights (Avery *et al.* 1976; Verheijen 1985; Beason 1999), though none has been conclusively established. One study suggests that this may be due to the “trapping effect” of light rather than actual attraction (Avery *et al.* 1976). This theory suggests that on entering an illuminated area, especially on a cloudy night, passing migrants are reluctant to leave; when approaching the edge of the illuminated area they are hesitant to fly into the darkness beyond and, instead, fly back toward the light. There are no detailed studies of the different risks posed by different lighting systems, though several studies show that changes in the type of lighting used, particularly the replacement of continuous red or white lights with intermittent lighting, has, in some

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circumstances, reduced the trapping effect and thus mortality of nocturnal migrants (Ogden 1996; Kerlinger 2000a; Gauthreaux and Belser 2006). Evidence for the effects of red versus white lights is contradictory. Avery *et al.* 1976 concluded that lights of different colours (red and white), flash rates (including non-flashing), heights, intensities and configurations all seem to elicit similar phototactic responses in nocturnal migrants. Kerlinger (2000a) in a comprehensive review of the existing literature concluded that, in spite of general consensus to the contrary, few or no published papers or recent databases were able to substantiate that white strobe lights resulted in fewer collisions than other colour or types of light. It is likely that any light source visible to humans is also visible to birds and may therefore represent a potential hazard (Verheijen 1985).

Gauthreaux (2000) studied the flight behaviour of migrating songbirds in spring and fall at communication towers; one with white-strobe and one with red flashing lights, and a control area with no tower to determine whether behavioural differences were evident. A greater proportion of birds showing curved, circling, or hovering at red lighted towers than white lighted towers or the control area. More convoluted flight was also found with white lights than in the control area. The findings suggest white-strobe lights are resulted in fewer collisions than red lights on towers. However, it should be noted that a hurricane blew the towers down before the results could be replicated.

A few reports indicate that white strobe lights, whose ultraviolet content is unknown, are less attractive to birds than steady or flashing red lights (Gauthreaux and Belser 1999). Several species, tested under laboratory conditions, are disoriented by red and yellow lights due to some form of disruption of their magnetic compasses (Beason 1999; Kerlinger 2000a), although there is as yet no evidence that this is related to collision risk. It is probable that light intensity and flash duration are more significant than colour: The longer the period between flashes of light, the less likely birds are to be attracted or disoriented (Manville 2000; Huppop *et al.* 2006), perhaps because birds can escape the trapping effect during the short time when the beam is extinguished. Evidence for the effect of floodlighting is also contradictory. Whereas losses due to collisions at lighthouses in Britain were reduced following illumination with floodlights, the installation of floodlighting at a lighthouse in Ontario, Canada, appeared to increase mortality (Baldwin 1965). Floodlighting is also implicated in high mortality levels at other structures (Weir 1976; Ogden 1996). One plausible explanation for this variable effect relates to the direction and width of beam created, with a broad beam directed downward less likely to cause a trapping effect (Verheijen 1985).

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Gehring *et al*. (2009) focused on the features of communication towers which are particularly hazardous to birds. By comparing the mortality rates at towers of varying heights and lighting a number of risk factors were identified. During the study period they found a mean of 3.7 birds under 116–146 m AGL towers equipped with only red or white flashing obstruction lights, whereas towers with nonflashing/ steady-burning lights in addition to the flashing lights were responsible for 13.0 fatalities. Further analysis revealed that towers lit at night with only flashing lights were involved in significantly fewer avian fatalities than towers lit with systems that included the Federal Aviation Administration (FAA) ‘‘status quo’’ lighting system (i.e., a combination of red, flashing lights and red, non-flashing lights). There were no significant differences in fatality rates among towers lit with red strobes, white strobes, and red, incandescent, flashing lights.

3.3 Location of structure

The location of a structure can dramatically affect the likelihood of collision mortality. Clearly, structures present a greater risk of collision if placed on or near areas regularly used by large numbers of feeding, breeding, or roosting birds, or on migratory flyways or local flight paths, such as those between foraging and nesting or roosting areas (Scott 1972; Faanes 1987; Henderson *et al.* 1996; Exo *et al.* 2003; Everaert and Stienen 2007). Although many

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migrants tend to fly along a broad front, topographical features, such as mountain passes, may funnel high numbers into obstacles. Similarly, structures placed along landscape features followed by migrating birds, such as river valleys, or in coastal areas where large numbers congregate before and after crossing the sea, are likely to present a greater risk of collision (Alerstam 1990; Richardson 2000).

A recent radar study was commissioned by the Cork Lower Harbour Energy Group, in order to identify nocturnal bird movement and interconnectivity within the Cork Harbour SPA (Simms *et al.* 2011). A number of significant nocturnal flight corridors were identified, particularly connecting Lough Beg to the Owenboy River Estuary at incoming and outgoing tide periods. This is located to the south of the proposed Ringaskiddy Resource Recovery Centre. No widespread distinct patterns were observed between Monkstown Creek and Lough Beg, although minor patterns were observed from birds flying northwards from Lough Beg over the Martello tower area, to the west of the proposed Ringaskiddy Resource Recovery Centre. No distinct flight patterns were observed over the proposed development site.

3.4 Differing Species Susceptibility

Not all bird species are equally susceptible to collision, and some species suffer disproportionately high levels of collision mortality. The location of structures in areas where such species congregate often results in high numbers of fatalities (Howell and DiDonato 1991; Orloff and Flannery 1992; Bevanger 1995; Ogden 1996; Barrios and Rodriguez 2004; Smallwood and Thelander 2004; Everaert and Stienen 2007; Hunt and Hunt 2006; Klem 2006; Newton 2007). Susceptibility to collision depends on morphology and physical flight characteristics and perhaps differences in vision, as well as flight behaviour, degree of flocking, and, in some cases, particular activities, such as provisioning young (Alerstam 1990; Bevanger 1994; Henderson *et al.* 1996; Ogden 1996; Alonso & Alonso 1999b; Richardson 2000; Everaert and Stienen 2007). In particular, flight characteristics have been shown to be one of the most important factors determining the likelihood of collision with power lines (Bevanger 1994; Savereno *et al.* 1996; Janss 2000).

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In addition to anatomical differences, flight behaviour, such as the use of updrafts and thermals, habitual flight activity at dusk, dawn, or night, aerial display flights, aerial pursuit hunting or territorial disputes, and flying in flocks, also contribute to collision risk (Scott *et al.* 1972; Faanes 1987; Alerstam 1990; Alonso and Alonso 1999a; Richardson 2000; Larsen and Clausen 2002). Gregarious species that form flocks during the autumn and winter appear prone to collision. This is due to the greater concentration of bird movements and perhaps also to the relatively lower levels of attention and anticipation shown by birds when following the lead bird in a flock (Alonso and Alonso 1999a; Pettersson 2005).

Flight height is clearly an important factor in collision and varies greatly, depending not only on species and behaviour, but also on topography, season, time of day and weather conditions. Flight distance also affects flight height, with local movements, such as between feeding and nesting or roosting areas, tending to be at low altitude. Generally a large range in flight altitudes is observed for any particular species. **Table 1** outlines the normal flight altitudes of a number of bird species as recorded at a Denmark windfarm (Noer *et al*. 2000). During migration flights most species use higher flight altitudes and are thus unlikely to be disturbed by the presence of the buildings at the proposed development site. Commuting flights between foraging grounds generally take place at a lower altitude (i.e. 0-5 metres) and thus could potentially encounter the buildings of the proposed development. At Ringaskiddy, this is likely to include Cormorants, ducks, some wader species and gulls. However flights such as this are likely to take place within the estuarine habitats (i.e. the open water or mudflats) and not over the site of the proposed development.

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Table 1. Normal flight altitudes for bird species recorded at windfarm (Noer *et al*. 2000)

Species	Flight altitudes 1- Birds which normally fly 0-5 metres; 2- Birds which normally fly 0-100 metres	
	Migration Flights	Foraging flights
Divers	-	1
Grebes	1	1
Fulmar	1	1
Gannett	2	2
Cormorant	2	1
Dabbling ducks	2	1
Eider	1	1
Common scoter	1	1
Oystercatcher	2	1
Knot	2	1
Dunlin	2	1
Other shorebirds	2	1
Auks	1	1
Arctic skua	1	(2)
Terns	2	(2)
Gulls	2	1

Some attempts have been made to quantify the interspecific risk of wind turbine collision. While this is not entirely comparable to collision risk with static buildings, such as stacks, it does give some indication of relative species risk. **Table 2** lists the bird species of qualifying interest and conservation concern located within Cork Harbour SPA. The vulnerability to collision of each of these species, according the European Commission Guidelines on Windfarms (2010) is also listed.

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It is most notably the flocking species of Dunlin, Lapwing and Golden Plover which are at potential risk of impact. The higher risk identified for Common Tern is probably associated with their foraging behaviour during breeding seasons. Henderson et al. (1996) found that Common Terns making frequent foraging flights during chick rearing, are more susceptible to collision with overhead wires because they tend to fly closer to the structures at this time. It is speculated that the pressure to find sufficient food for chicks causes the adults to take greater risks. Other studies have also found that even among those species that are susceptible to bird-strike, not all individuals are equally at risk. Behavioural observations indicate different risk factors for birds, vary with species, age, stage of the annual cycle and behaviour (Langston and Pullan 2003; Smallwood and Thelander 2004; Everaert and Stienen 2007).

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Table 2. Bird species of qualifying interest and conservation concern within Cork Harbour SPA

	Common Name	*Scientific Name*	Annex of EU Birds Directive	Vulnerability to Collision
Qualifying interests	Cormorant	*Phalacrocorax carbo*	n/a	1
	Shelduck	*Tadorna tadorna*	n/a	0
	Oystercatcher	*Haematopus ostralegus*	n/a	0
	Golden Plover	*Pluvialis apricaria*	Annex I	2
	Lapwing	*Vanellus vanellus*	n/a	2
	Dunlin	*Calidris alpine*	n/a	2
	Black-tailed godwit	*Limosa limosa*	n/a	1
	Bar-tailed godwit	*Limosa laponica*	n/a	0
	Curlew	*Numenius aquata*	n/a	0
	Redshank	*Tringa tetanus*	n/a	0
	Common tern	*Sterna hirundo*	Annex I	3
Special Conservation Interest	Little grebe	*Tachybaptus ruficollis*	n/a	0
	Great crested grebe	*Podiceps cristatus*	n/a	2
	Grey heron	*Ardea cinerea*	n/a	0
	Wigeon	*Anas Penelope*	n/a	0
	Teal	*Anas crecca*	n/a	0
	Pintail	*Anas acuta*	n/a	0
	Shoveler	*Anas clypeata*	n/a	0
	Red-breasted merganser	*Mergus serrator*	n/a	0
	Grey plover	*Pluvialis squatarola*	n/a	0
	Black-headed gull	*Larus ribundus*	n/a	0
	Common gull	*Larus canus*	n/a	0
	Lesser black-backed gull	*Larus fuscus*	n/a	0

4 = Evidence on substantial risk of impact, 3 = Evidence or indications of risk or impact, 2 = Potential risk or impact, 1 = small or non-significant risk or impact, but still to be considered in assessments, 0 = no risk.

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3.5 Season

There appears to be a significant connection between season and bird-strike. This relates mainly to the seasonal movements of birds, with large mortality events often occurring during peak migration periods (Crawford and Engstrom 2001). Higher mortality at this time is perhaps also due to the lack of familiarity of migrant and over-wintering birds with the locations of obstacles, compared with resident individuals (Alonso and Alonso 1999a). This view is supported by studies at power lines, which show relatively low or even no fatalities among resident species (Alonso and Alonso 1999a), though not by other studies of collisions at wind turbines, which show that resident populations are also at risk (Hunt 2002; Hunt and Hunt 2006). Clearly, determining risk based on migrant versus resident status is not straightforward, and mitigating factors, such as familiarity with the presence of structures, must be weighed against factors, such as period of exposure and species (or individual) susceptibility. For some species, mortality is greater during the post-breeding period, when there are increased numbers of young and relatively inexperienced birds. For example, Grey Herons are more likely to collide with power lines in August–December, when first-year birds comprise more than 71% of the recorded mortality (Rose and Baillie 1989).

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4. Cumulative impacts

The assessment of cumulative effects should be an essential component of the impact assessment of development proposals. Cumulative effects may arise for example, from the development of multiple wind farms or from individual wind farms in conjunction with other types of development. Impacts may operate at different spatial scales, from an individual breeding population or colony level to the bio-geographic population or flyway scale. Even where predicted impacts at a particular site are low, this does not necessarily mean that the cumulative impacts will be insignificant, particularly in landscapes with multiple small wind farms or where there are a few wind farms comprising a large number of turbines. For example, even relatively small increases in the mortality rates of breeding adults, or decline in productivity, could be significant for populations of some bird species, especially those which are long-lived with generally low annual productivity and long adolescence, notably seabirds, waders, wildfowl, raptors and soaring birds. This is particularly the case for species which are already rare or facing a number of other pressures from environmental changes and/or anthropogenic impacts.

The ESB Power Station Stack at Whitegate is located approximately 5km east of the proposed development with a height of 152m. Currently in the Cork Lower Harbour there are three existing wind turbines and a further turbine has planning permission, with a maximum height of 150m.

The closest turbine is located approximately 400m south of the proposed stack for the Ringaskiddy Resource Recovery centre at the DePuy facility (Loughbeg). The other constructed wind turbines are located at GlaxoSmithKline (Curraghbinny) and at Janssen (Barnahely) located 1.7km and 2.5km from the proposed Indaver stack respectively. Another permitted, but unbuilt, wind turbine has been proposed for close to the Novartis pharmaceutical plant at Barnahely, 2.5km from the proposed stack at the Indaver site. The built turbines themselves are separated from each other by distances ranging from 1.7km to 2.5km and all turbines are in excess of 5km from the ESB Power Station Stack at Whitegate. When the Novartis Turbine is constructed it will be approximately 700m from the closest existing turbine at Janssen and in excess of 5km from the ESB Power Station Stack at Whitegate. De Puy are proposing to construct a new 3MW turbine on their site at Loughbeg, Ringskiddy. The proposed turbine will be similar in appearance to the existing 3MW turbine on the site. The proposed turbine will be located to the south of the existing turbine, and approximately 1km from the Indaver site.

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No previous cumulative effect has been identified in Cork Harbour area from the existing and/or permitted structures and from the ESB Power Station Stack at Whitegate. The existing turbines in the lower harbour are located a considerable distance apart from one another. The stack at the Indaver site is static in nature and therefore poses a significantly lower collision risk than the wind turbines. Therefore there will no cumulative impacts on the Cork Harbour SPA as a result of the Indaver stack.

5. Summary

A number of published reports have voiced concern over the potential of buildings to negatively impact on bird populations, directly through collision mortality and indirectly through disturbance and displacement. Putting such bird-strike mortality in context is crucial to understanding its impact on bird populations. However, despite widespread public attention and more than five decades of research, measures of anthropogenic sources of mortality for birds remain speculative.

Several unique factors have been identified which affect the risk of bird-collision with manmade structures. These include building height, lighting, and location of structure, season and interspecific behavioural differences.

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Although there are few published studies of the effect of tower height, there is evidence to suggest that towers lower than 60 m to 150 m pose a lower risk to migrating birds. Tower lighting also appears to be a significant variable, however evidence for the effects of red versus white lights is contradictory. In spite of general consensus to the contrary, few or no published papers or recent databases can substantiate that white strobe lights are less of a collision risk than other colour or types of light. A number of studies suggest that light intensity and flash duration are more significant than colour: the longer the period between flashes of light, the less likely birds are to be attracted or disoriented. It is likely that any light source visible to humans is also visible to birds and may therefore represent a potential hazard.

Recent radar studies at Cork Lower Harbour have identified a number of distinct flight patterns between local bird foraging grounds. The location of the proposed structure, although adjacent to the Cork Harbour SPA, is not located within a distinct flightpath. However a number of species which use the Cork Harbour SPA are vulnerable to collision. These include Dunlin, Lapwing, Golden Plover and Common Tern.

6. Conclusions

Based on the above the final conclusions of this report are as follows.

i. The location of the proposed stack at Ringaskiddy Resource Recovery centre, is located 500m from the Cork Harbour SPA and is not a significant roosting area, flight line or migratory path for the birds using the SPA.

ii. The proposed stack height is relatively low, at just 75m OD (height of 70m), a height which has been shown to pose less collision risk than higher wind turbines and communication towers. Migratory flights over the area, would generally be at a height too great to encounter the stack, thus reducing the collision risk.

iii. The static nature of the stack, compared to wind turbines, means it would pose a much lower risk of collision.

iv. The top of the stack will be indicated by white strobe (flashing) obstacle warning lights. The lights will be incandescent or of a type visible to Night Vision Equipment. The lights will emit light at the near infra-red (IR) range of the electromagnetic spectrum specifically at or near 850 nanometres (nm) of wavelength. Light intensity to be of similar value to that emitted in the visible spectrum of light.

The literature review indicates that, while any light source has the potential to attract birds and therefore increase collision risk, flashing lights are involved in significantly fewer collisions that continuous lights. There is also some indication that white lights are less attractive than red lights, although the results to date are inconclusive. While bird vision does differ from human, on the lower UV end of the spectrum, IR light is also invisible to birds. Therefore the proposal for a combination of white flashing and IR lights on the stack, is the most favourable choice and is unlikely to pose a significant collision risk to birds.

v. The existing turbines in the lower harbour are located a considerable distance apart from one another. The stack at the Indaver site is static in nature and therefore poses a significantly lower collision risk than the wind turbines. Therefore there will no cumulative impacts on the Cork Harbour SPA as a result of the Indaver stack.

vi. Based on the findings of the literature review and the details of the proposed development, the overall collision risk posed by this development is low and will not have a significant effect on the qualifying interests of the Cork Harbour SPA.

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Reference list

Alerstam, T. 1990. *Bird Migration.* Cambridge University Press. Cambridge, UK.

Alonso, J.A. & J.C. Alonso. 1999a. Collision of birds with overhead transmission lines in Spain. In: *Birds and Power Lines: Collision, Electrocution and Breeding.* M. Ferrer & G.F.E. Janss, Eds. Quercus. Madrid.

Alonso, J.A. & J.C. Alonso. 1999b. Mitigation of bird collisions with transmission lines through groundwire marking. In: *Birds and Power Lines: Collision, Electrocution and Breeding.* M. Ferrer & G.F.E. Janss, Eds.: 113–124. Quercus. Madrid.

Arnold, T. W., and R. M. Zink. 2011. Collision mortality has no discernible effect on population trends of North American birds. PLoS One 6(9):e24708. CrossRef, PubMed

Avery, M., P.F. Springer & J.F. Chassel. 1976. The effect of a tall tower on nocturnal bird migration—a portable ceilometer study. Auk 93: 281–291.

Banks RC (1979) Human related mortality of birds in the United States. U.S. Dept. of the Interior, Special Scientific Report – Wildlife No. 215

Barrios, L. & A. Rodriguez. 2007. Spatiotemporal patterns of bird mortality at two wind farms of Southern Spain. In Birds and Wind Farms: Risk Assessment and Mitigation. M. de Lucas, G.F.E. Janss & M. Ferrer, Eds.: 229–239. Quercus. Madrid.

Baldwin, D.H. 1965. Enquiry into the mass mortality of nocturnal migrants in Ontario. Ontario Nat. 3: 3–11.

Beason, R.C. 1999. The bird brain: magnetic cues, visual cues and radio frequency effects. In: Proceedings of the Conference on Avian Mortality at Communication Towers, August 11, 1999, Cornell University, Ithaca, NY.

Bevanger, K. 1994. Bird interactions with utility structures: collision and electrocution, causes and mitigating measures. Ibis 136: 412–425.

Bevanger, K. 1995. Estimates and population consequences of tetraonid mortality caused by collisions with high tension power lines in Norway. J. Appl. Ecol. 32: 745–753.

Cochran, W.W. & R.R. Graber. 1958. Attraction of nocturnal migrants by lights on a television tower. Wilson Bull. 70: 378–380.

Coues, E. 1876. The destruction of birds by telegraph wire. Am. Nat. 10:734-736.

Crawford R.L. & R.T. Engstrom. 2001. Characteristics of avian mortality at a north Florida television tower: a 29-year study. J. Field Ornith. 72: 380–388.

Drewitt, A. L. & Langston, R. H. W. 2006. Assessing the impacts of wind farms on birds. Ibis, 148: 29-42.

Everaert, J. & E.W.M. Stienen. 2007. Impact of wind turbines on birds in Zeebrugge (Belgium): significant effect on breeding tern colony due to collisions. Biodiversity and Conservation 16; 3345-3359

Exo, K.-M., O. H¨uppop & S. Garthe. 2003. Birds and offshore wind farms: a hot topic in marine ecology. Wader Study Group Bull. 100: 50–58.

Consent of copyright owner required for any other use. For inspection purposes only.

EPA Export 20-07-2019:03:56:29

European Commission, 2010. Wind energy developments and Natura 2000: EU guidance on wind energy development in accordance with the EU nature legislation. Publication Office of the European Union, Luxembourg.

Faanes, C.A. 1987. Bird behaviour and mortality in relation to powerlines in prairie habitats. US Dept. of the Interior, Fish and Wildlife Service, Fish and Wildlife Technical Report, No. 7. Washington, DC.

Gauthreaux, S.A.. and C.G. Belser. 1999. The behavioural responses of migrating birds to different lighting systems on tall towers. In Proceedings of Conference on Avian Mortality at Communication Towers, August 11, 1999, Cornell University, Ithaca, NY. 1 p. Published on the Internet at <http://www.fws.gov/r9mbmo/homepg.html> and <www.towerkill.com>.

Gauthreaux, S. A. 2000. The behavioral responses of migrating birds to different lighting systems on tall towers. Transcripts of Proceedings of the Workshop on Avian Mortality at Communication Towers, August 11, 1999, Cornell University, Ithaca, NY

Gauthreaux, S.A. & C.G. Belser. 2006. Effects of artificial night lighting on migrating birds. In: Ecologicial Consequences of Artificial Night Lighting. C. Rich & T. Longcore, Eds.: 67–93. Island Press. Washington, DC.

Gehring J., Kerlinger P. & Manville II A.M. (2009) Communication towers, lights, and birds: successful methods of reducing the frequency of avian collisions. Ecological Applications, 19, 505-514

Hager SB, Trudell H, McKay KJ, Crandall SM, Mayer L (2008) Bird density and mortality at windows. Wilson J Ornithol 120: 550–564.

Henderson, I.G. & R.H.W. Langston & N.A. Clark. 1996. The response of common terns *Sterna hirundo* to power lines: an assessment of risk in relation to breeding commitment, age and wind speed. Biol. Cons. 77: 185–192.

Hotker, H., K.-M. Thomsen & H. Jeromin. 2006. Impacts on biodiversity of exploitation of renewable energy sources: the example of birds and bats – facts, gaps in knowledge, demands for further research, and ornithological guidelines for the development of renewable energy exploitation. Michael-Otto-Institut im NABU, Bergenhusen. http://bergenhusen.nabu.de/bericht/englische%20 windkraftstudie.pdf (accessed May 20, 2008).

Howell, J.A. & J.E. DiDonato. 1991. Assessment of the avian use and mortality related to wind turbine operations: Altamont Pass, Alameda and Contra Costa Counties, California, September 1988 through August 1989. Final report to Kenentech Windpower

Hunt, W.G. 2002. Golden eagles in a perilous landscape: Predicting the effects of mitigation for energy-related mortality. California Energy Commission Report P500-02-043F.

Hunt, W.G. & T. Hunt. 2006. The trend of golden eagle territory occupancy in the vicinity of the Altamont Pass Wind Resource Area: 2005 survey. California Energy Commission Public Interest Energy Research Final Project Report CEC-500-2006-056.

Janss, G.F.E. 2000. Avian mortality from power lines: a morphologic approach of a species-specific mortality. Biol. Cons. 95: 353–359.

Kerlinger, P. 2000a. Avian mortality at communication towers: a review of recent literature, research and methodology. Report to United States Fish and Wildlife Service Office of Migratory Bird Management. http://www.fws.gov/migratorybirds/issues /towers/review.pdf (accessed May 20, 2008).

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EPA Export 20-07-2019:03:56:29

Kerlinger, P. 2000b. An assessment of the impacts of Green Mountain Power Corporation's Searsburg, Vermont, wind power facility on breeding and migrating birds. Proceedings of the NationalWind Coordinating Meeting, San Diego, CA.

Klem, D. 2006. Glass: a deadly conservation issue for birds. Bird Observer 34: 73–81.

Langston, R.H.W. & J.D. Pullan. 2003. Windfarms and birds: an analysis of the effects of wind farms on birds, and guidance on environmental assessment criteria and site selection issues. Report T-PVS/Inf (2003) 12, by BirdLife International to the Council of Europe, Bern Convention on the Conservation of European Wildlife and Natural Habitats. RSPB/BirdLife in the UK.

Larsen, J.K. & P. Clausen. 2002. Potential wind park impacts on Whooper Swans in winter: the risk of collision. Waterbirds 25: 327–330.

Laskey, A.R. 1954. Bird mortality during night migration, October 1954. Migrant 25: 59–61.

Manville, A.M. II. 2000. The ABCs of avoiding bird collisions at communication towers: the next steps. Proceedings of the Avian Interaction s Workshop, December 2, 1999, Charleston, SC. Electric Power Research Institute. http://www.fws.gov/migratorybirds/issues/towers/abcs.html (accessed May 20, 2008).

Merriam, C.H. 1885. Preliminary report of the committee on bird migration. Auk 2:53-57.

Newton, I. 2007. Weather-related mass-mortality events in migrants. Ibis 149: 453–467.

Noer, H., Kjaer Christensen, T., Krag Petersen, I. 2000. Effects on birds of an offshore wind park at Horns Rev: Environmental impact assessment. NERI report. Ministry of Environment and Energy National Environmental Research Institute

Ogden, L.J.E. 1996. Collision course: the hazards of lighted structures and windows to migration birds. Report to WWF Canada and the Fatal Light Awareness Program. http://www.flap.org/new/ccourse.pdf (accessed May 20, 2008).

Orloff, S. & A. Flannery 1992. Wind Turbine Effects on Avian Activity, Habitat Use and Mortality in Altamont Pass and Solano CountyWindResource Areas, 1989–1991. California Energy Commission.

Pettersson, J. 2005. The impact of offshore wind farms on bird life in southern Kalmar Sound, Sweden. A final report based on studies 1999–2003. Report to the Swedish Energy Agency. ISBN 91-631-6878-2.7

Rose, P. & S. Baillie. 1989. The effects of collisions with overhead lines on British birds: an analysis of ringing recoveries. BTO Research Report No. 42. British Trust for Ornithology, Thetford, UK.

Richardson,W.J. 2000. Bird migration and wind turbines:migration timing, flight behaviour and collision risk. Proceedings of National Avian-Wind Power Planning Meeting II, 132–140. http://www.national wind.org/publications/wildlife/avian98/20- Richardson-Migration.pdf (accessed May 20, 2008)

Savereno, A.J., L.A. Savereno, R. Boettcher & S.M. Haig. 1996. Avian behaviour and mortality at power lines in coastal South Carolina. Wildl. Soc. Bull. 24: 636–648.

Scott, R.E., L.J. Roberts & C.J. Cadbury. 1972. Bird deaths from power lines at Dungeness. Brit. Birds 65: 273–286.

Consent of copyright owner required for any other use. For inspection purposes only.

EPA Export 20-07-2019:03:56:29

Smallwood, K.S. & C.G. Thelander. 2004. Developing methods to reduce mortality in the Altamont Pass Wind Resource Area. Final Report by BioResource Consultants to the California Energy Commission, Public Interest Energy Research 500-04-052.

Percival, S. 2005. Birds and Windfarms: What are the real issues? British Birds 98: 194-204.

Pedersen, M.B. and Poulsen, E. 1991. Impact of a 90m/2MW wind turbine on birds. Avian responses to the implementation of the Tjaereborg wind turbine at the Danish Wadden Sea. Danske Vildtunderogelser Haefte 47. Ronde, Denmark:

Simms, I.C., Plonczkier, P., & Johnson L. 2011. Cork Lower Harbour Wind Turbine Development; Bird radar monitoring.

Smallwood, K.S. & C. Thelander. 2008. Bird Mortality in the Altamont Pass Wind Resource Area, California. J. Wildl. Manage. 72(1): 215–223.

Verheijen, F.J. 1985. Photopollution: artificial light optic spatial control systems fail to cope with. Incidents, causations, remedies. Exp. Biol. 44: 1–18.

Weir, R.D. 1976. Annotated bibliography of bird kills at man-made obstacles: a review of the state-of-the-art and solutions. Can. Wildl. Serv., Ont. Reg., Ottawa. 85 pp.

Winkelman, J.E. 1992a. The impact of the Sep wind park near Oosterbierum (Fr.), the Netherlands, on birds, 1: collision victims. IN rapport 92/2. Arnhem IBN-DLO. (Dutch with English summary).

Winkelman, J.E.1992b. The impact of the Sep wind park near Oosterbierum (Fr.), The Netherlands, on birds, 3: flight behaviour during daylight. RIN rapport 92/4. IBN-DLO. (Dutch with English summary).

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Appendix 5

Assessment of Potential Bio-monitoring Programme

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Appendix 5. Literature review on the use of bio-monitoring programmes

5.1 Bio-monitoring tools

Studies of mercury in wild birds can be divided into three categories: eggs and reproduction, liver and other organs, and feathers. In the 1960's great concern over reproductive failures of many avian species prompted studies of various contaminant levels in eggs, particularly in eggs that failed to hatch. Many of these studies were "positive", showing that unhatched eggs had higher contaminant levels (particularly chlorinated hydrocarbons), than hatched eggs and in many cases the contaminants levels were linked to eggshell thinning. Although mercury also causes eggshell thinning, most field studies did not analyse for mercury, and those that did often did not find significant increases in mercury. Studies of mercury in organs such as the liver were often made on moribund or dead birds to ascertain a cause of death. Widespread surveys of mercury in organs required the killing of large numbers of individuals. This was both inconvenient and undesirable. Hence many studies relied on measuring mercury in feathers.

Bird feathers offer several advantages as bio-indicators of metal exposure, as well as being non-invasive. The affinity of mercury for the sulfhydral groups on proteins, accounts for the relatively high concentrations of mercury deposited in growing feathers which are comprised mainly of the sulfhydral rich protein, keratin. A substantial part of the body burden of methylmercury is found in feathers (Braune and Gaskin 1987), which, like human hair, have repeatedly proven their value as a means for monitoring mercury concentrations in birds (Malik and Zeb, 2009; Zamani-Ahmadmahmoodi et al. 2010). Moreover, feathers from newly born chicks indicate local contamination, derived mostly from food collected locally by their parents during the short period of egg formation and chick development (Boncompagni et al., 2003; Muralidharan et al., 2004). Waterbirds that breed in colonies provide additional advantages as bio-indicators of pollution: easy sampling (Burger and Gochfeld, 2000a, b); a limited foraging range around their colony site, thus allowing inference about the source of contaminants (Burger et al., 2004); and dependence on specific habitat and prey resources (Fasola et al., 1998).

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Interpreting concentrations and origins of contaminants in tissues of migratory animals presents unique challenges in that exposure may occur at breeding, migratory, or overwintering sites. Persistent organic pollutants (POPs) and mercury accumulate in body tissues and are readily transported by migratory animals from one region to another. In birds, contaminants stored within endogenous energy reserves (e.g., lipids) can be mobilised to eggs, and therefore, eggs have been used for monitoring contaminants, especially in colonial water birds.

Thompson et al. (1998) demonstrated the utility of feather mercury in documenting the temporal increase in mercury in the marine environment. Spalding et al. (2000a), Braune and Gaskin (1987) and Thompson and Furness (1989) found that the mercury levels in the feathers of provided a good indication of the mercury dose.

While feathers have been extensively used in bio-monitoring studies for heavy metal pollution, until very recently few studies had been performed on the use of feathers for monitoring of organic pollutants. In a recent review Garcia-Fernandez et al. (2013) examined the use of feathers for monitoring polyhalogenated compounds (PHCs). They discussed how some authors had found strong and significant correlations between the concentrations of PHCs in feathers and internal tissues, providing positive expectations for their future use in the field of ecotoxicology. However, changes in diet, time elapsed between the previous moult period and sampling, sample size, and/or external contamination have been suggested as possible causes to explain the lack of correlations reported in some studies. They concluded further studies with newly grown feathers and blood samples would be required in order to clarify this issue.

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Jaspers et al. (2011) investigated the variation in concentrations and profiles of various classes of organohalogenated compounds (OHCs) in different feather types, muscle tissue and preen oil from 15 White-tailed Eagle (*Haliaeetus albicilla*) carcasses from Greenland. The influence of moult patterns and potential external contamination onto the feather surface was examined. Concentrations of sum polychlorinated biphenyls (PCBs) in feathers from White Tailed Eagles ranged from 2.3 ng/g in a primary wing feather to 4200 ng/g in body feathers. Using body feathers, they found almost 50 different OHCs could be quantified and median concentrations in body feathers were tenfold higher than concentrations in tail feathers or primary wing feathers. Furthermore the effects of confounding variables such as feather size, moult and age were also minimised using body feathers.

While the use of feathers is still relatively new, several non-destructive bio-monitoring strategies have been developed for monitoring OHCs (Furness 1993, Burger 1993, Bustnes et al. 2005, Van den Steen et al. 2006). Eggs have been extensively used in bio-monitoring studies for organic pollutants (Becker et al. 1992, Lindberg et al. 2004, Van den Steen et al. 2006, Dauwe et al. 2006). One egg has been shown to reflect the contamination of the whole clutch (Van den Steen et al. 2006) and the collection of one egg is only expected to have a minor effect on the population level in species producing large clutches. However, the use of eggs does have some drawbacks, since they can only be collected during the breeding season from adult females. Therefore levels in eggs do not represent concentrations in the general population during the year. Moreover, sampling of viable eggs may have an impact on the population, while concentrations in unhatched eggs may be susceptible to microbiological degradation (Herzke et al. 2002). Other non-destructive bio-monitoring strategies are the collection of plasma or blood (Henriksen et al. 1998, Verreault et al. 2004) and the sampling of preen oil (Yamashita et al. 2007) that can be collected of both adults and nestlings. However, both techniques involve some sampling expertise and require the capturing of the birds. Furthermore, the amount of blood that can be collected is limited (species-dependent) and thus analytical problems may be of concern. In addition, levels in the blood only present a snapshot and are subject to variations in the diet, season and condition of the bird.

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While feathers have been commonly used to measure heavy metal levels in birds, a number of factors have been identified which can cause variations in the levels of deposition including species, age, sex, life history. Becker et al. (1994) tested eggs, feathers (down, body feathers from side/shoulder and back) and some dead chicks (liver) from broods Herring Gull, Black-headed gull and Common Terns to examine inter-sibling differences in mercury contamination and elimination into the growing feathers. The mercury contamination in eggs, feathers, and liver of the terns was about four times that of the gulls; Black-headed Gulls had the lowest mercury concentrations. Body feathers, which grow when the chicks became older, had lower mercury levels than down feathers in the more contaminated species (11% lower in Herring Gulls, 49% in Common Terns), indicating the advancing decontamination of the body by the plumage development. The elimination of mercury was greater in chicks with higher mercury levels. Furthermore down of the first hatched Herring Gull and Common Tern chick contained more mercury than down of the siblings hatched later, because of its higher burden derived from the first laid egg.

Tavares et al. (2013) examined levels of mercury in Wandering Albatrosses (Diomedea exulans) Mercury concentrations in tissues of the wandering albatross are greater than in any other vertebrate, including closely related species. In order to explore the alternative explanations for this pattern, total mercury concentrations in feathers, plasma and blood cells of wandering albatrosses of known age, sex and breeding status were sampled. Mercury concentrations were low in feathers and blood components of chicks, and higher in the feathers of young pre-breeders than in feathers or blood of older pre-breeders and breeding adults. There was no effect of sex on mercury concentrations in the feathers of pre-breeders or breeding adults, whereas levels were significantly higher in blood cells of

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breeding females than males. The high feather mercury concentrations of young pre-breeders compared with older birds suggest an increase in moult frequency as birds approach maturity.

As discussed organic contaminants and mercury accumulate in body tissues and are readily absorbed and therefore will be transported by migratory animals from one region to another. Therefore interpreting concentrations and origins of contaminants in tissues of migratory animals presents unique challenges in that exposure may occur at breeding, migratory, or overwintering sites (Hargreaves et al. 2010, Dietz et al. 2009). Feathers may be an effective mode of mercury bio-transport and deposition, as they are often moulted at sites far removed from the initial source of mercury exposure. For example, long-lived, piscivorous seabirds may transport marine sourced mercury to inland colonies, where concentrations in aquatic sediments from feathers, eggs, carcasses, and faeces may reach toxic level (Blais et al. 2007, Blais et al. 2005) Alternatively, species such as the Common Loon, Common tern and Roseate Tern (Sterna dougallii) accumulate more mercury in summer-grown feathers and may therefore transport mercury from northern breeding sites to the wintering grounds (Burgess et al. 2005, Burger et al. 1992, Nisbet et al. 1992).

5.2 Conclusions

An important method for examining the impact of pollutants in the wild is bio-monitoring. While studies on heavy metals, in particular mercury, are well established, non-invasive bio-monitoring for dioxins is still relatively new. Bird feathers and eggs have been successfully used to monitor mercury levels in birds for many years. In the case of dioxins, bird livers and muscle are commonly used, although a number of studies have successfully used eggs to monitor contamination levels. However, other factors, including age, sex, time of year, migratory status and, in the case of eggs, laying sequence, will affect the levels of mercury or dioxins detected. Therefore using such techniques to monitor mercury patterns in a single area, or from a single source very difficult.

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An important method for examining the impact of pollutants in the wild is bio-monitoring. While studies on heavy metals, in particular mercury, are well established, non-invasive bio-monitoring for dioxins is still relatively new. Bird feathers and eggs have been successfully used to monitor mercury levels in birds for many years. In the case of dioxins, bird livers and muscle are commonly used, although a number of studies have successfully used eggs to monitor contamination levels. However, other factors, including age, sex, time of year, migratory status and, in the case of eggs, laying sequence, will affect the levels of mercury or dioxins detected. Therefore using such techniques to monitor mercury patterns in a single area, or from a single source (in this case the proposed Indaver facility) appears very difficult if not impossible.

It is noted that long-term bio-monitoring programmes of this nature are generally not carried out by private companies. The predicted levels of dioxins and mercury generated by the facility will be low and no significant impact on piscivorous bird species is predicted. Given the difficulties inherent in determining the source of dioxins and mercury in piscivorous birds and the difficulties in ascribing levels to any particular source, the use of cows milk is considered an adequate means of determining if problematic levels of dioxins are entering the food chain via atmospheric deposition.

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5.3 References

Becker PH1, Henning D, Furness RW. 1994. Differences in mercury contamination and elimination during feather development in gull and tern broods. Arch Environ Contam Toxicol. 27(2):162-7.

Becker PH, Heidmann WA, Buthe A, Frank D, Koepff C. 1992. Chemical residues in eggs of birds from the southern coast of the North-Sea - trends 1981-1990. Journal fur ornithologie 133(2): 109-124.

Blais, J. M.; Macdonald, R. W.; Mackay, D.; Webster, E.; Harvey, C.; Smol, J. P. Biologically mediated transport of contaminants to aquatic systems. Environ. Sci. Technol. 2007, 41 (4), 1075−1084.

Blais, J. M.; Kimpe, L. E.; McMahon, D.; Keatley, B. E.; Mallory, M. L.; Douglas, M. S. V.; Smol, J. P. Arctic seabirds transport marine derived contaminants. Science 2005, 309, 445.

Braune, B. M. and Gaskin, D. E. 1987. Merucy levels in Bonaparte's Gulls (Larus philadelphia) during autumn moult in the Quoddy region, New Brunswick, Canada. Archives of Environmental Contamination and Toxicology. 16:539-49.

Burgess, N. M.; Evers, D. C.; Kaplan, J. D. Mercury and other contaminants in common loons breeding in Atlantic Canada. Ecotoxicology 2005, 14, 241−252.

Boncompagni, E., Muhammad, A., Jabeen, R., Orvini, E., Gandini, C., Sanpera, C., Ruiz, X., Fasola, M., 2003. Egrets as monitors of trace-metal contamination in wetlands of Pakistan. Arch. Environ. Contam. Toxicol. 45, 399–406.

Burger, J.; Nisbet, I. C.; Gochfeld, M. 1992. Metal levels in regrown feathers: Assessment of contamination on the wintering and breeding grounds in the same individuals. J. Toxicol. Environ. Health, 37(3), 363−374.

Burger, J., Gochfeld, M., 2000a. Effects of lead on birds (Laridae): a review of laboratory and field studies. J. Toxicol. Environ. Health 3, 59–78.

Burger, J., Gochfeld, M., 2000b. On developing bio-indicators for human and ecological health. Environ. Monit. Assess. 66, 23–46.

Burger, J., Bowman, R., Glen, E., Gochfeld, W.M., 2004. Metal and metalloid concentrations in the eggs of threatened Florida scrub-jays in suburban habitat from south-central Florida. Sci. Total Environ. 328, 185–193

Burger J. 1993. Metals in avian feathers: bio-indicators of environmental pollution. Reviews in Environmental Toxicology 5: 203-311.

Bustnes JO, Skaare JU, Berg V, Tveraa T. 2005. Interseasonal variation in blood concentrations of organochlorines in Great Black-backed Gulls (Larus marinus). Environmental Toxicology and Chemistry 24: 1801-1806.

Dauwe T, Jaspers VLB, Covaci A, Eens M. 2006. Accumulation of organochlorine and brominated flame retardants in the eggs and nestlings of Great Tits (Parus major). Environmental Science and Technology 40: 5297-5303.

Dietz, R.; Outridge, P. M.; Hobson, K. A. 2009. Anthropogenic contributions to mercury levels in present-day Arctic animals; A review. Sci. Total Environ. 407, 6120−6131.

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EPA Export 20-07-2019:03:56:29

Fasola, M., Movalli, P., Gandini, C. 1998. Heavy metal, organochlorine pesticide, and PCB residues in eggs and feathers of herons breeding in northern Italy. Arch.Environ. Contam. Toxicol. 34, 87–93.

Furness RW. 1993. Birds as monitors of pollutants, in: Furness R W, Greenwood J J D (Eds.), Birds as monitors of environmental change. Chapman and Hall, London, pp 86-143.

García-Fernández AJ1, Espín S, Martínez-López E. 2013. Feathers as a biomonitoring tool of polyhalogenated compounds: a review. Environ Sci Technol. 2013 Apr 2; 47(7):3028-43

Hargreaves, A. L.; Whiteside, D. P.; Gilchirst, G. Concentrations of 17 elements, including mercury, and their relationship to fitness measures in arctic shorebirds and their eggs. Sci. Total Environ. 2010, 408, 3153−3161.

Henriksen EO, Gabrielsen GW, Skaare JU. 1998. Levels and congener pattern of polychlorinated biphenyls in Kittiwakes (Rissa tridactyla) in relation to mobilization of body-lipids associated with reproduction. Environmental Pollution 92(1): 27-37.

Herzke D, Kallenborn R, Nygard T. 2002. Organochlorines in egg samples from Norwegian birds of prey: Congener-, isomer- and enantiomer specific considerations. The Science of the Total Environment 291: 59-71.

Jaspers, V. L. B., Rodriguez, F. S., Boertmann, D., Sonne, C., Dietz, R. and Rasmussen, L. M.2011. Body feathers as a potential new biomonitoring tool in raptors: a study on organohalogenated contaminants in different feather types and preen oil of West Greenland White-tailed Eagles (Haliaeetus albicilla). Environ. Int. 37, 1349–1356.

Lindberg P, Sellström U, Häggberg L, de Wit CA. 2004. Higher Brominated Diphenyl Ethers and Hexabromocyclododecane Found in Eggs of Peregrine Falcons (Falco peregrinus) Breeding in Sweden. Environmental Science & Technology 38(1):93-96

Malik, R.N., Zeb, N., 2009. Assessment of environmental contamination using feathers of Bubulcus ibis L., as a biomonitor of heavy metal pollution, Pakistan. Ecotoxicology 18, 522–536.

Muralidharan, S., Jayakumar, R., Vishnu, G., 2004. Heavy metals in feathers of six Species of birds in the district Nilgiris, India. Bull. Environ. Contam. Toxicol. 73, 285–291.

Nisbet, I. C. T.; Montoya, J. P.; Burger, J.; Hatch, J. J. Use of table isotopes to investigate individual differences in diets and mercury exposures among common terns Sterna hirundo in breeding and wintering grounds. Mar. Ecol. Prog. Ser. 2002, 242, 267−274.

Spalding, M.G., P.C. Frederick, H.C. McGill, S.N. Bouton and L.R. McDowell (2000a) Methylmercury accumulation in tissues and its effects on growth and appetite in captive Great Egrets, J. Wildlife Diseases 36:411-422.

Tavares S1, Xavier JC, Phillips RA, Pereira ME, Pardal MA. 2013. Influence of age, sex and breeding status on mercury accumulation patterns in the wandering albatross Diomedea exulans. Environ Pollut. 2013 Oct;181:315-20

Thompson, D. R., R. W. Furness, and L. R. Monteiro. 1998. Seabirds as bio-monitors of mercury inputs to epipelagic and mesopelagic marine food chains. Science of the Total Environment 213:299–305

Van den Steen E, Dauwe T, Covaci A, Jaspers VB, Pinxten R, Eens M. 2006. Withinand among-clutch variation of organohalogenated contaminants in eggs of Great Tits (Parus major). Environmental Pollution 144: 355-359.

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Verreault J, Gabrielsen GW, Letcher RJ, Muir DDC, Chu S. 2004. New and Established Organohalogen Contaminant and Their Metabolites in Plasma and Eggs of Glaucous Gulls from Bear Island. Norwegian Polar Institute, Report 914/2004.

Yamashita R, Hideshige T, Murakami M, Fukuwaka M-A, Watanuki Y. 2007. Evaluation of non-invasive approach for monitoring PCB pollution of seabirds using preen gland oil. Environmental Science & Technology 41: 4901-4906.

Zamani-Ahmadmahmoodi, R., Esmaili-Sari, A., Savabieasfahani, M., Ghasempouri, S.M., Bahramifar, N., 2010. Mercury pollution in three species of waders from Shadegan wetlands at the head of the Persian Gulf. Bull. Environ. Contam. Toxicol. 84, 326–330

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Appendix 6

Information requested by the NPWS on emission monitoring data Carranstown, Co. Meath, comparative data from similar waste-to-energy incinerator facilities, Effects of hazardous compounds and information on plant start-up and shut-down procedures

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Appendix 6. Additional information requested by the NPWS.

This appendix provide additional information on issues raised by the NPWS during consultation meetings. It addresses the following issues.

- Information on plant start-up and shut-down procedures including frequency of start-up and shut-down, and emergency response procedures (Requested at the NPWS meeting, May 2015). (**Appendix 6**)
- Information on air emission monitoring data from Indaver's plant at Carranstown, Co Meath. (Requested at the NPWS meeting, May 2015). (**Appendix 6**).
- Comparative data from similar waste-to-energy incinerator facilities (Point 3 of DAU letter). This information is provided in (**Appendix 6**).
- Effects of hazardous compounds (Point 8 of DAU letter). This is addressed in **Appendix 6.**

1. Plant start-up and shut-down procedures and frequency of start-up and shut-down, and emergency response procedures with particular reference to the paper by Wang (2007)

Furnace Start Up And Planned Shut Down Procedure

The start-up and shut down of the furnace will be carefully controlled, in accordance with standard operating procedures. The procedures will be developed in detail prior to the commissioning of the furnace. There is a maximum of two planned shutdowns per year and can be up to 5 in total, each of these is a controlled shutdown and start up as outlined in the procedure below

The start-up sequence for the furnace line will be as follows:

- The computerised control system for the line will be started up, which will mean that measurements and interlock systems will be in operation.
- Utilities for the plant such as water, electricity, instrument air, the firewater system and safety systems will then be started up.
- Monitoring of some of these utilities will be carried out, as certain conditions such as firewater availability must be satisfied before the start-up procedure can commence.
- Peripheral equipment, such as the equipment to supply chemicals to the plant, to receive the process steam from the plant and the stack emissions monitoring equipment will then be started up.
- After verification of process parameters such as liquid levels, pressures, steam cycle etc., and adjustment as necessary, the flue gas cleaning systems will be started up.
- The ID-fan will commence running and pre-ventilation of the line for a pre-set time period will occur.
- The oil-fired burners, to initiate the combustion in the furnace, will be started up and the flue gas temperature will be raised to 850°C at a gradient of 50°C per hour.
- Once the temperature in the furnace has stabilised, the supply of waste will then commence and oil firing will be stopped when the process is steady.

The planned shut down sequence for a furnace line will be as follows:

- The waste supply to the furnace will be shut off

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- To ensure complete combustion of the waste remaining in the furnace, the oil burners will be re-started to ensure that a temperature of 850°C, as appropriate, will be maintained for a period of up to 1 hour or until all the waste is incinerated.
- The ID fan of the flue gas cleaning system will remain operating to ensure that the flue gases will be treated to the emission limits during the operation.
- The furnace will then be allowed to cool down to a temperature of 200°C at a gradient of 50°C per hour (a period of circa 13 hours) which will be controlled by supplementary firing.
- The furnace line will have stopped incinerating waste for a number of hours, there will be no waste remaining in the furnace and consequently there will be no flue gases to be cleaned. Once the temperature at the stack is sufficiently low at approximately 60°C, the flue gas cleaning systems will be stopped.
- Some utilities to the plant such as instrument air, etc. and the majority of the peripheral equipment will be shut-off.
- Other utilities such as electrical supply will continue operating as they will be required even when the plant is shut down.

Emergency Shutdown Procedure

The emergency shut down will bring the incinerator line to a safe status. The main objectives of the emergency shut down procedure are as follows:

- To shut down the plant safely, avoiding injury to staff or damage to equipment
- to minimise emissions
- to protect equipment from damage caused by temperatures which are too high.

The experience of the operators of Indaver's plants in Meath/Belgium is that an emergency shut down is not a frequent occurrence.

In case of failure of electrical power supply, the plant will switch over to island mode and power itself through the turbine. The plant will reduce in load and remain in a stable condition. If the turbine trips in this condition then the motors and equipment required for the emergency shut down will be powered by the emergency generator.

The emergency shut down will be automatically executed in two steps.

Step 1 is the waste burn out. As soon as the emergency shut down commences all waste supply will be stopped immediately. The ID-fan will be stopped. The water supply to the spray reactor will be stopped. An emergency supply may be provided for use in the spray reactor, if the temperature of the flue gases exceeds 250ºC. This option will be decided at detailed design stage.

The injection of activated carbon/clay and lime will stop and may be reactivated by the operator, manually, once the reason for the shut down is known and it is determined that there will be no risk in doing so.

The inertia of the ID-fan will ensure that the flue gases will continue to be evacuated through the flue gas cleaning systems, prior to the start-up of the ID-fan via the auxiliary motor, which will be powered by the emergency generator.

In the grate furnace, air to burn out the residual waste will be drawn into the furnace because the inertia of the ID-fan will maintain under-pressure in the furnace. During this period the flue gas flow will drop quickly to less than 20 % of the normal flow. At this stage the waste in the furnace will be almost completely burned. Only a few bigger waste parts will still be smouldering. The auxiliary motor (with gear box) of the ID-fan will then engage and continue

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on partial load. The power of this motor will be sufficient to evacuate the remaining flue gas through the flue gas cleaning system.

Step 2 is the cooling step. Once there is no more waste in the furnace, the ID fan will continue to pull air through the furnace boiler for a controlled cool down to protect the refractory and boiler from to rapid a cool down which could lead to mechanical failure. The ID fan can then be stopped once the plant is below 60° C.

During any emergency shutdown, while there is waste in the furnace all the flue gases pass through the gas cleaning system and are emitted through the stack. As stated above, the ID Fan is kept operating during the shutdown by means of an auxiliary motor and an emergency generator. In the event of an emergency shutdown and failure of the emergency generator the inertia of the ID Fan would continue to draw the flue gases through the gas cleaning system for an initial period. It is highly unlikely that there would be both an emergency shutdown and a failure of the emergency generator at the same time.

While step 1 of the shutdown sequence is underway, the combustion gases will continue to pass through the flue gas cleaning systems and the bag house filter and particulates will be removed as efficiently as during normal operations (except in the case of catastrophic failure of the baghouse). The activated carbon/clay/lime mixture present on the sleeves of the bag house filter will continue to remove heavy metals, dioxins, HCI, HF and SO2 from the combustion gases.

The fixed installed emissions monitoring equipment located on the stack will continue to monitor the emissions from the stack. In the event of loss of mains power, the monitoring equipment will be supplied with electricity from the Uninterruptible Power Supply (UPS) and emergency generator

A risk analysis will be carried out on this procedure during the detailed design phase of the project (in the form of a Hazard and Operability Study) during which the final details of the procedure will be decided.

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Quick stop incineration

During the operation of the plant there can be conditions that force a scenario called quick stop incineration. These conditions are for example when the pressure increases in the furnace. If this occurs, the first stage alarm will indicate to the operator that the pressure is increasing and if no action is taken by the operator, then the second stage alarm will increase the ID fan speed to reduce the pressure. If this does not reduce the pressure then waste feeding will be stopped and the air supplied to the furnace for combustion will be reduced or stopped and the ID fan will reduce to ensure that the waste on the grate is still combusting in a controlled manor. The operator can then resolve the issue that lead to the quick stop incineration conditions and return the plant to normal operating conditions.

The fixed installed emissions monitoring equipment located on the stack will continue to monitor the emissions from the stack during this time.

Assessment of the paper by Wang (2007)

The paper '*Influence of start-up on PCDD/F emission of incinerators'*, Wang et al (2007) highlights the potential for dioxin production during a cold start up of an incinerator. It is noted that the paper does not provide information explaining the process conditions and process set-up details. More specifically the paper does not provide details on the following:

- year of construction of the plant
- secondary air mixing effect,
- residence time of flue gas at minimum 850°C,

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- combustion temperature,
- calorific value of the waste,
- the equipment setup,
- information on boiler cleaning,
- quantity of activated carbon used,
- temperature in the flue cleaning,
- combustion air pre-heating or the presence of a bypass valve for flue gas over the dioxin abatement step.

As a lot of the potential reasons for poor control of dioxin levels are ignored in the article, it is problematic to accurately assess the validity of the paper. It is correct that in the absence of control measures, the cold start-up of the incinerator is favorable for dioxin production. It is also correct that some materials absorb dioxins and release dioxins (memory effect). However these effects are effectively negated by the control measures as detailed below. These measures ensure that excess emissions of dioxins do not occur during start-up procedures.

1. The number of cold starts is limited to a minimum. The maintenance strategy is focused on a high plant availability. This is only possible with a low frequency of unscheduled shut downs and cold start-ups.
2. Cold startup is done through the bag filter. The filter cake is not removed or a filter cake is applied in case of new filter bags. It contains activated carbon and this abates dioxins. The flue gas cleaning residue is mainly re-circulated in order to get a better use of the carbon and lime. The carbon dosing can be started if necessary to ensure there is no bypass of the dioxin abatement step during a cold start. Hence the downstream equipment is not exposed to increased dioxin concentrations and the memory effect does not occur.
3. The combustion chamber is state of the art. Geometry and flow patterns are also designed to limit undesirable conditions for burnout at cold start up.
4. Fuel burners are selected with a low CO and NOx production in cold start conditions. This reduces also the amount of dioxin precursors.
5. The bag filter is pre-coated with a lime/carbon/residue mixture prior to cold startup. The carbon concentration is higher than during normal operation with waste.
6. The plant is designed and operated with a big margin below the dioxin emission limit. The limit is 0.1 ng TEQ / Nm3. The plant is operated with an emission of less than 10 % of this emission limit in order to absorb unwanted events or suboptimal process conditions.
7. Materials that absorb dioxins and release it as memory effect are avoided.
8. The boiler has fixed installed cleaning devices. Before a shut down extra cleaning cycles will be executed. During the shutdown the boiler will be cleaned manually if the fouling is abnormal.

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2. Data from other European sites

Indaver and the project team met representatives of the National Parks and Wildlife Service (NPWS) in April 2015. At the meeting, the NPWS representative suggested that data on the monitoring of the effects of waste to energy plants on nearby special protection areas would be useful. Indaver/ARUP carried out a desktop review to identify incinerators in proximity to SPAs in Europe. A recent International Solid Waste Association report provided information on over 472 plants in 18 European countries (Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Hungary, Italy, Ireland, Netherland, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and United Kingdom). Each of the plants is treating more than 100,000 tonnes per annum of municipal solid waste.

A closer look identified over 60 of these that were within 15km of special area of conservation (SPA) (See **Table 1**). In Belgium, France and the UK examples of incinerators can be found located within less than 0.5km of an SPA and the results suggest that proximity to an SPA does not, in general, create a significant barrier to permission being granted to incinerators in proximity to SPAs. Indaver contacted representatives of the waste-to-energy industry in the UK, Ireland, Germany, Belgium and The Netherlands but found no evidence for a biomonitoring programme instigated by a specific incinerator. The general consensus was that such programmes are not required due to the low emission levels and the low potential for impacts.

Indaver specifically contacted the following waste to energy facilities:
(*a) Runcorn municipal waste incinerator (Cheshire, UK), within 300m of the Mersey Estuary SPA;*
(b) Marchwood Energy from Waste Facility (Southampton, UK), within 1km of the Solent and Southampton Water SPA;
(c) Exeter Energy from Waste facility (Devon, UK), within 2km of the Exe River SPA;
(d) La Collete non-hazardous waste incinerator facility (Jersey, UK), near to the South East coast of Jersey Ramsar site.

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It is Indaver's understanding that the facilities noted above do not have ecological data on the impact of operating incinerators collated to support the conclusion of the Appropriate Assessment No specific bio-monitoring programmes to monitor the effects of the operations on the nearby SPA are implemented by these plants. All of the incinerators proposals were subject to a full assessment as part of the planning and licencing procedures.

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Table 1: List of European incinerator facilities located within 15km distance from special protection areas for birds.

Country	Location	Name of Plant	Year of Establishment	SPA Code	Distance from SPA (KM)
Austria	Wels (I) & Wels (II)	WAV I & WAV II	1995 & 2006	AT3113000	7.2
				AT3126000	2.4
	Amoldstein	TBA Amoldstein	2004	AT2116000	7.0
Belgium	Wilrijk (Antwerpen)	ISVAG	1999-2000	BE2301336	12.0
				BE2300222	7.2
				BE2301235	4.7
	Eeklo	IVM	1982	BE2500932	13.0
				BE2301134	4.3
	Gent	IVAGO	1996	BE2301235	11.7
	Oostende	IVOO	1981	BEMNZ0003	4.3
	Herstal	Uvelia-Intradel	2009	BE33004A0	3.9
	Houthalen	Bionerga	1984	BE2200727	0.5
Finland	Vaasa	Westenergy Oy Ab	2013	FI0800056	4.89
				FI0800057	12.7
Denmark	Aars	Aars Fjernvarmeværk	1986-1995	DK00FX001	12.5
	Aalborg	Reno-Nord I/S	1991-2005	DK00FX001	12.1
				DK00FX007	12
	Nykøbing F	I/S REFA	1983-1999	DK006X085	13.6
				DK006X083	4.5
				DK006X086	1.5
	Næstved	AffaldPlus Næstved	1995-2005	DK006X081	0.6
				DK005X096	11.6
				DK006Y093	12.1
	København	I/S Amagerforbrænding	1971	DK002X110	5.3
				DK002X111	6.9
	Roskilde	KARA/NOVEREN Roskidle forbrændingsanlæg	1980-1988	DK004Y105	2.7
	Slagelse	AffadPlus Slagelse	1990	DK005X100	12
				DK006Y093	13.5
	Horsens	Horsens Kraftvarmeværk A/S	1992	DK00DY036	6.6
France	Saint Pourcain sur Sioule	Bayet	1982-1988	FR8310079	3.2
	La Rochelle	La Rochelle	1988	FR5410100	12.2
				FR5410013	10.5
				FR5412026	0.5
	Plouharnel	Plouharnel	1971	FR5310086	9.6
				FR5310093	2.0
				FR5310094	12.3

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Country	Location	Name of Plant	Year of Establishment	SPA Code	Distance from SPA (KM)
	Thonon Les Bains Cedex	Thonon Les Bains	1988	FR8212020	0.3
				FR8210018	0.4
	Bayonne	Bayonne	1990	FR7210063	8.4
				FR7212002	10.3
	Lens	Noyelles sous Lens	1973	FR3112002	14.2
	Planguenoual	Lamballe (Planguenoual)	1993	FR5310050	8.4
	Concarneau	Concarneau	1989	FR5310057	2.4
	Monthyon	Monthyon (Somoval)	1997-1998	FR1112003	7.4
	Sète	Sète	1992	FR9110042	6.9
				FR9112018	1.1
				FR9112035	1.2
	Brest	Brest	1988	FR5310071	10.4
	Fourchambault	Nevers (Sonirval)	2002	FR2610004	1.1
	Montereau Fault Yonne	Montereau	1973	FR1112002	0.0
				FR1112001	9.5
				FR1110795	13.1
	Saran	Saran (Orléans)	1995	FR2410017	5.8
	Villefranche sur Saône	Villefranche/Saône	2002-2003	FR8212016	9.2
	Livet	Bourg d'Oisans	1998	FR9310036	13.8
	Pontcharra	Pontcharra	1977	FR8212003	13.4
	Toulouse Mirail	Toulouse	2003-2006	FR7312014	3.1
	Douchy les Mines	Douchy	1977	FR3112005	9.3
Germany	Premnitz	E.ON energy from waste Premnitz GmbH	2009	DE3339402	0.6
				DE3542421	12.6
				DE3341401	9.2
	Darmstadt	Müllheizkraftwerk Darmstadt	1967-1977	DE6116450	13.2
				DE6217403	8.1
				DE6119401	13.1
				DE6017401	8.3
	Würzburg	Müllheizkraftwerk Würzburg	1984-1998	DE6027471	13.7
Ireland	Carranstown, Duleek	Meath Waste-to-Energy Plant	2011	IE0004080	9.4
				IE0004232	5.0
				IE0004158	10.3
Italy	Padova	Padova	1970-2000	IT3260018	6.4
	Venezia	Fusina	1998	IT3250046	1.6
	Trieste	Trieste	2000-2004	IT3341002	3.3
				SI5000008	7.6
	Reggio Emilia	Reggio Emilia	2004-2005	IT4030023	14.8
				IT4020027	16.2

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Country	Location	Name of Plant	Year of Establishment	SPA Code	Distance from SPA (KM)
				IT4030011	14.2
	Milano	Milano	2009	IT2050006	9.1
				IT2050401	6.1
	Livorno	Livorno	2003	IT5170002	3.1
				IT5160001	2.5
	Ospedaletto (PI)	Ospedaletto	2000	IT5170002	3.1
				IT5160001	5.8
	Trezzo sull	Trezzo sull'Adda	2002	IT2030008	14.0
	Dalmine (BG)	Dalmine	2001	IT2030008	15.8
	Messina	Messina	1979	ITA030042	0.0
	Modena	Modena	1994-1995	IT4030011	4.4
				IT4040010	16.3
				IT4040011	10.5
	Melfi (PZ)	Melfi	1999	IT9210201	7.2
				IT9210210	5.0
	Roma	Roma	1996	IT6030085	13.4
	Coriano (RN)	Coriano	1994-2001	IT5310025	8.4
Sweden	Malmö	SYSAV Sydskånes Avfallsaktiebolag	1973	DK002X110	13.7
				SE0430091	10.1
				SE0430002	14.1
				SE0430173	1.0
	Helsingborg	Filborna KVV1	2013	SE0430125	16.5
	Jönköping	Jönköping Energi	2006	SE0310221	9.6
	Karlskoga	Karlskoga Kraftvärmeverk	1986	SE0240052	1.8
				SE0240022	14.4
	Mora	Utmeland Avfallsanläggning	1981	SE0620322	8.0
UK	Runcorn	Cheshire		UK9005131	0.4

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3. Summary of air emission monitoring data from Indaver Carranstown, Co Meath.

The waste-to-energy plant at the Ringaskiddy Resource Recovery Centre will be very similar to the Indaver Carranstown, Co Meath, plant, which is currently operating. Air emission monitoring data from the Indaver Carranstown, Co Meath, plant is provided in **Figures 1,2 and 3.** The following data are provided;

- Dioxin emissions in 2012, 2013 and 2014, relative to the licensed emission limit
- Daily average emissions of all licensed substances in 2014, relative to the licensed emission limits
- Volume of pollutants emitted in 2014.

The data show that the concentration of dioxins in emissions from the plant, in the years 2012, 2013 and 2014, were substantially less than one tenth of the licensed emission limit value. For the year 2014, the daily average emissions of dust, metals, acid gases, carbon monoxide, sulphur dioxide and nitrous oxides from the facility complied with the licensed emission limit values.

Figure 1. Dioxin emissions in 2012, 2013 and 2014, relative to the licensed emission limit

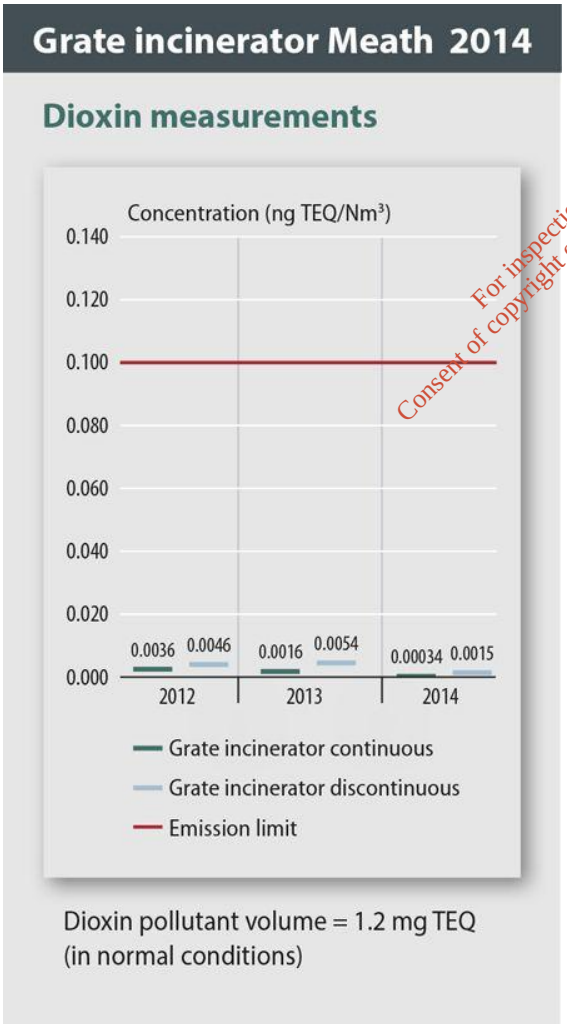

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Figure 2. Daily average emissions of all licensed substances in 2014, relative to the licensed emission limits

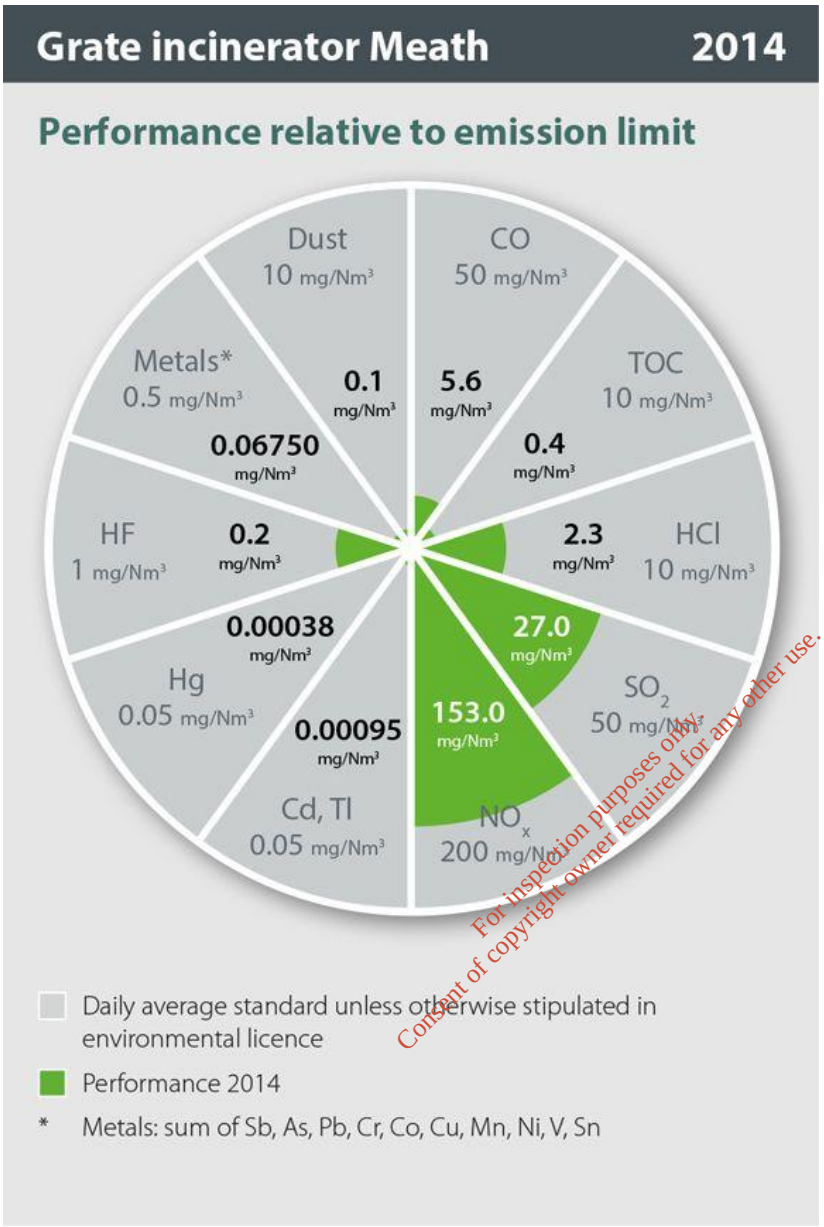

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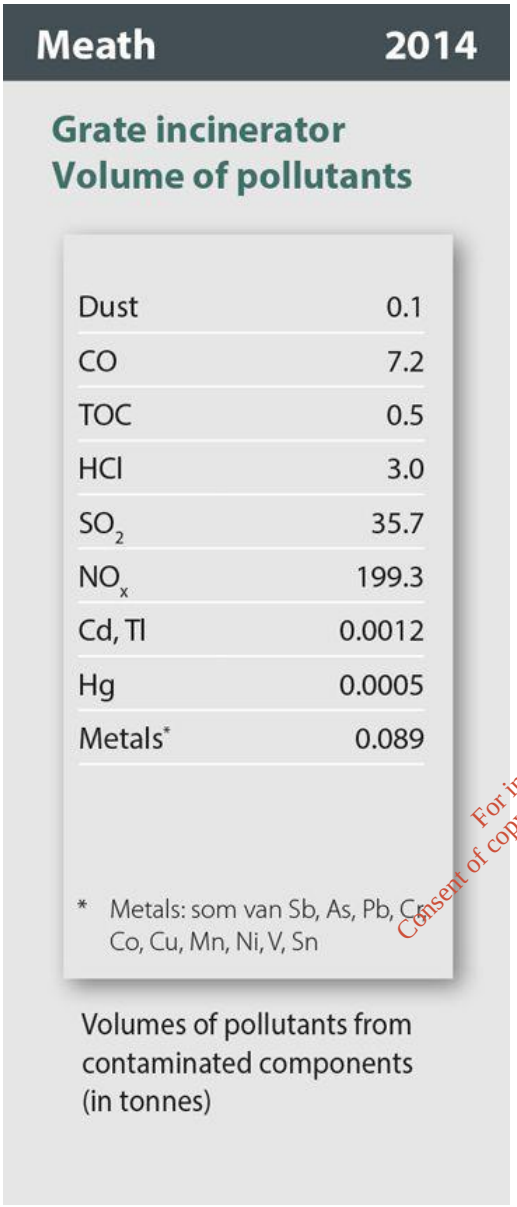
Figure 3. Volume of pollutants emitted in 2014.



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4. Potential Effects of hazardous compounds

Grate furnaces are used for the destruction of a wide variety of waste streams and are a well-recognised, robust and established technology for these purposes. Waste is burned on the grate for a period of 1 hour approximately, and the resultant flue gases must maintain a temperature of 850°C for a minimum of 2 seconds after the last injection of air to ensure complete combustion of any volatiles and unburned flue gas components. In reality the flue gas temperatures range from 850°C to 1,200°C in the combustion zone above the grate. These temperatures ensure destruction of organics and other flue gas components. Consequently a hazardous substance that is fed into the furnace does not come out unchanged as the same hazardous substance, either in the residues or in the exhaust gases. In the furnace the hazardous substance is oxidised which means it under goes a chemical reaction and is converted into one or more different substances with different properties. These different substances are removed in the ash or flue gas cleaning residues and a very small quantity is discharged to the air in the exhaust gases. Compounds such as dioxins which form after combustion is complete (and at lower temperature windows in the boiler of around 450°C) are removed by the injection of activated carbon/clay.

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Appendix 7

Introduction

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1 Introduction

1.1 Project Overview

1.1.1 Introduction

Indaver proposes to develop a resource recovery centre (including waste-to-energy facility) in Ringaskiddy in County Cork.

The proposed development will consist principally of a waste-to-energy facility (waste incinerator) for the treatment of up to 240,000 tonnes per annum of residual, household, commercial and industrial non-hazardous and hazardous waste which is currently landfilled or exported. Of the 240,000 tonnes of waste, up to 24,000 tonnes per annum of suitable hazardous waste will be treated at the facility.

In line with European Union and national policy, this residual waste will be diverted away from landfill and exports, moving the management of waste up the waste hierarchy, allowing Ireland to become more self-sufficient in the treatment of waste and reducing the environmental impact of residual waste management. The proposed development will maximise the extraction and recovery of valuable material (in the form of ferrous and non ferrous metals) and energy (in the form of 21 megawatts of electricity) resources from residual waste.

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This chapter outlines the background to the project and summarises the required planning procedure. This chapter also describes the methodology used to prepare this EIS and the consultation process that has been carried out to date. For ease of reference, the Ringaskiddy Resource Recovery Centre (including waste-to-energy facility) is referred to as “proposed development” or “Ringaskiddy Resource Recovery Centre” in this chapter and throughout the EIS.

1.1.2 Project Location

The site for the Ringaskiddy Resource Recovery Centre is located approximately 15km to the south-east of Cork City, in the townland of Ringaskiddy on the Ringaskiddy Peninsula in the lower part of Cork Harbour. The site occupies an area of approximately 13.55 hectares and is located approximately 800m east of the village of Ringaskiddy.

The L2545, the main road from Ringaskiddy village to Haulbowline Island, forms the northern boundary of the site. The eastern boundary of the site extends to the foreshore of Cork Harbour along Gobby Beach. The site surrounds the Hammond Lane Metal Recycling Co Ltd facility. Refer to **Figures 1.1** and **1.2** which show the site location.

1.1.3 Main elements of the Project

The main element of the proposed Ringaskiddy Resource Recovery Centre project is a waste-to-energy facility (waste incinerator).

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Other elements include an upgrade of a section of the L2545 road, coastal protection measures on Gobby beach, a connection to the national electrical grid, and raising the ground levels in part of the site. Refer to **Figure 1.3** for the overall site layout. A summary of proposed development as detailed in public notices is provided below.

1.1.4 Summary of proposed development as detailed in public notices

In accordance with Section 37E of the Planning and Development Act, 2000 as amended, Indaver Ireland gives notice of its intention to make an application to An Bord Pleanála for permission in relation to the proposed Ringaskiddy Resource Recovery Centre development and all associated works in the townland of Ringaskiddy, County Cork.

10 year planning permission and a 30 year operational life from the completion of the construction of the proposed development, is sought for a Waste to Energy Facility (waste incinerator) for the treatment of non-hazardous and hazardous waste on a 13.55 Hectare site owned by Indaver Ireland at Ringaskiddy, Co. Cork. In addition, the proposed development will include an upgrade to a section of the L2545 road, coastal protection measures on Gobby Beach, a connection to the national electrical grid, the raising the ground levels in part of the site; and the provision of an amenity walkway along the eastern and part southern boundary of the site

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The Development includes 13,369m² of buildings and will consist of the following elements:

A. Waste to Energy Facility consisting of: Process Building (including warehouse, workshop and admin area), 8 storeys, up to 11,255m² total floor area, up to 45.7m Maximum height above ground; Stack, up to 70m high above ground; Administration Building (including gate house), 2 storeys, up to 998m² total floor area, up to 8.2m high above ground; Aero-Condenser, single-storey, up to 482m² plan area, up to 16m high; Turbine Hall, single-storey, up to 375m² floor area, up to 16m high; Pump House, single-storey, up to 157m² floor area, up to 6m high, Firewater storage Tank, 2,200m³ volume, up to 11m high; 38 kV ESB Substation and Compound, single-storey, up to 102m², up to 5m high; 2no. weigh bridges, pipe racking, light fuel oil storage tank, packaged sewage treatment plant and ancillary site development works consisting of 57 no. car parking spaces, underground surface water attenuation tank and firewater retention tank, aqueous ammonia storage tank and unloading area, site services, 2 no. site entrances, all landscaping, boundary fences and changes to site levels to facilitate the above.

B. Upgrade to L2545 road consisting of raising a 185m length of the road by a maximum height of up to 1 metre between Gobby Beach car park and the entrance to the National Maritime College of Ireland (NMCI); upgrade of surface water drainage network in the L2545 road from the western end of the Indaver site to the eastern end of Gobby Beach car park

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C. Grid Connection consisting of: 38kV underground connection to adjacent ESB Networks Loughbeg substation located to the east of The Hammond Lane Metal Company Ltd premises

D. Increase in ground levels in western section of the site consisting of: raising a 10,000m^3 area by a maximum height of up to 2.5m above ground level

E. Coastal Protection Measures on Gobby Beach consisting of: the placement of 1100m^3 of shingle above the foreshore along the eastern boundary of the Indaver site and to be repeated every two to five years.

F. Amenity walkway along the eastern and part southern boundary of the site

A full description of the proposed development is provided in **Chapter 4 *Project Description*** of this EIS.

1.2 Background

1.2.1 The positive effects of Ireland's first large scale waste-to-energy facility

Indaver has successfully operated Ireland's first large scale waste-to-energy facility in Duleek, Co Meath since 2011. The facility treats 235,000 tonnes per annum of household, commercial and industrial non-hazardous waste and, since 2015, hazardous waste. The facility in Meath has a similar capacity to that proposed for Ringaskiddy.

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Each year since 2011, the Meath facility has diverted over 200,000 tonnes away from landfills and export, recovered over 6,000 tonnes of ferrous metals, and generated 138 gigawatt hours of electricity. The production of 138 gigawatt hours is enough to power the equivalent of 30,000 homes per annum, or a town the size of Drogheda and Navan combined. Like any large-scale industrial facility, the facility in Meath is subject to an extremely rigorous environmental and compliance regime. Its highly-designed systems are tuned to monitor 14 different individual aspects of the Meath facility continuously. Since 2011, more than 120,000 individual measurements of operations have been taken and evaluated.

Not only is the Meath facility compliant and well-run, but it is also successfully integrated in the local area. In order to provide an effective and transparent means of communication and as part of a planning condition, Indaver and the local community in Meath set up a Community Liaison Committee in 2008, whose members include representatives from the Carranstown Residents Association, local Council members, Meath County Council, and Indaver. The Community Liaison Committee has proved invaluable. It ensures that any issues that arise are quickly identified and speedily resolved.

1.2.2 A Plan-Led Development

Indaver's proposed thermal treatment facility for residual non hazardous and hazardous waste streams supports and reflects the recommendations and policies of the National Hazardous Waste Management Plan 2014-2020 and the

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Southern Region Waste Management Plan 2015-2021. Consistent with the Cork County Development Plan 2014, the proposed Ringaskiddy Resource Recovery Centre will be located in an industrial area that is also designated as a Strategic Employment Area. It will address a local need for treatment facilities while contributing to a diversity in renewable energy generation and reaffirming Ringaskiddy's strategic industrial role.

The principle of proximity underpins Indaver's choice of the site in Ringaskiddy. Cork is a hub for Ireland's pharmaceutical industry, the producers of the hazardous and non-hazardous industrial waste streams the proposed waste-to-energy facility would treat. Within the southern region, the largest population centre is Cork City, which means this is the area where the largest concentration of household and commercial residual waste is produced. In addition to this,.

1.2.3 Project History and Current Proposal

The project design has changed since the last application for permission was submitted in 2008, as Indaver has responded to the concerns raised by both An Bord Pleanála and the local community. In this application, Indaver addresses concerns about overdevelopment, localised flooding of the road, preservation of the Martello Tower as an amenity, and coastal erosion.

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The facility's footprint has been reduced significantly. Whereas the original footprint of the process building, aero-condenser and turbine proposed in 2008 was more than 14,000m^2, the current design describes a process building, aero-condenser and turbine footprint of less than 9,300m^2. Consequently, the proposed development does not constitute overdevelopment of the site. Refer to **Figure 1.4** for a footprint comparison.

The proposed development will include an upgrade of the local road (L2545) adjacent to the Indaver site to alleviate local flooding issues along the road. This upgrade will be a significant planning gain for the benefit of existing and future users of the immediate area. The proposed development will include landscaping along the southern boundary of the L2545, thus enhancing the aesthetics of the approach to Haulbowline and any future amenities there.

The ground levels of the Indaver site will be raised to alleviate localised flooding issues. It is worth noting that the Indaver site is classified as Flood Zone C[1] according to the OPW Planning Guidelines (2009) which means that the probability of flooding from rivers and the sea is low.

The facility has been angled on the site so as to keep a clear sightline (or inter-visibility) between the top of the nearby Martello Tower and Fort Mitchell on Spike Island.

An amenity walkway, incorporating a viewing platform is proposed as part of the development. This walkway will commence at the existing car park at Gobby Beach and will be located close to the eastern and southern boundaries of the proposed development site. The walkway will provide a connection from Gobby

[1] Flood Zones are geographical areas within which the likelihood of flooding is in a particular range. There are three types of flood zones defined in the OPW Planning Guidelines (2009): A, B & C. The Indaver site is located in *Flood Zone C* which is defined as "Probability of flooding from rivers and the sea is low (less than 0.1% or 1 in 1000 for both river and coastal flooding)"

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Beach towards the Ringaskiddy Martello tower. This walkway will be a significant planning gain for the benefit of existing and future users of the immediate area.

A full description of the proposed development is provided in **Chapter 4** ***Project Description*** of this EIS.

Finally, issues in relation to coastal erosion were raised by An Bord Pleanála during the course of the 2008 planning application process. The coastline along the eastern boundary of the Indaver site consists of a glacial till face adjoining Gobby Beach. In response to the issues raised by the Board, a coastal study was carried out by Arup in order to better understand the coastal processes in the vicinity of the site, the rate of erosion of the glacial till face and the specific coastal protection measures required. Coastal protection measures in the form of shingle above the foreshore on Gobby Beach are proposed along the eastern boundary of the Indaver site. Further details on these mitigation measures are provided in Chapter 13 ***Soils, Geology, Hydrogeology, Hydrology and Coastal Recession*** of this EIS.

1.3 Structure of Environmental Impact Statement

This Environmental Impact Statement (EIS) has been prepared to provide information on the likely significant effects of the project on the environment and, in particular:

1. a description of the project comprising information on the site, design, size and other relevant features of the project;
2. a description of the features of the project and/or measures envisaged in order to avoid or reduce and, if possible, offset likely significant adverse effects on the environment;
3. the data required to identify and assess the main effects which the project is likely to have on the environment;
4. an outline of the main alternatives studied by the developer, which are relevant to the project and its specific characteristics, and an indication of the main reasons for the options chosen, taking into account the effects of the project on the environment; and
5. a non-technical summary of the information referred to in the above four points.

The EIS has been prepared on behalf of Indaver by environmental specialists under the supervision of Arup.

The EIS comprises four volumes of which this is the second. The four are as follows:

Volume 1 - Non-Technical Summary

Volume 2 - Environmental Impact Statement (Main Text)

Volume 3 - Figures

Volume 4 – Appendices

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In addition, a Natura Impact Statement has been submitted with the application for permission, so as to enable An Bord Pleanála to carry out the Stage One and Stage Two assessments required pursuant to Article 6(3) of the Habitats Directive and Part XAB of the Planning and Development Act 2000, as amended.

1.4 Duration of Planning Permission

The construction of the Ringaskiddy Resource Recovery Centre including site development works will take circa 31 months. However, in view of the complexity of the development, licensing requirements and the need for the advance agreement of all conditions, Indaver is applying for a 10-year planning permission to commence and complete the construction phase.

In addition, permission is sought to operate the proposed development for an initial period of 30 years after commissioning with the option to extend the operating period for a further 30 year period, subject to obtaining a grant of permission for that extended period.

1.5 Planning Procedure for the Proposed Resource Recovery Centre

The provisions of section 37A of the Planning and Development Act 2000, as amended ("the 2000 Act"), require an application for permission in respect of the proposed Ringaskiddy Resource Recovery Centre to be made directly to An Bord Pleanála ('the Board') under Section 37E, in circumstances where the Board has determined that the proposed development is of a class specified in the Seventh Schedule to the Act and that the condition set out in section 37A (2) of the Act was satisfied.

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An Bord Pleanála has notified Indaver and Cork County Council that the proposed Ringaskiddy Resource Recovery Centre is of a class specified in the Seventh Schedule to the Act and falls within one of the paragraphs of section 37A (2). Accordingly, the application for permission is being made to the Board and not to the planning authority. Refer to **Appendix 1.1** for a copy of the letter from An Bord Pleanála.

The 2000 Act details that pre-application consultations with the Board shall form part of the process leading to the Board's determination that an application for permission should be made directly to Board. In compliance with this, and in preparation for submitting the planning application and this Environmental Impact Statement, Indaver engaged in 6 pre-application consultation meetings, between the 12th November 2012 and the 23rd November 2015.

1.6 Environmental Impact Statement Methodology

1.6.1 Statutory Requirements for the Contents of an EIS

This EIS has been prepared in accordance with the relevant provisions set out in the Planning and Development Regulations 2001, as amended ('the Regulations'), and the provisions of the codified Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the

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assessment of the effects of certain public and private projects on the environment. Annex IV to the EIA Directive and Schedule 6 to the Regulations specify the information to be contained in an EIS.

Thus, pursuant to the provisions of Article 5(1) of the EIA Directive, the information specified in Annex IV is to be provided, in as much as the information is relevant to a given stage of the consent procedure and to the specific characteristics of a particular project or type of project and of the environmental features likely to be affected, having regard to current knowledge and methods of assessment.

This EIS has been prepared in compliance with the requirements of Directive 2011/92/EU and the Regulations. Moreover, although the requirements of Directive 2014/52/EU have not yet been transposed into Irish law, this EIS has had regard to the provisions of Directive 2014/52/EU.

The format used in the EIS is the grouped format, in which each topic is addressed in a separate section. This is designed to allow readers to access the issues of interest to them as easily as possible. However there is overlap of some topics. For example, effects on human beings are addressed in a number of chapters including Landscape and Visual Assessment, Air Quality and Climate Assessment, and Noise and Vibration, as well as Human Beings. Issues not directly addressed in individual chapters and interactions between environmental issues are described in **Chapter 16 *Potential Cumulative & Other Impacts and Interactions*** of this EIS.

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1.6.2 EPA Guidelines

This EIS has been prepared with due regard to the guidelines on the preparation of environmental impact statements published by the EPA. These are contained in Advice Notes on Current Practice (in the preparation of Environmental Impact Statements) (2003), and Guidelines on the Information to be contained in Environmental Impact Statements (2002). Moreover, the EIS has been prepared having had due regard to:

- Revised Guidelines on the Information to be Contained in Environmental Impact Statements (Environmental Protection Agency, draft September 2015);
- Advice Notes for Preparing Environmental Impact Statements Draft September 2015
- European Union (2013) Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment
- European Commission (2012) Interpretation suggested by the Commission as regards the application of the EIA Directive to ancillary/associated works
- European Commission (2006) Clarification of the application of Article 2(3) of the EIA Directive
- European Commission (1999) Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions

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1.7 Consultation

Indaver has engaged in statutory pre-application consultations with An Bord Pleanála and has also consulted with the planning authority, statutory bodies, interested parties, and the local community regarding its plans for this development. For a representative list of these stakeholders, please see **Appendix 1.2 (*Consultation*).**

1.7.1 Community Stakeholder Engagement

In addition to the consultations referred to above, Indaver has consulted the public and interested parties regarding its plans for the proposed development.

Following initial discussions with representatives of the community and other individuals, Indaver proceeded to hold public engagement days in the area for all interested members of the local community.

The first information day was held between 10am and 2pm and between 4pm and 8pm on the 31st of July 2015 at the Carrigaline Court Hotel. The second information day was held in the Ringaskiddy Community Centre on the 8th of September between 4pm and 8pm. The third information day was held at Shanbally National School on the 15th of September between 6pm and 9pm.

Indaver advertised each information day in advance on the Indaver website and in a number of local papers such as *The Carrigdhoun*, *The Southern Star*, *The Evening Echo* and *The Examiner*. The Ringaskiddy Community Centre and Shanbally National School information days were also advertised on each venue's noticeboards. Indaver sent letters advertising the information days to members of the local community in July and in September. Over 300 letters were sent out on each occasion to individuals who had previously expressed interest in the project, and whose details Indaver had recorded in a communications register. A letter was sent to the same group of people in November 2015 to inform them of the closing stages of the planning preparation and possible submission in January 2016.

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Members of the project team, including the project manager, the managing director, and the manager of Indaver's Meath facility attended each day.

The project team used a series of posters and other visual aids to give an overview of the project, the planning history, and the legislative and policy context; to demonstrate how the project is complementary to other industry in the area; and to show how it is compatible with plans for the harbour more widely.

Anyone who attended the information days was invited to come to the Meath facility in order to see the day-to-day operation of a facility similar to the one proposed in Ringaskiddy. The project team also used a video of the waste treatment process in the Meath facility. The video of the waste treatment process in the Meath facility is on the Indaver website www.indaver.ie.

In addition to inviting people to the information days, Indaver has also been in contact with over 140 groups and individuals to discuss the project. These stakeholders consist mostly of business and community groups. Contact was through briefing letters and emails, over the phone, and through meetings.

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Indaver has been engaging with community stakeholders for over six months, since May 2015. Indaver has created a stand-alone website: www.ringaskiddyrrc.ie which includes all of the planning application documentation including this EIS, the Natura Impact Statement (NIS), and planning drawings etc.

Copies of an advert, letters to the local community, and an information leaflet giving an overview of the project are provided in **Appendix 1.2**.

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Appendix 8

Proposed Site and Project Description

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4 Description of the Proposed Development

4.1 Introduction

4.1.1 Overview

Indaver proposes to develop a Resource Recovery Centre in Ringaskiddy in County Cork.

The proposed development will consist principally of a waste-to-energy facility (waste incinerator) for the treatment of up to 240,000 tonnes per annum of residual household, commercial and industrial non-hazardous and hazardous waste and the recovery of energy. Of the 240,000 tonnes of waste, up to 24,000 tonnes per annum of suitable hazardous waste will be treated at the facility. The proposed development will maximise the extraction and recovery of valuable material (in the form of ferrous and non-ferrous metals) and energy (in the form of 21 megawatts of electricity) resources from residual waste.

In addition to the provision of the waste-to-energy facility, the proposed development will include an upgrade of a section of the L2545 road, a connection to the national electrical grid, an increase in ground levels in part of the site, coastal protection measures above the foreshore on Gobby beach and an amenity walkway towards the Ringaskiddy Martello tower.

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This chapter presents a description of the proposed Ringaskiddy Resource Recovery Centre development.

The site location and neighbouring land uses are described in Section 4.2. Principal design objectives and design constraints are presented in Sections 4.3 and 4.4. The main features of the proposed development are described in Section 4.5. Sections 4.6 to 4.16 describe the operations, processes and controls, site services, site management, health and safety and decommissioning of the waste-to-energy facility.

4.2 Site Location and Neighbouring Land Uses

4.2.1 Site Location

The site for the Ringaskiddy Resource Recovery Centre is located approximately 15km to the south-east of Cork City, in the townland of Ringaskiddy on the Ringaskiddy Peninsula in the lower part of Cork harbour. Refer to **Figures 1.1** and **1.2** in **Chapter 1** ***Introduction*** of this EIS which show the site location.

The L2545, the main road from Ringaskiddy village to Haulbowline Island forms the northern boundary of the site. The eastern boundary of the site extends to the foreshore of Cork harbour along Gobby Beach. The lands to the immediate south and west are in agricultural use. The site surrounds the Hammond Lane Metal Recycling Co Ltd facility. The site is located approximately 800m east of the village of Ringaskiddy.

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4.2.2 Existing Site Description

The site covers an area of approximately 13.55 hectares and is situated on a north-facing slope. The land rises from north to south, and also generally from east to west. The lowest elevation is approximately 2.05-3.0m Ordnance Datum (OD) along the northern boundary with the local road. The highest point is approximately 41.0m OD along the southern site boundary in the vicinity of the Martello Tower, which is in the adjoining field to the south. The site is currently covered in scrub with some pockets of trees and open grass areas. Refer to **Figure 4.1** which shows the existing site layout

The overall outer boundary of the site is roughly rectangular in shape with narrower sections at the eastern and western ends, and with the Hammond Lane Metal Recycling Company Ltd metal/scrap processing yard located centrally within the site with its own direct access from the local L2545 road to the north. Although this yard is located centrally within the Indaver site, it does not form part of the site. There is also an ESB Networks compound located between the eastern boundary of the Hammond Lane facility and the Indaver site. Refer to **Figures 4.1** and **4.2** which show the existing site layout.

The site can be divided into six areas as described below. Refer to **Figures 4.1** and **4.2** which show the existing site layout. Refer also to **Figures 4.3** to **4.6** which show the site in context in the surrounding environment.

Area 1: An area of flat ground along the northern site perimeter to the west of the Hammond Lane Metal Recycling Company entrance. This flat ground is under arable cultivation. This area is referred to as "*western fields*" in this EIS.

Area 2: An area of scrubby land which extends east from the Hammond Lane Metal Recycling Company entrance to the top of the glacial till face which adjoins Gobby Beach at the harbour edge and to the eastern portion of the southern site boundary. This area is largely covered in gorse and brambles interspersed with small patches of grassland. A farm track runs through this area from the L2545 to the southern boundary of the site. This area to the east of Hammond Lane is referred to as "*waste-to-energy facility*" in this EIS. There is a small rectangle of land not in Indaver's ownership in Area 2 that is encircled by the site. Refer to **Figures 4.1** and **4.2. (**No development is proposed within this small rectangle of land as part of the Ringasdkiddy Resource Recovery Centre).

Area 3: An area of land in pasture along the high southern perimeter of the site. This widens towards the west, sloping sharply down to the north-western corner of the site.

Area 4: An area of dense undergrowth growing across the centre of the site where the slope is steepest. This overgrown section extends west behind (and to the south of) the Hammond Lane Metal Recycling Company. The upper slopes at the western side are overgrown with trees.

Area 5: This is the area within Indaver ownership encompassing the L2545 local road and Gobby Beach carpark along the northern boundary of the site

Area 6: This is the Gobby beach area within Indaver ownership above the foreshore. The coastline along the eastern boundary of the Indaver site consists of a glacial till face adjoining Gobby Beach. The glacial till face is very shallow

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near the public carpark to the north and steepens to the south to a maximum of 10-12m high.

4.2.3 Immediate Vicinity

The site encircles the Hammond Lane Metal Recycling Company facility. The facility contains several metal buildings, concrete walls, and some large pieces of machinery. Hammond Lane expanded its facilities in 2015. There is also an ESB Networks compound located adjacent to the eastern boundary of the Hammond Lane facility. Refer to **Figures 4.1** to **4.6**.

The L2545 is an extension of the N28 that leads from Ringaskiddy past the proposed development site and over the bridge to the crematorium on Rocky Island and Haulbowline Naval base.

The Irish Maritime and Energy Research Cluster (IMERC) campus is being developed on the northern side of the L2545 road, which forms the northern boundary of the site. IMERC is supported by University College Cork, Cork Institute of Technology and the Irish Naval Service. The National Maritime College of Ireland (NMCI), the first major component of IMERC, opened in 2004. The Beaufort Research Laboratory (construction completed in 2015), is located on the site to the east of the National Maritime College of Ireland, will be IMERC's second major building. Further developments for IMERC will be located on the remainder of the land to the east of the National Maritime College of Ireland (refer to **Figures 4.3 to 4.6**).

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Some warehouses are located on the northern side of the L2545 road, to the west of the National Maritime College of Ireland.

The land to the immediate south of the Indaver site is owned by IDA Ireland and is in agricultural use. Refer to **Figures 4.3 to 4.6**. Just beyond the southern boundary, the site is further visually defined by the high voltage electricity line that runs west overhead to connect with the ESB sub-station near Shanbally and east (then north) to Haulbowline Island. Further to the southwest, the land continues to rise slightly to create the ridgeline on which a Martello Tower is located at the highest point (43m OD).

The land to the west of the site is in agricultural use. Further to the west there is a single, large, white-painted residential property (Ring House) located approximately 50m from the boundary, set within a field and surrounded by trees.

The eastern section of the M28 Cork to Ringaskiddy Motorway Scheme is proposed to cross the far western part of the Indaver site. The scheme, proposed by Transport Infrastructure Ireland (TII) (formerly the National Roads Authority) has not yet been published. Refer to Figure 4.7 which shows an indicative location of the proposed M28 Cork to Ringaskiddy Motorway Scheme in the vicinity of the Indaver site.

4.2.4 The Wider Area

The centre of Ringaskiddy village is located approximately 800m to the west of the site of the proposed development. The Port of Cork's port facilities are located to the north of Ringaskiddy village.

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The Ringaskiddy peninsula is industrial in character, with a number of pharmaceutical companies having large manufacturing facilities in the area, in addition to the Port of Cork facilities. The locations of some of these industries are shown in **Figures 4.3 to 4.6**. Recent additions to the Ringaskiddy area include three 100m hub-height wind turbines, located on industrial sites. A fourth similar wind turbine has received planning permission. The DePuy wind turbine is located to the south of the Indaver site

The Cork Harbour area has a mixture of urban developments, such as Cobh, Rushbrooke and Monkstown, and pockets of industry near the shore. Spike Island is located approximately 500m to the east of the site, with the disused Fort Mitchell prison being situated there. There is an Irish Naval Service base situated on Haulbowline Island (refer to **Figure 4.3**) and a crematorium on Rocky Island. Both islands lie to the north of the site.

4.3 Principal Design Objectives

4.3.1 Waste-to-Energy Facility

The principal design objectives for the waste-to-energy facility can be summarised as:

- the facility should treat industrial hazardous and non-hazardous waste and municipal solid waste with energy recovery.
- the facility's capacity should be selected to ensure that the incentive to minimise waste is maintained.
- the technology should be robust and adaptable to the small and changing Irish market.
- safety and environmental protection should be given the highest priority.
- the existing need for waste management facilities should be addressed, in conformance with Irish Government and EU policy, in a sustainable manner.
- the facility should meet all current and foreseeable future regulatory standards.
- the facility must be BAT in accordance with the Integrated Pollution Prevention and Control Reference Document on the Best Available Techniques for Waste Incineration (BREF) (EC 2006) and the requirements of the Industrial Emissions Directive 2010/75/EU.
- the facility's construction and operation should minimise resource consumption and the generation of waste.
- the facility should optimise existing site features and have the minimum feasible impact on the neighbourhood.

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4.3.2 L2545 Road Upgrade

The principal design objective for the upgrade of the L2545 road is to improve the surface water drainage so that the road does not flood after prolonged rainfall and to raise the level of the road above the 1:200 year tidal event with an added allowance for climate change.

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4.3.3 Increase in levels of the Indaver site

The principal design objective for raising the ground levels of the Indaver site is to raise the levels above the 1:200 year tidal event with an allowance for climate change. The site is not indicated in the Carrigaline Local Area Plan 2011 zoning map for Ringaskiddy as being in Flood Zone A or B. It is worth noting that the Indaver site is classified as Flood Zone C[1] according to the OPW Planning Guidelines (2009) which means that the probability of flooding from rivers and the sea is low.

4.3.4 Coastal Protection Measures

The principal design objective for the coastal protection measures is to reduce the rate of erosion of the glacial till face, which forms the eastern boundary of the Indaver site, while minimising the impact on recreational users of the beach and on the adjoining coastline to the north and south. The design of the coastal protection measures include an allowance allow for climate change. The proposed waste-to-energy facility is not reliant on these coastal protection works.

4.4 Design Constraints

4.4.1 Site Use

The site is approximately 13.55 hectares. The location of the Hammond Lane Metal Recycling Company and ESB Networks compound premises divides the site into two distinct parts, one to the east and one to the west. The layout of the waste-to-energy facility will be confined to the eastern part.

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The topography of the site imposes other constraints, particularly on access to the upper part, to the south and west of the Hammond Lane Metal Recycling Company. However, the topography also presents the opportunity to use the difference in level to facilitate gravity feeding of waste into the bunker.

The works proposed to connect into the National Grid are confined to the land owned by Indaver.

4.4.2 Building Height and Building Location

To help to minimise the visual impact of the waste-to-energy facility, the building height was reduced to the practical minimum in the context of the available technology for facilities such as these. More detail is provided in **Chapter 11 *Landscape and Visual Assessment*** of this EIS. Refer also to **Appendix 4.5** (***Architectural Design Report***)

The design of the main waste-to-energy process building is based on a straight line process. The axis of the process building preserves the views from the Martello tower. In addition, design of the main process building is broken down

[1] Flood Zones are geographical areas within which the likelihood of flooding is in a particular range. There are three types of flood zones defined in the OPW Planning Guidelines (2009): A, B & C. The Indaver site is located in *Flood Zone C* which is defined as “Probability of flooding from rivers and the sea is low (less than 0.1% or 1 in 1000 for both river and coastal flooding)”

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into a series of irregular block shapes to reduce visual impact. Colours have been used to integrate the building shapes into the adjacent landscape

4.4.3 L2545 Road Upgrade

The upgrade works to the L2545 are confined to the land owned by Indaver and a narrow strip owned by Hammond Lane. The upgraded road must tie into the levels of the access roads to the adjoining premises and the existing road levels at either end of the upgrade.

4.4.4 Coastal Erosion Protection Measures

The coastal protection measures are confined to the land owned by Indaver, above the foreshore.

4.5 Main features of the Ringaskiddy Resource Recovery Centre

The proposed development will consist principally of a waste-to-energy facility (waste incinerator).

In addition, the proposed development will include an upgrade of a section of the L2545 road, a connection to the national electrical grid, an increase in ground levels in part of the site, coastal protection measures above the foreshore on Gobby beach and an amenity walkway to the Ringaskiddy Martello tower. These are all described in detail below.

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4.5.1 Overview

The waste-to-energy facility will treat up to up to 240,000 tonnes per annum of hazardous and non-hazardous residual household, commercial and industrial waste which is currently landfilled or exported. Up to 24,000 tonnes per annum of suitable hazardous waste will be treated at the facility. The facility will maximise the extraction and recovery of valuable material (in the form of ferrous and non-ferrous metals) and energy (in the form of 21 megawatts (MW) of electricity) resources from residual waste.

Waste-to-energy (or incineration) is the burning of waste at high temperature, in a carefully controlled environment, using the heat to generate electricity. Incineration does not destroy waste, but converts it to ash, a large proportion of which is suitable for recovery or recycling, for example in road construction. Ferrous and non-ferrous metals within the ash can also be recovered for recycling. These processes are described in more detail below in Section 4.6.

The heat produced by the combustion process will be recovered and will generate approximately 21 megawatts of electricity of which up to 18.5MW will be exported to the National Grid. The electricity produced by the waste-to-energy facility will be enough to supply the power needs of approximately 30,000 households.

The main elements of the waste-to-energy facility are described below and include:

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- Main process building, with a stack extending to 75mOD
- Turbine hall and aero-condenser structure
- Security building/gate house and weighbridges
- Administration building
- Firewater storage tank and pump house
- Surface water attenuation tank and firewater retention tank
- Light fuel oil storage tank, aqueous ammonia storage tank and unloading area
- Aqueous waste storage tank and tanker unloading area
- Electricity substation, compound and grid connection
- Emergency access
- Site lighting

Refer to **Figures 4.7 to 4.10** for the overall layout plans of the proposed development. Refer to the planning application drawings for the building details. An outline description of the buildings is provided below. Note: the dimensions provided below are rounded to the nearest 0.5m. Refer to the planning application drawings for further details.

The other elements of the proposed development include:

- Public amenity footpath
- L2545 road upgrade
- Increase in levels on site
- Coastal protection measures
- Diversion of services

These are all described in detail below.

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4.5.2 Main Process Building

The main process building will be circa 176m x 81m approximately, in plan. The building height will be up to 50.7m metres above Ordnance Datum (mOD (Malin) The ground floor level will vary from circa 0 to circa 10 metres OD. The bunker will be of reinforced concrete. The bunker floor will be constructed as a concrete watertight basement. In the event of a fire in the building, this area will act as a firewater retention tank.

The main part of the building will be largely a single space, with sub-divisions as required by the process.

The furnace, boiler and flue gas cleaning equipment will be located in the building. The bottom ash handling area will be located in the building at the south side. The boiler feed water treatment equipment, boiler feed water tank, will be located between the boiler and the steam condensate area within the building. The transformers and high voltage switch room will be located in the building along the northern side. The lime silo, boiler ash silos, flue gas cleaning residue

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silos and activated carbon or activated clay storage area will be located inside the building along the south side.

The waste bunker and the tipping hall will also form single storey spaces. The floor of the waste bunker will be at circa 0mOD and the floor of the waste reception hall will be at circa 10mOD. Waste, discharged into a chute in the wall/floor of the tipping hall, will be gravity fed into the waste bunker. The multi-storey portion will house offices, locker rooms, the control room/crane operator room, a laboratory canteen and offices.

A room to house the stack emission monitoring equipment will be located the sixth floor under the roof. It will be adjacent to the stack, in the main building. This room will be accessible by stairs. The circular shaped stack is attached to the main process building and there will be access from the emissions monitoring equipment room to the sampling points on the stack. The top of the stack will be at 75mOD. The top of the stack will be indicated by white strobe (flashing) obstacle warning lights. The lights will be incandescent or of a type visible to Night Vision Equipment. The lights will emit light at the near infra-red (IR) range of the electromagnetic spectrum specifically at or near 850 nanometres (nm) of wavelength. Light intensity to be of similar value to that emitted in the visible spectrum of light.

The tipping hall will be enclosed and trucks carrying waste will enter the reception hall through doors at its southern side. There will be six chutes in the western wall/floor of the tipping hall into which waste will be tipped therefore a number of trucks will be able to empty the waste into the reception hall over a short period of time. The tipping hall and waste bunker will be under negative pressure with the air extracted from these spaces used for primary combustion air. This will also minimise the risk of odours leaving the building.

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The workshop will be located on the northern side of the main process building. The floor level will be at circa 5mOD and the workshop will be approximately

16.5m long by 10m wide by 8m in height. The workshop will be used by the maintenance team on site for repairs and will contain tools and equipment such as a welding facility, grinders etc.

The warehouse will be located underneath the tipping hall.. The floor level will be at circa 5mOD and the building will be approximately 40m long by 13.5m wide by 4m in height. The warehouse will be used for the storage of spare parts and consumables such as personal protective equipment.

A perimeter access road surrounds the main production building providing vehicular access to the main building as well as other buildings on site.

On the north east side of the main process building there will be a multi-storey admin area that will house the production team for the operation of the facility. This will include offices, changing facilities, meeting rooms, the main control room and a laboratory for testing of incoming and outgoing waste streams.

There will be a nitrogen generator and nitrogen buffer storage vessel located just to the south of the process building.

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4.5.3 Turbine Hall and Aero-Condenser structure

The turbine hall will be located to the rear and south of the main process building. It will be approximately 25m by 15m and circa 16m in height. An aero-condenser structure will be located adjacent to the turbine hall. This structure will be approximately 35m by 15m and circa 16m high. It will support the air cooled condenser fans and will be open to allow free air flow.

4.5.4 Security building / gate house and weighbridges

The security building will form part of the administration building. It will accommodate the site security. The drivers of waste trucks and tankers will report to the security staff on arrival at the waste-to-energy facility. The only exception will be some truck drivers on long term contracts, carrying non-hazardous waste, who will access the facility using swipe cards. The security building will also have toilet facilities for truck drivers. Further details on traffic management of the waste trucks entering and departing the site are provided in in **Chapter 7 *Roads and Traffic*** of this EIS.

Two weighbridges will be located close to the waste-to-energy facility entrance, situated at the north-western part of the site. All trucks will be weighed on entering and before leaving the facility.

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4.5.5 Administration Building

The administration building will be a two-storey building located to the west of the main entrance. The building will primarily contain office space and meeting rooms for staff but will also have a visitors' centre and a training centre. Parking for 57 cars will be provided adjacent to the admin building.

The training centre will include a high-tech, multi-media training facility. Using the Indaver German Training Centre model, this facility will provide courses for industrial customers in areas such as; Dangerous Goods, Transport Safety & Legislation, Waste Legislation and Packaging of Waste. The Centre will also provide opportunities for waste education for second and third level institutes. With a high-tech laboratory on site, Indaver could also provide training in the analysis of waste composition.

The visitor centre will act as a gateway to the site, showcasing best practice in resource recovery management and sustainability. Indaver will strive to deliver a high quality, exciting experience for visitors. A viewing area will give visitors a 'birds-eye' view of the site. As the owners of Ireland's first waste-to-energy facility, Indaver understands and values the importance of education. Since Indaver has opened their gates of the Meath facility in 2011, they have welcomed more than 2,000 visitors onsite.

4.5.6 Fire water storage tank and pump house

A tank will be provided for the storage of water to be used for firefighting. The tank and associated pump house will be located to the south of the main process building. The floor level of the pump house will be at circa 11mOD and the building will be approximately 17m long by 9.25m wide by 6m in height. The

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pump house will accommodate the fire-fighting water pumps and process water pumps.

4.5.7 Surface water attenuation tank and firewater retention tank

A surface water tank and a firewater retention tank will be provided. Both tanks will be located underground beneath the administration building car park to the west of the main entrance.

4.5.8 Light fuel oil storage tank, ammonia storage tank and unloading area

A double skinned tank for the storage of light fuel oil will be located south of the process building. Light fuel oil will be used to heat up the waste-to-energy facility to conditions ready for waste and the keep the incineration temperature above 850°C during operation on waste. An aqueous ammonia tank will be located to the east of the fuel oil storage tank. Aqueous ammonia is used as a reagent for the reduction of nitrogen oxides in the flue gases as described in Section 4.7.4 below.

Directly to the north of the light fuel oil storage tank a common unloading area will be provided for deliveries of both light fuel oil and aqueous ammonia. This area will be contained in the event of any leaks or spills during unloading operations.

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4.5.9 Aqueous waste storage tank and unloading area

Aqueous wastes referred to in this document includes liquid wastes such as water waste streams with mixed solvents and/or inks, contaminated water from fire fighting and clean up operations, storm water and leachate from landfill sites etc. Solvents referred to in this document are solvent streams with a high water content.

A double skinned tank for the storage of aqueous waste will be located to the east of the light fuel oil storage tank. Aqueous waste deliveries will either be unloaded directly into the tank or fed to the furnace directly (direct injection). Unloading time will be approximately 1 hour into the tank and up to 24 hours when fed by direct injection. The feeding rate from the storage tank and by direct injection will be the same and fully controllable up to a maximum of 1.5 tonnes per hour.

The unloading area will be located to the west of the storage tank and will be designed to contain any potential spills or leaks from unloading operations. An overhead gantry will be provided to facilitate sampling and inspection of the tankers delivering aqueous waste.

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4.5.10 Electricity substation building, compound and grid connection

4.5.10.1 Electricity substation building and compound

The electricity import/export substation and compound within the Indaver site will be located east of the main entrance to the waste-to-energy facility.

The electricity import/export substation will be approximately 15m by 5m in size and will contain the electrical switchgear, protection relays, current transformers and voltage transformers and a transformer; all associated with the import/export of electricity from the facility from/to the national grid. The compound will be divided into two adjacent parts. One part of the compound will be dedicated to the infrastructure required by ESB Networks and will also contain a substation building for the ESB metering and associated equipment.

The other part of the compound (dedicated for Indaver's equipment) will be directly adjacent and will contain the transformer required to step down the voltage from 38kV to 10kV and other associated equipment such as switchgear, protection relays, current transformers and voltage transformers. Indaver will also have a substation building which will be built adjacent to the one required by ESB. The entire compound will be fenced and the two parts will be separated by a fence.

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4.5.10.2 Grid Connection

The waste-to-energy facility will be connected to the national electrical grid via the 38kV electrical substation (known as Lough Beg substation) adjacent to the eastern boundary of the Hammond Lane facility. This connection method has been determined by a feasibility study carried out by ESB Networks (Refer to Appendix 3.2). Based on discussions with ESB Networks, the connection will simply be an extension of the 38kV line into the ESB side of the proposed Indaver electricity compound as this line currently terminates at the existing Lough Beg substation. ESB Networks have confirmed that the extension of the 38kV line into the Indaver site can be over ground or underground. Indaver have selected the underground option and the proposed routing for the underground lines has been identified on the drawings. The routing has been designed in compliance with ESB guidelines and standards. The grid connection will be made by running underground cables from the ESB side of the Indaver electricity compound to the Lough Beg substation.

The lands over which the entire grid connection will be constructed lie within Indaver's ownership (save for a small section comprising associated works on the adjacent Lough Beg substation owned by ESB Networks). These works will be carried out by ESB Networks and do not form part of the planning application.

Based on the discussions with ESB Networks in relation to the connection of the 38kV cable within the ESB Networks lands, there is the possibility to connect in two ways and the decision as to which way will be decided in the detailed engineering phase by ESB Networks

- *Option 1: Cable Connection within the ESB Lough Beg substation building.*

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This involves a trench of approximately 5m to be excavated on the ESB side of the substation fence that will meet up with the trench that will be excavated on the Indaver lands from the new Indaver substation building to the ESB fence. The underground cable will then emerge in the Lough Beg substation building and be connected to the existing busbar within the distribution board. There shall be some electrical switchgear for protections as per the ESB standards/specifications along with metering equipment that shall allow ESB to monitor usage on both import and export of power.

- *Option 2: Cable connection directly to cable on existing end mast*

  Much like option one this involves a trench of approximately 5m to be excavated on the ESB side of the substation fence that will meet up with the trench that will be excavated on the Indaver lands from the new Indaver substation building to the ESB fence. The underground cable will then emerge in the Lough Beg substation building. This cable shall then be connected to some electrical switchgear for protections as per the ESB standards/specifications along with metering equipment that shall allow ESB to monitor usage on both import and export of power. The cable shall then exit the Lough Beg substation via a second trench that will be excavated between the Lough Beg substation building and the mast that carries the existing 38Kv power line from the Barnahely substation. This trench shall be approximately 5m in length and will be within the ESB Networks Lough Beg substation lands. The underground cable will then emerge next to the existing mast and shall be connected directly to the existing 38kV line via a standard T connection, this form of connection is possible on an end mast like the one situated in the Loughbeg substation.

Due to the layout of the facility, there will be no requirement to divert the existing 38 kV lines which traverse the site.

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4.5.11 Emergency access

Emergency access is provided through the main entrance on the left and right hand sides of the weighbridges. In addition, an emergency access will be provided to the facility in the event that the main access point is blocked. This will be located to the east of the main access road and will be reserved for use by the emergency services.

4.5.12 Site Lighting

Site Lighting will include a mixture of 8m high pole mounted and building mounted lights to light up entrances and roads with full cut off LED light head fixtures to reduce any light pollution into the surrounding area. There will be 3 number low intensity obstacle lights at the top of the stack, as described in Section 4.5.2 above.

4.5.13 Public amenity footpath

A public amenity footpath and viewing gallery, located outside the facility's security fence, will be provided along part of the southern and eastern site boundaries to allow public access between the Martello tower and Gobby Beach car park. Refer to **Chapter 11 *Landscape and Visual*** of this EIS for a more detailed description.

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4.5.14 L2545 Road Upgrade

The proposed upgrade works to a section of the L2545 local road, which adjoins the northern boundary of the site, will consist of raising a section of the road and improving the surface water drainage to alleviate local flooding issues along the road.

4.5.14.1 Background to flooding issues on the L2545

The existing levels of the road along the northern boundary of the Indaver site are set at circa 2.4m to 2.95m OD. Based on a review of all available information, the predicted 1 in 200 year design tidal level has been estimated as 2.73m OD. Sections of the road close to the Gobby beach car park are below this level and are therefore at risk of tidal flooding during a 1 in 200 year tidal event.

Based on a review of the historic flooding of the road, discussions with Cork County Council, and the preliminary flood risk assessment mapping produced by the OPW, there is a significant risk of pluvial flooding of the road during periods of heavy rainfall combined with high tide.

The existing storm water drainage system along the road consists of a 450mm diameter pipe which outfalls to the sea at Gobby Beach. There are a minimal number of gullies along the road to accept water and transfer it to the storm water sewer. Therefore, it can be concluded that the existing formal drainage system along the road is inadequate. The dominant drainage mechanism for the road is “over the edge” drainage to the Indaver site on the south side of the road. A number of channels have been cut in the berm on the southern side of the road which allow surface water runoff from the road to discharge directly into the Western Fields area of the Indaver site.

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The invert level of the outfall is -0.28mOD. As the level of the tide rises above this elevation the drainage system can become tide locked if there is insufficient differential head at the outfall. When this occurs the surface water which has reached the pipe is unable to discharge through the outfall and collects in the drainage pipe. The discharge pipe becomes surcharged and any subsequent rain water falling on that area of the road normally drained by the existing gullies cannot drain away and causes the road to flood. This area of the road is located adjacent to the entrance to the public car park at Gobby beach.

The L2545 upgrade has been designed to address the above issues.

4.5.14.2 Description of L2545 upgrade

The proposed L2545 upgrade works will include raising a 185m section of the road to a maximum height of 3.45m OD between the car park and the eastern end of the Hammond Lane Metal Company. This is approximately 1.0m above the existing road level. This will elevate the road to above the 200 year design tidal water level plus an allowance for climate change. This will offer a high level of protection to the road from tidal flooding. The road will be raised over a length of approximately 185m in order to ensure a smooth transition down to existing road levels, in accordance with road design standards. The recently constructed footpath on the northern side of the road will also be raised to the new road level.

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The proposed road drainage network upgrade will extend along the entire northern boundary of the Indaver site. It has been designed to cater for the 7 hours when the storm water outfall is tide locked by a 200 year design high tide, 2.73m top water level (TWL), combined with a 1 in 30 year rainfall event plus an allowance for climate change.

A 260 metre length of new linear concrete surface water channel will extend from the western boundary (of the western field area) of the Indaver site, running along the southern edge of the L2545 until it meets the entrance to the Hammond Lane Metal Company. This section of the L2545 is currently super-elevated – i.e. the camber on the road falls from north to south, therefore surface water drains to the south. This section of the L2545 will not be raised as the existing levels are already above the predicted 1 in 200 year design tidal level (2.73m OD). The new surface water channel will be drained at regular intervals by gullies which will outfall to the existing 450mm diameter surface water sewer beneath the road. Therefore surface water will no longer flow from the road into the Indaver site (western fields) to the south.

The raised section of the L2545 between the car park and the eastern end of the Hammond Lane Metal Company will be drained by a kerb and gully sealed drainage system which will be connected to two new surface water pipes underneath the road. The two 1500mm diameter pipes will be approximately 190m in length and will provide 660m^3 of surface water storage. There will be three large concrete chambers constructed on the line of the twin surface water pipes at the start middle and end of the run. The first two chambers will be situated in the road and the terminal chamber will be constructed at the entrance to the car park by Gobby Beach. The recently constructed surface water drainage system on the Haulbowline road will be diverted into the terminal chamber. This chamber will be connected to the existing 450mm diameter surface water sewer via a short length of new 450mm diameter pipe, a new Class 1 bypass hydrocarbon interceptor and a new manhole constructed on the line of the existing pipe. This will allow the upgraded surface water drainage system to discharge to sea via the existing 450mm surface water outfall at Gobby Beach.

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All of the above works will be within Indaver ownership, apart from a small area in Hammond Lane ownership. Consent has been given by Hammond Lane to undertake these works.

4.5.15 Increase in levels of the Indaver site

The ground levels of the Indaver site vary considerably in both the north-south direction and the east-west direction. Along the southern boundary of the site the levels vary from circa 10m OD to circa 41m OD. Along the northern boundary of the site the ground levels vary from circa 2.05m OD to circa 4.0m OD. As discussed above, the 1 in 200 year design tidal level has been estimated as 2.73m OD.

The levels of the low-lying parts of the site will be raised to 4.55m OD. The ground levels in the western fields area of the site consisting of a 10,000m^3 area will be raised by a maximum height of 2.5m above ground level. A small area of land within the waste-to-energy side of the site adjacent to the L2545 road will also be raised to 4.55m OD. This level will offer a very high standard of flood protection to the site. The calculation of this level has been determined as follows:

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The minimum site flood defence level was calculated at 4.28m OD Malin. This levels allows for 2.73m (200 year tidal level) plus 1.05m (climate change) plus 0.5m (freeboard).

For climate change, the OPW Draft Guidance on the "Assessment of potential future scenarios for Flood Risk Management" suggests the use of two scenarios, a mid-range future scenario (MRFS) and a high end future scenario (HEFS). The MRFS represents a likely future scenario which is within the bounds of the widely accepted projections. The HEFS is a more extreme, but plausible future event, and is within the upper bounds of the widely accepted projections.

The proposed 1.05m allowance for climate change allows for the high end future scenario.

It was decided to use an even more conservative site flood defence level of 4.55m OD given that that a number of recent developments close to the site in Ringaskiddy (Beaufort Research Laboratory and IMERC) have already utilised this level. The 4.55m OD level will offer a very high standard of flood protection to the site.

Further details on flood risk are provided in **Appendix 13.4 *Flood Risk Assessment.***

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4.5.16 Coastal Protection Measures

Coastal protection measures in the form of shingle above the foreshore on Gobby Beach are proposed along the eastern boundary of the Indaver site.

The coastline along the eastern boundary of the Indaver site consists of a glacial till face adjoining Gobby Beach. The glacial till face is very shallow near the public car park to the north and steepens to the south to a maximum of 10-12m high. Issues in relation to coastal erosion were raised by An Bord Pleanála during the course of the 2008 planning application process. In response to the issues raised by the Board, a coastal study was carried out by Arup in order to better understand the coastal processes in the vicinity of the site, the rate of erosion of the glacial till face and the specific coastal protection measures required. The coastal erosion study undertaken included an evaluation of the retreat rate of glacial till face based on historical information and surveys. Numerical wave modelling, a wave run-up assessment and beach sediment transport assessment were carried out.

The study found that the proposed development would not increase the current rate of erosion of the glacial till face.

As part of the study, a very conservative rate of erosion was applied to the site in order to assess whether the proposed development could be impacted over the duration of the planning permission (40 years in total). The study found that there would be no impact on the proposed development after 30 years. The study found that there could be a risk of an impact on a small section of the proposed development after 40 years however this would be confined only to the amenity walkway and a small section of a diverted gas pipeline outside of the fence line. The waste-to-energy facility would not be impacted by coastal erosion during the duration of the planning permission.

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Indaver engaged with Gas Networks Ireland (GNI) in relation to the proposed diversion route within the Indaver site. GNI confirmed that they were satisfied that the proposed gas diversion route was feasible.

Coastal protection mitigation measures are not required for the waste-to-energy facility element of the development. However, given the concerns raised by An Bord Pleanála and given the low risk that the amenity walkway and a section of the diverted gas pipeline could be impacted in 40 years' time, coastal protection measures have been included in this planning application as a precautionary measure so as to reduce the rate of erosion of the glacial till face.

The protection measures will consist of the placement of approximately 1100m^3 of shingle (of appropriate size and shape (rounded) above the foreshore on Gobby beach along the eastern boundary of the Indaver site. This will be a 'soft' solution which will reduce erosion rates by increasing beach levels i.e. reducing near shore water depth and wave heights and will protect the glacial till face from breaking waves.

The addition of sacrificial material such as shingle, is well-recognised worldwide as a coastal engineering solution. The net coastal sediment transport will go from south to north according to wind conditions and swell, therefore the material is likely to move towards the north in the medium and long-term. The Cork Harbour Special Protection Area (SPA) is located to the south west of the site therefore the sacrificial material will not impact on the SPA.

Further details on these mitigation measures are provided in Chapter 13 ***Soils, Geology, Hydrogeology, Hydrology and Coastal Recession*** of this EIS.

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4.5.17 Diversion of services

4.5.17.1 Diversion of services along the L2545 local road

The known underground services are a 450mm diameter watermain, 220kV electricity cables, 4 bar 125mm gas transmission main, public lighting cables, Eircom underground cables and Enet fibre optic cables. There is also an overhead electricity line crossing the road. There is only a marginal increase in road level (circa 100mm) at this location. The public lighting columns at the northern edge of the footpath, on the northern edge of the road, will have to be raised to match the new road level and the associated duct chambers will also be raised to match the new footpath level.

New Eircom ducting is proposed for the northern road verge to allow Eircom cables to be locally diverted within the road. The gas main will also be locally diverted within the road. The existing surface water drainage from the Haulbowline road will be diverted into the new surface water system as described above. The 450mm diameter watermain will also be diverted along the section of road to be raised between the car park and east of Hammond Lane. All of the utilities providers have been consulted in relation to the proposed diversions.

The 220kV power lines and corresponding ESB telecoms fibre optics cables beneath the L2545 may need to be raised as a result of the raising of the L2545. Both ESB Networks and EirGrid have been consulted in relation to the proposed works. ESB networks will carry out a thermocouple temperature study of the existing cables to determine if the power capacity of the cables will be derated

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because of the works. A number of potential solutions have been identified by ESB Networks if it is determined that the cables will be derated to an unacceptable level. The worst case option in terms of potential impacts would involve diverting the cables into new ducts laid at a higher level underneath the raised section of road. The existing cable would be cut and recovered over the section of the road that is being raised and reused in the new higher ducts. A short length of new cable would also be required. Three new joint bays would be required to allow the raised cable to be jointed back to the existing cables at either end and to join the short length of new cable to the recovered length of cable respectively.

Diversion works to the remaining services are not envisaged, however some protection measures like cover slabs may need to be employed during the construction phase. Refer to **Chapter 5 *Construction*** for further details.

4.5.17.2 Diversion of services within the Indaver site

Gas main

There is an existing underground 300m diameter 19Bar gas transmission main located within the site. The gas main is not currently supplying gas to any site. The gas main runs along the southern boundary of the site and then moves northwards through the site. The gasmain terminates at the existing Above Ground Installation (AGI) along the Haulbowline Road before the bridge to Rocky Island. Due to the nature of the proposed works, the gasmain will require to be diverted within the site. Gas Networks Ireland have been consulted in relation to the proposed diversion and have agreed on an indicative diversion route along the eastern boundary of the site. The indicative diversion route within the site is shown on planning drawings.

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Overhead power lines

There is a 10kV power line located on an approximate north-south alignment in the eastern part of the site, adjacent to the Hammond Lane premises. This will require a diversion within the site. ESB Networks have been consulted in relation to the proposed diversion and have confirmed that an underground or over ground diversion is possible within the site. The indicative diversion route within the site is shown on the planning drawings.

There is another 10kV power line on an approximate north-south alignment adjacent to the western boundary of the western part of the site. This will not be impacted by the proposed development.

There is 38kV power line which enters the ESB Networks substation, adjacent to the Hammond Lane premises, from the southwest. This will not be impacted by the proposed development.

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4.6 General Operations of the Waste-to-energy Facility

4.6.1 Operating hours

Subject to the necessary permissions, it is anticipated that construction of the Ringaskiddy facility will commence in 2017/2018. It is assumed that the peak construction period will occur in 2019. It is assumed that the facility will be operational in 2020.

It is anticipated that the facility will operate 24 hours per day, seven days per week, for an average of 8000 hours per year. There will be planned shutdowns for maintenance purposes. Waste acceptance will be limited to the hours 06.00 to 20.00 on week days and 09.00 to 14.00 on Saturdays. As detailed in **Chapter 7** (***Roads and Traffic***) operational waste deliveries will be restricted during the AM and PM peak periods (from 07.00-09.00 and 16.00-18.00 respectively).

The waste bunker will have sufficient capacity which will allow the acceptance of waste during shut downs and periods when there are no deliveries such as holiday periods and Bank Holidays.

A scheduled shut down for maintenance will take place once a year. Such a shutdown will be typically longer than 1 week, but less than 3 weeks. As these shutdowns will be planned it will be possible to organise an alternative outlet for the waste. Alternatives would be another waste incinerator or a landfill facility, depending on the type of waste and the availability of such facilities at the time. However, the facility will still take waste during a shutdown but at a reduced rate.

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4.6.2 Scope

The waste-to-energy facility will have one furnace and flue gas cleaning line. The line will have a moving grate furnace with a state-of-the-art flue gas cleaning system.

The moving grate line will burn non-hazardous and suitable hazardous household, commercial, industrial and other suitable waste. The line will also be able to burn the residues from mechanical-biological treatment of waste, if these residues become available. The facility will have the capability to treat low risk hazardous wastes. Many of these can be found in municipal solid waste, (e.g. paint tins, rags and wipes contaminated with paints or oils), which are treated without difficulty on a grate furnace. Other streams would include “low hazard” materials from industry such as contaminated personal protective equipment/clothing, filters, absorbents, redundant over-the-counter preparations, medicines, and raw materials such as sugars, starches and gelatine tablet coatings. These streams are classified as hazardous in compliance with the European Waste Catalogue due to their chemical or physical properties. However, this does not imply that they are dangerous to handle (i.e. they may be handled by householders and businesses regularly). Refer to **Appendix 4.1** for a complete list of EWC codes proposed for the facility.

Heat will be recovered and converted to electricity. The incineration process will produce bottom ash, much of which will be suitable for recovery as daily cover for landfill sites or for recycling in civil engineering applications such as road

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construction. A small quantity of waste, which will require disposal in a landfill for hazardous waste, will be produced, primarily as a result of the flue gas cleaning process (see **Section 4.9**). This will be disposed of to a landfill for hazardous waste after treatment if necessary or to a salt mine, either in Ireland, if one is available, or abroad.

4.6.3 Moving grate furnace

The capacity of the moving grate furnace, in terms of the tonnage of waste per annum to be treated, will depend on the calorific value of the waste being burned and on the number of operating hours per annum of the facility.

The calorific value of municipal solid waste is variable. The experience from operating a similar facility in Meath, Ireland and Flanders, Belgium, is that the average calorific value of non-hazardous municipal solid waste in the bunker at any given time ranges from 6 – 16 MJ/Kg, with an average of circa 9.5 MJ/Kg.

The facility will be able to operate at 60 - 110% of its nominal capacity and the number of operating hours per annum of the facility is expected to be 8,000 hours. Regardless of the various permutations possible, it is proposed that the facility will not exceed an annual throughput of 240,000tpa.

4.7 Processes

The design of the proposed facility has been optimised to include the most up to date emissions control and flue gas cleaning technology. The waste-to-energy process will consist of a number of main process elements as follows:

- waste acceptance
- waste intake and storage
- combustion process
- energy recovery process
- flue gas cleaning.

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4.7.1 Waste acceptance – general

Solid hazardous and non-hazardous waste will arrive at the site in a number of different waste vehicles including compactor trucks, skip trucks ejector trailers and walking floors, with all contents covered. All waste trucks entering the waste-to-energy facility will pass through a scanner to detect the presence of any radioactive elements. Radioactive waste will not be accepted in the facility. A truck found to be carrying radioactive waste will not be accepted for treatment.

Waste trucks will drive onto the weighbridge, located at the entrance. All trucks carrying waste, which enter and leave the facility, will be weighed. Drivers will present their documentation, relating to the waste load, to the staff in the security gatehouse. Some trucks, on long-term contracts, carrying non-hazardous waste, will access the facility using a swipe card, which will record their details. The drivers of these trucks will not have to report to the security offices.

Following completion of the waste acceptance procedures, the trucks carrying waste will proceed via the site road to the enclosed tipping hall.

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Tankers of aqueous waste will be sampled and analysed prior to offloading into the aqueous waste storage tank or direct injection. This sampling may be done before or after arrival on site. If sampled and analysed on site, the sampling will be done in the aqueous waste unloading area adjacent to the aqueous waste storage tank. Key parameters will be analysed to ensure conformity with the specified waste acceptance criteria and with the parameters agreed with the customers. As a minimum, water content, pH, chlorine and calorific value will be checked for each aqueous waste load. In the event that the specification for the aqueous waste load is not met, then arrangements will be made for the dispatch of the tanker to the most suitable facility either in Ireland or abroad.

Access for sampling the tankers on site will be provided by an overhead gantry. This gantry will also facilitate operations associated with offloading the tanker.

4.7.2 Waste Handling

The waste handling and storage facilities for solid waste will consist of:

- the waste tipping hall
- the waste bunker with semi-automatic grab cranes
- waste hopper.

Waste handling and storage facilities for aqueous waste will consist of tanker offloading bays and the aqueous waste tank.

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4.7.2.1 Waste tipping hall

Covered trucks containing solid waste will enter the supervised tipping hall and will be directed towards discharge chutes. The trucks will discharge the waste into the bunker through chutes in the wall of the waste tipping hall.

Effluent treatment facility sludge will be treated in the waste-to-energy facility. This material will have a moisture content of approximately 75% and will be handled in a similar manner to solid waste.

To prevent the egress of odours, the tipping hall will be maintained under negative pressure, i.e. air will be drawn in through any openings rather than escaping out. Air for combustion will be drawn from the tipping through the waste bunker. As the waste tipping hall will be an enclosed area, windborne litter will not be generated.

If for any reason the waste-to-energy facility is shut down, typically for 1or 2 weeks per year, the main fans for combustion air and flue gases will be kept in operation for as long as possible to maintain the tipping hall under negative pressure.

4.7.2.2 Waste Bunker

The bunker capacity has been chosen to allow the facility to accept waste during periods when the furnace is shut down for maintenance and also to allow the facility to continue operating over prolonged periods, such as long weekends, without deliveries. The floor of the bunker will be at 0.00mOD approximately, that is 10m below the floor level of the tipping hall. Mixed solid waste such as non-

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hazardous household, commercial and industrial waste, of the type the facility will treat, typically has a density of 0.3 to 0.5 tonnes/m^3, giving an approximate bunker capacity of circa 4,100 tonnes, or equivalent to circa 5 days operation of the facility.

Crane operators, positioned in the control room/crane operator room overlooking the bunker, will use travelling grab cranes to mix the waste in the bunker, so that despite the variety within the solid waste loads delivered, the feed to the furnace will be relatively uniform.

4.7.2.3 Waste Hopper

The lower section of the waste feeding chute will be double walled, with cooling water circulating in the cavity. There will be two grab cranes. The grab cranes will feed the mixed waste into the hoppers. The approach of the grab crane to the hopper opening will be controlled automatically by the facility's computerised control system. Once the operator has selected the option of placing the material held by the grab crane in the hopper, the crane will proceed to the hopper and discharge the material.

The grab crane will be designed to fit into the hopper so as to ensure that any bridging or blockage can be broken up or removed. The waste will then be discharged to the furnace from the hopper.

The waste will be moved forward from the hopper into the furnace using a ram mechanism. The waste plug in the chute will provide a seal between the high temperature furnace and the bunker. The volume of waste will be controlled by adjusting the stroke and the frequency of the ram.

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4.7.2.4 Process Control within the Waste Bunker

The process of waste acceptance/delivery into the bunker and feeding into the hopper is closely controlled via the control room using visual control sensors in the bunker. The bunker will be continuously monitored by the operator, who will ensure that there will be adequate mixing of waste and will also monitor the bunker should any portion of the waste begin to smoulder. A lower explosive limit (LEL) detector will be installed in the waste bunker to monitor methane levels. The lower alarm level will alert the facility operators to the raised methane levels and the need to take corrective action.

The operator of the grab crane will ensure that the correct mix and volume of waste will be fed into the hoppers. The actual feeding of waste into the hopper will be controlled automatically, but under operator supervision. There will be monitors in the control room relaying pictures from CCTV cameras, which will allow the operator to observe the discharge of waste from the grab crane, the quantity of waste remaining in the hopper and also to observe any blockages in the hopper. Should the level of waste in the hopper drop to a pre-defined level, an alarm will sound in the control room to alert the grab crane operator to this fact. The temperature in the hoppers will be monitored continuously by the process control system.

The rate of feeding the waste to the furnaces will be controlled by adjusting the ram on the hopper.

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4.7.2.5 Process Control for aqueous waste storage and unloading

The aqueous waste storage tank will have a capacity of 250 m^3. The tank will be double walled and fabricated from mild steel.

When aqueous waste tankers will be unloaded into the aqueous waste tank, there will be close monitoring and supervision by an operator in the field and by the panel operator at the central control system. Level indication, oxygen monitoring and overflow protection will be provided in the tank. The empty space above the liquid level inside the tank will be kept under a constant nitrogen blanket. This is to ensure that an inert atmosphere will always be maintained inside the tank as there will be mixed solvents present in the incoming aqueous wastes.

The nitrogen blanket will be supplied by a nitrogen generator and nitrogen buffer storage vessel. The generator is essentially a molecular sieve that is fed with dry, oil-free air from the compressed air system on site. The generator and the buffer storage vessel will be located to the west of the aqueous waste tank. The buffer storage vessel will have a capacity of 5m^3.

During unloading operations from waste tankers into the tank, the headspace of both will be connected using a flexible hose. This will allow the displaced nitrogen from the storage tank to be exchanged with the tanker as it offloads. This will ensure that an inert atmosphere is maintained at all times and will keep air (and hence oxygen) out of the tank and incoming waste tankers.

Based on the demands of the plant and available storage capacity in the aqueous waste storage tank, once the specifications have been met, the aqueous waste will be offloaded into the storage tank or sent for direct injection to the furnace. The average feed rate to the furnace for direct injection will range from 0.5T per hour to 1.5 T per hour. The feed rate will be dependent on the calorific value of the waste and the prevailing conditions in the furnace at that time. If the tanker is offloaded directly to the storage tank, then this operation will take approximately 1 hour.

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The stormwater drainage from the aqueous waste unloading area will be contained as described in Chapter 4.14.3.

In addition to the nitrogen blanket and oxygen monitoring in the tank, standard fire protection measures which will be employed for the protection of the aqueous waste tank. This will include a fixed, automatic deluge system fed by the fire ring main on site. In the unlikely event of a fire in the area, sprinkler heads fixed to the tank will activate to protect the tank. In the event that suitable tanker cleaning facilities are not available in the Cork area, tanker cleaning equipment will be installed. The equipment will consist of a series of pumps, and a small boiler unit used in conjunction with cleaning agents to wash out tankers and clean them for re-use. The equipment will be located on the south side on the main process building (directly north of the aqueous waste storage tank.

Once aqueous waste tankers have been emptied on site, then a cleaning head will be inserted into the top opening of the tanker from the gantry access platform. The tank will then be cleaned and the washings will either be re-circulated for another cleaning operation or unloaded to the aqueous waste storage tank.

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4.7.3 Furnace

4.7.3.1 Moving Grate Furnace

A moving grate furnace is proposed for the facility. Refer to **Figure 4.12** for a schematic of its operation. The moving grate furnace will operate in a similar fashion to an escalator, pushing waste from the top of the furnace to the bottom to ensure complete combustion. An excess quantity of air will be drawn in through the furnace to ensure sufficient cooling of grate bars. The chosen technology is considered BAT.

The moving grate mechanism will transport the waste slowly from the feed point at the top of the furnace to the ash discharge at the bottom of the furnace. The rate at which the waste will travel through the furnace will be controlled to optimise the combustion. The residence time for waste in the furnace will be approximately one hour.

As the waste enters the hot furnace the material will be heated due to contact with the hot flue gases and radiated heat from the walls of the incinerator. The initial heat (temperature range of 50˚C to 100˚C), will drive off the moisture from the waste.

The next stage in the combustion process will be volatilisation, where the combustible gases and vapours will be driven off. The volatilisation stage will take place within the temperature range of 200˚C to 750˚C.

The volatile components of the organic material of municipal solid waste typically account for 70 to 90% of the flue gases, and are produced in the form of hydrogen, carbon monoxide, methane and ethane. The combustion of these volatiles will take place immediately above the surface of the waste and in the combustion chamber above the grate.

The volatile gases and vapours released will immediately ignite in the furnace due to the temperature of the furnace gas, which will be within the range 850˚C and 1,000˚C. Typical mean residence times of the gases and vapours in the combustion chamber will be 2 to 4 seconds. The final section of the grate will be the burnout section where the ash will be held for long enough to ensure sufficient burnout.

The grate will discharge the resultant bottom ash into a water bath/ wet de-slaggers, and then via a conveyor to an ash hall. Refer to **Section 4.14** for further information on ash handling and recovery of ferrous and non-ferrous metals.

Refer to **Appendix 4.2** for details on furnace start up and shut down procedures.

4.7.3.2 Combustion Air

Primary combustion air will be drawn from the reception hall and bunker by the primary air fan. Secondary combustion air will be drawn from the roof spaces above the furnaces and boilers, by the secondary air fan. The air in the roof space will be heated by convection and radiation.

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4.7.3.3 Process Control of the Moving Grate Furnace

The control parameters to be monitored to optimise the conditions in the moving grate furnace will be as follows:

- Waste feed
- Burnout of waste in the furnace
- Temperature
- % O_2 in the flue gases
- concentration of CO in the flue gases
- concentration of NO_x in the flue gases
- Steam flow and pressure.

The addition of combustion air to the furnace will be controlled to ensure optimum operating conditions. The secondary air will be provided to assist in the combustion process, to provide mixing of the flue gases. The operating conditions will ensure complete combustion of the volatile gases. The induced air movement through the furnace will prevent the possibility of “flames” from the furnace entering the hopper. Air will also be used as a cooling source for the grate itself.

The burnout of waste in the furnace will be controlled by visual inspection of the flame front via cameras and monitors, and by automatic monitoring of the temperature in the last section of the furnace. The temperature will be controlled by the air supply rate and the waste feed rate. Light fuel oil will be used to bring the furnace up to the specified temperature of 850˚C prior to start-up of the waste feed.

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The furnace temperature will be continuously monitored and controlled to ensure that this minimum temperature is maintained and supplementary firing with light fuel oil will be used if necessary.

The levels of O_2 and CO and the temperature in the flue gases will be monitored and the combustion air input optimised to ensure efficient and effective combustion.

The rate of waste feed will be controlled to maintain constant steam production at the desired temperature and pressure.

4.7.3.4 Inputs and Outputs to the Moving Grate Furnace

The inputs to the moving grate furnace will be mixed solid wastes, aqueous wastes, fuel and combustion air. The outputs will be combustion gases and bottom ash.

4.7.3.5 Emissions from the Furnace

There will be no emissions to the environment from the furnace during normal operations.

The furnace will normally be maintained under negative pressure. There will be a number of reasons why there might be excessive air pressure in the furnace, for

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example, a blockage downstream of the furnace in the flue gas treatment systems or the sudden increase in the calorific value of the waste. Pressure sensors in the furnace will detect the high pressure in the furnace. The computerised control system will increase the speed of the induced draught fan, which will control the velocity of the flue gases, to reduce the pressure in the furnace. If the fan reaches its full capacity without a corresponding drop in pressure in the furnace, the facility will automatically generate an alarm to reduce the waste feed. If there is a further increase in the pressure, the facility will automatically initiate a quick-stop sequence. The quick-stop sequence is described in **Appendix 4.3**.

In the moving grate furnace, there will be the possibility that a pressurised object, such as a large gas cylinder, would enter the furnace undetected in the waste feed. This could cause an explosion which could result in damage to the refractory brick lining of the furnace. The furnace will be designed to withstand such incidents and monitoring of the condition of the refractory bricks will be undertaken.

4.7.4 Control of Nitrogen Oxides (NOx) - Urea/Ammonia Solution Injection

4.7.4.1 Process Description

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All combustion processes lead to the formation of nitrogen oxides (NOx). These substances are formed partly from combustion of the nitrogen fraction in the waste feed and partly from the oxidation of nitrogen in the combustion air. NOx formation will be controlled in two ways. Optimal combustion conditions in the furnace will minimise the oxidation of nitrogen in the combustion air. Mixing of the waste will also prevent localised high temperatures (and therefore higher NOx levels) in the furnace and cladding materials with suitable heat transfer properties will be used to give an optimal flue gas temperature. Secondly, in order to meet the strict NOx emission values set by the EU Industrial Emissions Directive 2010/75/EC, 'De-NOx' technology will be used.

This technology uses the reaction of ammonia and nitrogen oxides at high temperature to convert the nitrogen oxides to nitrogen and water vapour. This reaction will be achieved by the injection of either an ammonia solution or urea into the first section of the boiler. The urea, if used, will break down to form ammonia due to the temperature (approximately 900°C). The ammonia will then react with NOx to produce nitrogen and water. Throughout this process the NOx levels will be monitored to optimise the quantity of ammonia solution/urea injected and ensure that emission values will be well within the EU NOx emission limits.

This technology of ammonia solution/urea injection is known as Selective Non Catalytic Reduction (SNCR). SNCR is a proven technology and experience has shown that it will attain the daily NOx emission limit of 200 mg/Nm^3. Typical NOx emissions from the proposed facility will be well below this Industrial Emissions Directive emission limit. The impact of the NOx emissions is addressed in **Chapter 8 *Air Quality*** of this EIS.

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4.7.4.2 Process Control for the Urea/Ammonia Injection

The ammonia solution or urea will be injected into the first section of the boiler at a controlled rate, which will be based on the NOx concentration and flue gas flow measured continuously in the stack.

4.7.4.3 Emissions from the Urea/Ammonia Injection

There will be no emissions to the environment from the urea/ammonia injection system.

4.7.4.4 Inputs and Outputs

The inputs to the system will be flue gases and ammonia solution or urea. The output will be cleaned flue gases and nitrogen.

4.8 Energy Recovery

4.8.1 Waste Heat Boiler

4.8.1.1 Process Description

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Technology has improved in recent years and energy recovery has become very efficient for waste to energy facilities. The aim of this facility is to generate 21MWh of electricity for use in approximately 30,000 homes. To achieve this the following is proposed.

The thermal energy generated by burning the waste in the furnaces will be transformed into electricity using a conventional steam cycle. This will consist of a boiler to generate steam, a steam turbine across which the steam will be expanded to produce motive power and a condenser to condense the steam and dissipate the low-grade waste heat.

The steam boiler will operate to 40 bar and 400°C, the standard steam parameters for electricity generation from waste incineration.

The boiler outlet temperature for the proposed development will be 180°C and is considered BAT. Such a temperature is required for the evaporation of excess water in the process and the minimisation or avoidance of liquid effluent.

The boiler will consist of a number of empty passes and a final pass with tube bundles. The empty flue gas passes will be constructed from membrane walls without obstructions such as tube banks. The empty passes will allow heat transfer from the flue gas to the evaporating water in the membrane walls mainly by radiation. There will be no tube bundles in this section of the boiler as the fly ash will be sticky at temperatures above 650ºC, and would quickly deposit on, and foul the surfaces.

For the grate furnace the large empty first pass will allow sufficient time at high temperature to complete combustion. The lower part of the first pass will be refractory lined to avoid corrosion and to provide thermal insulation close to the furnace. The refractory lined part of the first pass of the boiler will be designed to

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ensure that the specified minimum residence time, temperature and oxygen content, after the last air/fuel injection, will be maintained, to ensure compliance with the Industrial Emissions Directive.

The flue gases, (combustion gases leaving the 1st boiler pass) will then pass through three further stages containing heat exchangers (refer to **Figure 4.13**):

- Evaporator – The evaporator will evaporate the boiler water to form wet steam at 45 bar gauge, 260°C.
- Superheater – This will heat the wet steam to form superheated steam at about 41 bar gauge, 400°C.
- Economiser – This will preheat the boiler feed water to about 220°C, in order to recover more heat from the flue gas.

The primary purpose of the steam boiler/economiser will be to exchange heat between the flue gas and the water/steam circuit, which will produce steam for power generation.

Some 85% of the energy produced by the combustion of waste will be recovered as steam in the boiler. This is somewhat lower than with a power facility for the following reasons:

- The flue gases from the incineration process will contain corrosive elements, which would attack the boiler components if steam were to be recovered over a wider temperature range, either at higher temperatures or at lower temperatures.
- Variation in waste parameters requires a higher amount of unused air passing through the stack and hence greater heat losses compared to that of a power facility for instance, where excess oxygen is typically 1 to 3% vol.

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De Novo-synthesis, that is the reformation of dioxins, has the potential to occur over the temperature range 450˚C to 250˚C during cooling in the latter stages of the boiler. In order to minimise the formation of dioxins the following design measures will be implemented:

- Automatic controlled cleaning, by mean of fixed installed cleaning devices, of heat transfer surfaces to reduce the amount of metals, particularly copper, present which can act as a catalyst in the formation of dioxins.
- Rapid cooling over the range 450˚C to 250˚C by increasing the velocity of the flue gases through the section of the boiler where cooling over this temperature range will occur. This increase in velocity will accelerate heat transfer and cool the gases more rapidly. The total residence time of the gases in the boiler will be approximately 30 seconds.

As with all boiler facilities it is necessary to treat the feed water to the boiler to a high level of purity. A demineralisation facility will be provided for this purpose to meet a demineralised water demand of the order of 25 m^3/day. An equivalent volume of water will then be purged from the boiler to prevent the build-up of salts in the steam circuit. This purge is often referred to as ‘boiler blow down’. This blow down will be re-used back in the process. Small quantities of boiler treatment chemicals will be added to the boiler feed water to prevent corrosion and scale build up in the steam circuit.

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4.8.1.2 Process Control for the Boiler

The steam flow will be controlled by valves, which will control the flow of the steam to the turbine according to a specified load or other operating conditions. The system will be equipped with stop valves, which will interrupt the steam flow if the operating conditions fall outside pre-set levels.

4.8.1.3 Emissions from the Boiler and Condenser

A small quantity of water will be purged constantly from the system and replaced with fresh make up water. This blow down will be recycled for re-use in the process. There will be no other emissions from the boiler and condenser.

4.8.1.4 Inputs and Outputs

The inputs into the boiler will be hot flue gases and boiler feed water and the outputs will be cooler flue gases, boiler ash and superheated steam. Refer to **Section 4.13.3** for details of the boiler ash. In addition, some small amounts of boiler treatment chemicals will be added to the boiler feed water to prevent corrosion and scale build up in the steam circuit.

4.8.2 Steam Turbine

4.8.2.1 Process Description

In the proposed facility, the steam from the boiler will be expanded in a single steam turbine down to a pressure of 0.1 bar absolute (see **Figure 4.14**). This low pressure will maximise the energy recovery from the turbine, which will be used to drive the generator set and give a total electrical output of approximately 21MW. As approximately 2.5 MW is required for electrical demand within the facility, the net electrical output will be approximately 18.5 MW.

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The wet steam (about 11% will be condensed in the turbine) from the turbine will exit at a temperature of approximately 50˚C and will be further condensed in an air-cooled condenser. This will maintain the low pressure at the turbine exhaust and dissipate the waste heat into the air via banks of heat exchangers similar to a car radiator. The air-cooled condensers will reduce the water requirement of the facility, as no cooling water will be required.

The condensate will be collected in a tank, from where it will be pumped to the boiler feed water tank for recirculation to the boiler.

The electrical generator will be cooled using a smaller air cooler, with oil as the heat transfer fluid and water in a closed circuit as cooling source.

4.8.2.2 Process Control for the Steam Turbine

There will be a steam bypass to the condenser, which will be used during start up and in the event of a failure of the steam turbine. The steam pipes will be provided with pressure relief valves, which will automatically activate in the unlikely event of the steam pressure exceeding a set level.

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The turbine will control the steam coming from the boiler by changing its rotation speed. The turbine hence 'follows' the steam production from the boiler.

Alarms, controls and measurements from the steam turbine control and protection system will be relayed to the main facility control system, so that the operation of the turbine can be best monitored and controlled from the central control room.

4.8.2.3 Process Emissions from the Turbine

There will be no emissions from the turbine or generator set.

4.8.2.4 Inputs and Outputs

The inputs into the turbine will be superheated steam, and the outputs will be lower grade steam taps mentioned above for application in the process and low pressure steam which will go to the condenser. The turbine will drive the generator set, which will produce electricity for facility consumption and export to the national electricity grid, approximately 21MW.

4.9 Flue Gas Treatment

4.9.1 General

The flue gas treatment system has been designed to ensure compliance with the emission limits specified in the EU Industrial Emissions Directive 2010/75/EC. The flue gas treatment equipment proposed is a 'semi dry' system. The 'semi dry' system would comprise a cooling section, a dry reactor and a bag house filter.

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4.9.2 Cooling section

4.9.2.1 Process Description

The flue gas leaving the boiler will still be relatively hot at approximately 180˚C and will be further cooled in the cooling section to a temperature of about 145˚C. The lower temperature is required for the optimal operation of the lime and activated carbon or clay injection downstream. The cooling section will be essentially an enlarged flue gas duct with either a flue gas / hot water heat exchanger or a water quench.

An activated carbon or carbon/clay mixture will also be injected as a first stage dioxin removal step. The process description and control is described in Sections 4.9.3.1 and 4.9.3.2 below.

In the subsequent dry reactor, lime, reactivated flue gas cleaning residue and activated carbon or clay will be injected.

4.9.2.2 Process Control for the Cooling section

The temperature of the flue gases leaving the cooling section will be monitored and maintained at the required temperature of about 145˚C by controlling the rate

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at which the water is sprayed directly in the flue gas process control for the dry reactor or the heat exchanged in the flue gas/ hot water heat exchanger

The rate of lime injection in the dry reactor will be dependent on the acid concentration in the flue gases measured in the stack and upstream after the boiler. The flue gases will enter the top (or bottom) of the reactor by forced draft and will travel downwards (or upwards), through the cloud of lime, reactivated flue gas cleaning residue and activated carbon or carbon/clay mixture. The added re-agents and dust entrained in the flue gases will be collected in the baghouse filter. Part of the residue from the bag filter will be reactivated and returned to the reactor to obtain a better use of the lime. The remainder of the residue will be sent as solid wastes for offsite disposal (refer to **Section 4.13.1**).

4.9.2.3 Emissions from the Cooling section

There will be no emissions from the cooling section.

4.9.2.4 Inputs and Outputs

The inputs to the cooling section and dry reactor will be flue gases, water, lime, recirculated flue gas cleaning residue and activated carbon or clay. The outputs will be cooled clean flue gas, water vapour and reaction salts. The quantity of solid residues collected at the bottom of the reactor will be negligible.

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4.9.3 Activated Carbon/Clay Injection and Baghouse Filter

4.9.3.1 Process Description

Dioxins and furans are complex chlorinated hydrocarbon molecules, which are formed as a consequence of any combustion process. As described previously the facility is designed to minimise the reformation of dioxins and furans (the term 'dioxin' is taken to include dioxins and furans), by maintaining the flue gases at a high temperature of over 850˚C for over 2 seconds in the furnace and by rapidly cooling the gases from 450˚C to 250˚C. These measures will reduce the dioxin concentration in the flue gases to a low level. The flue gas cleaning equipment will reduce dioxin concentrations in the flue gas to levels well below the limit set in the Industrial Emissions Directive. Typical emissions from a facility with this equipment are 0.01ng TEQ/m^3 (0.000,000,000,01g TEQ/m^3).

A fixed amount of activated carbon or a carbon/clay mixture will be injected in two places. The first will be into the flue gases in the cooling stage and the second into the flue gas either in the dry reactor or just after it. Activated carbon consists of small, porous carbon particles, which due to their porosity have a very large surface area. The large surface area will adsorb heavy metals and trace levels of organics present in the flue gas, such as dioxins, furans, Polycyclic Aromatic Hydrocarbons (PAHs) and hydrocarbons. These carbon granules and other particulates, such as dust, will then be removed by filtration as the flue gases pass through the baghouse filter. The activated carbon/clay mixture will work in a similar manner to activated carbon and the activated carbon/clay mixture will contain a minimum of 10 % activated carbon. This is to ensure the adsorption of heavy metals and mercury.

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The dosing of the activated carbon or carbon/clay mixture will have redundancy built in, starting from the bottom extraction point of the storage silo and ending at the injection point in the flue gas flow. This means that each of the two injection points will have two lines running towards it so that one is always available. It will be possible to run both lines simultaneously and the control of the dosing flow will be doubled.

The baghouse filter will contain multiple filter bags in separate compartments. The separate compartments will allow for maintenance and changing of filter bags whilst the filter is on-line. The dust laden flue gases will be sucked from the outside (foul side) to the inside (clean side) of the filter bags leaving a dust cake on the outside of the bags. The pressure drop over the bags will increase as more dust accumulates. A reverse pulse of clean compressed air will be blown inside the bag as soon as a preset pressure drop set-point is reached. The airwave will inflate the bag and make the carbon and particulates on the outside crack and fall into collection hoppers below.

The dust cake will consist primarily of fly ash carried over from the boiler, reaction salt from the flue gas pollutants with lime, excess lime and activated carbon or clay.

4.9.3.2 Process Control

The activated carbon or carbon/clay mixture will be injected at a fixed rate controlled by a volumetric dosing screw. This fixed rate will be based on operating experience of the Indaver's incineration facilities in Meath and Belgium. The rate of dosing will allow for the maximum reduction in emissions.

The weight of the activated carbon or carbon/clay feed bin will be monitored continuously to ensure that dosing is continual. Should the weight of the feed bin remain steady, which would indicate that the feed to the process had stopped, an alarm will be activated in the process control room.

The pressure drop over the bags will be monitored continuously. The removal of carbon and particulates from the bags will be controlled on defined pressure set-points. The baghouse filter will have one redundant compartment.

4.9.3.3 Emissions

Activated carbon or clay will be stored in a silo fitted with a high efficiency particulate air (HEPA) filter. Residues will be transferred from the baghouse filter to an enclosed silo fitted with a HEPA filter by an enclosed conveyor with the process building. Both handling systems will prevent dust or carbon emissions to the atmosphere from the activated carbon or clay injection or baghouse filter stages. Therefore the only emission will be filtered air from the storage silos and such emissions will only occur when the silos are being filled.

4.9.3.4 Inputs and Outputs

The inputs from this stage of the process will be the activated carbon/clay/lime. The outputs will be flue gases and flue gas cleaning residues.

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4.10 Waste-to-Energy Facility Control System

4.10.1 Control Room

The control room will be located above the bunker. From here crane operators will visually inspect the waste and, using a grab and automated transfer system, will control waste entering the furnaces from the bunker.

The facility's automated computer system will be controlled and monitored from here. Emissions data from the emissions monitoring station located on the stack will also be monitored here.

4.10.2 Automated Control System

The facility will be controlled by an interface computer system (screens, keyboard, and printers). The system will monitor all the parameters and measurements required in order to have a good overview of facility performance. It will execute facility control loops, report low-level and high-level alarms and will control different levels of safety interlocking.

The control system will include the following measurement equipment:

- air flows (primary, secondary, wall cooling if any, recirculation if any) in each section of the different injection systems;
- temperatures and pressures of all flows;
- furnace temperatures;
- temperature in the burn-out section
- flue gas temperature at the roof of the first boiler pass (for verification of burning at a minimum temperature of 850°C for 2 seconds);
- oxygen content of the flue gas at boiler outlet;
- temperature of the flue gases at the roof of the first boiler pass (triple measurement); and
- temperature at outlet of the boiler.

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Flue gas emission monitoring is described in **Section 4.11** below.

Minimum control parameters will include the steam rate, temperature in the post combustion chamber, waste throughput, NOx-content and O_2-content. The control system will use these parameters to control the various inputs into the furnace.

The system will include the following operating modes:

- Full automatic control under normal operating conditions where minimum control parameters can be set for the system, such as steam or waste flow and temperature. In this mode no intervention on the response characteristic of the control should be required or be made available to the operator.
- Safe manual control where different input flows can be set for the system, with system protections and interlocks operating normally. This mode will be required for starting and shutdown, and when reacting to variations in operating conditions, such as extreme fuel variations. When switching from

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the full automatic mode to safe manual control mode due to an operational situation beyond the limits of the control loop, the operator will be guided by the control system.

- Maintenance mode where either the automatic or manual control mode will be in operation but with control system parameters, alarm settings and interlocks available to the operator for optimisation. This mode will be protected by means of keys and/or passwords.

The control system will be assisted by:

- A visual check of the combustion process by means of one or more colour cameras on the furnace;
- An on-screen indication of the position of the current waste treatment and energy production of the furnace;
- Operational procedures which will be in place for reaction to low-level alarms or when the facility is not running to full capacity.

Operational procedures will be in place for normal operations, start up, controlled shut down and automatic shutdown.

The facility is protected by an interlock system, which is described in **Appendix 4.2**.

4.11 Emissions Monitoring

The Industrial Emissions Directive 2010/75/EC requires continuous monitoring of specific parameters and regular sampling of dioxins present in the flue gases prior to discharge from the stack to ensure compliance with emission limit values.

The facility will be licensed by the EPA, which will specify the environmental monitoring that must be performed. Sample points will be accessible to EPA personnel for their independent inspection and monitoring programme.

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4.11.1 Continuous Monitoring of Flue Gases

The furnace and gas cleaning facility will be operated under negative pressure generated by the induced draft fan located adjacent to the stack. This will ensure that the only emissions from the facility will be those fully treated by the flue gas cleaning system and discharged through the stack.

Flue gas monitoring equipment will be installed to monitor emissions. The equipment will consist of continuous monitors and regular grab sampling according to the specifications laid down in EU and Irish legislation for incineration facilities.

The following parameters will be continuously measured in the stack: total dust, TOC, HCl, HF, SO_2, NO_x, CO, temperature and O_2. These continuous measurements will be accessible in 'real time' in the control room.

There will also be regular monitoring for heavy metals Cadmium, Thallium, Mercury, Antimony, Arsenic, Lead, Chromium, Cobalt, Copper, Manganese, Nickel, Vanadium and Tin.

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The emission values will be relayed to both the control room, where the operators will have 24 hour access to this information and will be able react if necessary, and to the QESH (Quality, Environmental, Health & Safety) Department where they will be monitored for compliance with the relevant half-hourly, daily and monthly averages.

All monitoring equipment will be certified by an independent certification company and will adhere to the relevant standards. The company used will ensure the reliability, safety and quality of the equipment.

Preventive maintenance contracts will be put in place with the equipment suppliers who will also be able to provide a 24-hour call out service. Calibration of equipment will be carried out as per supplier recommendations. Calibration by means of parallel measurement is conducted at least annually in Indaver facilities in Meath and Belgium and this practice will also be applied at the proposed facility. The monitoring equipment will also have auto calibration capabilities where possible.

There will also be back-up monitoring equipment available for use during maintenance and calibration.

4.11.2 Continuous Sampling of Dioxin Emissions

Although it is not a requirement of EU or Irish legislation, the monitoring equipment will include a state of the art continuous dioxin sampler.

Due to the very low levels of dioxins in the flue gases leaving the stack, no proven technology is currently available, which is capable of providing continuous monitoring. The continuous dioxin sampler will allow the dioxin emissions to be sampled continuously. A dioxin filter will be placed in the stack to collect dioxin emissions on a fortnightly basis. This will then be removed and analysed in an independent laboratory. Laboratory testing of the samples will give dioxin emission concentrations and mass emission rates over a two-week period. This equipment is in use in existing Indaver facilities such as the Waste-to-Energy facility in Meath.

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The monitoring and sampling systems proposed are considered BAT for compliance with emission limit values set down in EU Directive 2010/75/EC.

4.12 Process Inputs

The major input to the process is waste for incineration. Other inputs include water, light fuel oil and reagents such as lime and activated carbon.

4.12.1 Waste

Waste inputs are described and quantified in **Section 4.7** above.

4.12.2 Water Supply and Use

As the facility uses an air cooled condenser rather than cooling towers it will have a significantly lower water requirement than would otherwise be the case. The major water requirement will be for flue gas cleaning due to cooling by direct

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water injection and the wet de-slagger. Process water (for the steam cycle), domestic potable water and water for cleaning account for the rest of the demand. The expected water requirements are listed in the following **Table 4.4**.

Table 4.4 Water Requirement

Use	(m^3/hr)
Flue gas cleaning	2.88
Process (steam cycle)	1.0
Domestic supplies	0.27
Cleaning	1.0
Fire fighting	0.2
Total	**5.4**

The water requirement will be supplied from the Irish Water water main in the road. Refer to **Section 4.15.1**.

4.12.3 Support Fuel

The facility will use light fuel oil at start up to bring the furnace to the required operating temperature of 850˚C'. Light fuel oil may also be occasionally required as a supplementary fuel to maintain the temperature if waste of an exceptionally low calorific value is received. An automatic control system will bring light fuel oil on line should the temperature drop below 850˚C. It will also be required for operation of the emergency power generator. It is estimated that 400 tonnes of light fuel oil will be used per annum to raise the temperature at start up and maintain it as required.

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This light fuel oil will be supplied from an on-site storage tank.

4.12.4 Other Inputs

Other inputs included sodium hydroxide (NaOH) 50% solution, and hydrogen chloride (HCl) 30% solution in the demineralisation facility, ammonium hydroxide (NH_4OH) and sodium phosphate Na_3PO_4 for the boiler feed water, lime, activated carbon and clay in the flue gas cleaning and urea/ammonia in the de-NOx stage.

The quantities of inputs will vary, depending on the calorific value of the waste and the flue gas cleaning equipment chosen. Estimated hourly consumption is indicated in **Table 4.5** below.

Table 4.5 Estimate Hourly Consumption of Inputs

	(kg/hr)
Lime	304
NaOH (50%)	4.0
HCl (30%)	5.0
Ammonia (25%)	104
Or Urea	65

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(as alternative to ammonia)	
Activated Carbon	16
Clay/Carbon mixture (as alternative to Activated carbon)	20

4.13 Process Outputs

4.13.1 Solid Waste Residues

There will be three solid residues from the waste-to-energy facility:

- Bottom Ash
- Boiler Ash
- Flue Gas Cleaning Residues.

Ferrous and non-ferrous metals will be recovered from the bottom ash. The types and approximate quantities of ash and residues expected to be produced from the waste-to-energy process are detailed below.

The classification of the residues as hazardous or not will be made by reference to the classification set out in the European Waste Catalogue (EWC). If the residue does not contain the properties listed in H1 to H15 of the 'Waste Catalogue and Hazardous Waste List', and Annex III of the Waste Framework Directive 2008/98/EC, it will be non-hazardous. A suite of analyses will be carried out on the residue and the results will be compared with the requirements of the Directive.

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A separate suite of analyses, including leachate testing, of the residue is required to determine the type of landfill, to which it should be disposed. This will ultimately determine if the residue is suitable for disposal to a non-hazardous landfill in accordance with the Landfill Directive (99/31/EC), the Waste Framework Directive 2008/98/EC and the Council Decision 2003/33/EC establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 of and Annex II to Directive 1999/31/EC.

Leachate is the aqueous effluent produced by rainwater on landfill sites and generally contains a high concentration of dissolved solids. A leachate test involves filtering water through ash and then analysing the water properties.

4.13.2 Bottom Ash

The bottom ash will be at a high temperature when it exits the furnace. The bottom ash from the grate will be discharged into a water bath, and then via a conveyor to the ash hall. This process will take place within the building. Refer to **Figure 4.15** for a schematic of the ash handling operations.

The bottom ash will consist of silicates, minerals, metal pieces and glass compounds. Ferrous metals, e.g. scrap steel, and non-ferrous metals, will be recovered from the moving grate bottom ash during transfer to the ash hall. A metal separator (over-band rotating magnet) and a non-ferrous metal inductive separator, located on and after the last conveyor before the bottom ash bunker, will remove ferrous metal and non-ferrous metals and transfer them to separate

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compartments of the ash hall. The ash hall bunker will have the capacity to store the equivalent of 10 days of ash. Ash will be transferred from the bunker to collection trucks using a front end loader. All trucks leaving the facility will be securely covered to prevent any ash escaping from the trucks.

From experience of operating similar facilities in Meath Ireland and Flanders, Belgium, it is anticipated that the bottom ash will be non-hazardous. The bottom ash from the Meath waste-to-energy facility has been classified as non-hazardous and non-toxic to the aquatic environment according to EPA methodology and Commission Regulation (EU) No 1357/2014 and Commission Decision 2014/955/EU. The bottom ash has been tested since 2011 and to date there has been no change in the classification.

Bottom ash from waste incineration in EU countries, including Belgium, is widely used in civil engineering applications such as road construction. Although there are no Irish or European legislation or standards governing the quality of ash for use in roads, if the ash is to be used for road construction it must generally be of better quality than if it were to be disposed of in landfill. This improvement in quality can be achieved by treating the ash in an ash recovery facility. This option for the recovery of bottom ash is discussed in **Chapter 15 *Material Assets*** of this EIS**.**

If an ash recovery facility is constructed in Ireland it would be the intention of Indaver to proactively identify potential uses for the bottom ash. If no market can be found for the bottom ash, it will be sent off-site of to a suitably licensed landfill for non-hazardous waste.

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4.13.3 Boiler Ash

About 1-2% by weight of the waste input will be collected as boiler ash. The boiler ash will consist of compounds that will be carried over in vapour or particulate form from the combustion chamber. Boiler ash will be separately collected and stored in accordance with BAT. Residues will be removed from the boiler by an enclosed conveyor system and transferred to a silo located within the building. The silos will be fitted with HEPA filters to prevent dust emissions. The boiler ash will be transferred to a specialised collection truck which will have an enclosed container. One boiler ash silo of approximately 100m^3 will have the capacity to store the equivalent of 10 days of residue. Refer to **Figure 4.15** for a schematic of the ash handling operations. Boiler Ash will be treated in the same way as flue gas residues and sent to a landfill for hazardous waste or to salt mines.

4.13.4 Flue Gas Cleaning Residues

The flue gas cleaning residues will be approximately 4-5% by weight of the waste input. This material will contain particulates which were not collected in the boiler ash. It will also contain spent activated carbon or clay.

Flue gas cleaning residues will be removed from the baghouse filter by an enclosed conveyor system and transferred to silos located within the enclosed building. There will be two silos with a combined capacity of between 360m^3 and 540m^3. This will provide approximately 10 days storage capacity of residue. The silos will be fitted with HEPA filters to prevent dust emissions. These residues will be transferred to a specialised collection truck which will have an enclosed

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container. The truck will be parked alongside the building and the silo will be connected to the container opening prior to discharge of the residues. There is no prerequisite to solidify these residues prior to transport off-site. Refer to **Figure 4.15** for a schematic of the ash handling operations.

Due to their leachate characteristics it is expected that these residues will be classified as requiring disposal in a landfill for hazardous waste.

If such a facility is available in Ireland, then the residues may be pre-treated on site prior to dispatch. The pre-treatment process will consist of a simple batch mixer which will mix water with the residues and then discharge into 1m^3 FIBC bags to solidify prior to dispatch off-site. The equipment will be located close to the flue gas residue silos within the main process building on the south side. The solidification process will take between 4 and 6 hours.

The bags will then be loaded directly onto trailers and sent off site for treatment. If this option is available, then there will be approximately 77 additional traffic movements per year (due to the addition of water to the residues) which has been accounted for in the traffic assessment in **Chapter 7, *Roads and Traffic*** of this EIS.

Indaver is working with private partners to develop potential outlet options on the island of Ireland and although it is an objective of the EPA National Hazardous Waste Management Plan (2014 - 2020) to develop landfill capacity for hazardous waste in Ireland, there is currently no such capacity. Until such landfill capacity is developed in Ireland, the flue gas cleaning residues will be exported for final disposal. In this case, the residues will be treated at the disposal site to immobilise any components which have the potential to leach.

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Indaver has over 20 years' experience of sourcing suitable outlets, both in Ireland and abroad, for the disposal of hazardous waste. Indaver also operates its own landfill for hazardous waste in Antwerp, Belgium. Similar residues from Indaver's Meath facility are currently being shipped to salt mines in Germany where the residues are solidified and used to back-fill the mine instead of using other raw materials.

The quantities of ash and residues will vary, depending on the calorific value of the waste, the pollutants in the waste and the flue gas cleaning equipment chosen. Estimate quantities are indicated in **Table 4.6** below.

Table 4.6 Estimated Quantities of Residue and Recovered Metals

Material	(kg/h)
Bottom Ash (incl. 15 % moist) (Non-Hazardous for disposal)	6583
Boiler Ash (Hazardous for disposal)	250
Flue Gas Cleaning Residues (Hazardous for disposal)	1138
Ferrous metals	300
Non-ferrous metals	30

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4.13.5 Electricity

The waste-to-energy facility will generate 21MW of electrical energy produced by the combustion of the waste, of which 2.5MW will be used by the facility itself with the remainder, approximately 18.5 MW being exported to the national grid. This will supply 150 GWh of electricity per annum, which will contribute to reducing Ireland's greenhouse gas emissions. Refer to **Chapter 9 *Climate*** of this EIS. Enough electricity will be exported to power 30,000 homes annually.

4.13.6 Heat Balance

Depending on the calorific value of the waste, the heat balance will vary slightly. The expected heat balance is outlined below. Refer also to **Figure 4.16**.

Heat loss by radiation from hot equipment (furnace, boiler, steam cycle) will be approximately 2 MW (2%). This heat, while not recovered, will heat the building. It will be emitted to atmosphere through the natural draught of the building ventilation system.

The expected internal heat recovery (waste to steam) for the facility will be 66.7MW.

66.7 MW steam will enter the turbine at a pressure of 40bar and a temperature of 400˚C. This steam will be converted to 21 MW of electricity and 45.7 MW of hot air which will be dissipated by the air cooled condenser. 7.8 MW steam at lower pressure will be extracted from the steam turbine for internal use.

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Steam will leave the turbine at a pressure of 0.10 bar, a temperature of 46 ˚C and only 11% condensed. The remaining 89% of the steam will be condensed in the air condensers using an indirect cooling system. Therefore the steam will be condensed in a closed loop and ambient air will be heated.

The remaining 11.3 MW of heat will be released from the boiler to the flue gas cleaning system and will be emitted via the stack and through insulation heat loss. This heat is not expected to have any impact on the site or surrounding area.

4.13.7 Energy Efficiency

The electrical generation efficiency of this design will be about 25%, which is low compared with efficiencies of about 37% that can be achieved with coal burning technology or about 57% with modern natural gas combined cycle gas turbine facilities. However, the principal function of the technology is to reduce the volume of waste going to landfill rather than to generate electricity efficiently. The electrical generation efficiency of the proposed facility is high for a waste-to-energy facility.

A number of options are being investigated by suppliers to improve the energy recovery of waste incineration. One of these options is the use of external superheaters that boost the temperature and pressure of the steam from the boiler. However these technologies are not proven in waste-to-energy context and do not have an economical payback as they require additional fossil fuel, and thus have not been considered for this facility.

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A number of novel technologies for the use of the low-grade heat available from waste incineration are at the research stage. These include the Kalina cycle, an ammonia and water based system, and the upgrade of gas turbine fuel (synthesis gas) by chemical change. These technologies are however still in the development stage and thus have not been considered for this facility.

Ireland is required, under EU Directive 2009/28/EC, to ensure that by 2020 at least 20% of all energy consumed in the State is from renewable sources. Incineration with energy recovery of the biodegradable fraction of non-hazardous waste results in production of renewable energy. This is addressed in more detail in **Chapter 2** ***Planning and Policy Framework and Need for the Scheme*** of this EIS.

4.14 Description of Secondary Process/Activities

4.14.1 Emergency Generator

The proposed facility will have a sophisticated control system and back-up system for protection against events which could have the potential to damage the facility, human health or the environment. In the event of a power cut the facility will automatically go into island mode and run independently from the grid, where the turbine is ramped down to provide only house load to the facility and no export. If the turbine is then to shut down while in island mode the complete facility will go into shutdown. During automatic shutdown waste will be prevented from entering the furnace and most electrical/electronic equipment, motors and fans will cease operating except those required to cool the facility and provide emergency lighting. In the event of a power cut, however, these critical motors and fans will require an emergency power supply. This will be provided with a backup or emergency electrical generator powered by a diesel motor.

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The backup generator will be tested weekly for approximately 1hour but only used during automatic shutdowns or power cuts.

4.14.2 Un-interruptible Power Supply

The emergency generator will start-up within seconds after the detection of a power cut but not quickly enough to completely avoid an interruption of power supply. Hence, in the unlikely event of a failure of the supply from the electrical distribution system, the facility's un-interruptible power supply (UPS) will supply electricity to the critical systems, such as the facility control and computer systems. The UPS will be designed to maintain a power supply to the control systems until the emergency generator comes on line for a maximum of 30mins.

4.14.3 Waste-to-Energy Facility Water Management

4.14.3.1 Waste-to-Energy Facility Storm Water Management

The eastern part of the resource recovery facility, when constructed, will form a rainwater catchment area of 3ha consisting of roofed areas, roads and hard standings. The storm water runoff will be discharged to the Local Authority sewer located in the L2545 road to the north of the site.

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In order to prevent flooding of the local sewers the rate of discharge from the site will be controlled to the greenfield rate, based on the SUDS Design Guidelines. The site will be provided with attenuation to store and control the storm water discharge. The attenuation storage capacity will be sufficient for a 1 in 30 year storm over a 24 hour period allowing for 10% for climate change, having a greenfield discharge rate of 18l/s.

The storm water from all of the roads and hard standings will be conveyed via a class 1 hydrocarbon interceptor to the fire water retention tank, which is indicated as tank no. 1 on the drainage drawings. The fire water retention tank will have a capacity of 1690m^3. **Refer to Figure 4.18**.

The storm water from the roofs of all of the buildings will be conveyed to the surface water attenuation tank, which is indicated as tank no. 2 on the drainage drawings. The surface water attenuation tank will have a capacity of 1250m^3.

The tanker unloading area, which is located adjacent to the fuel tank, will be provided with cut off drains to collect any spillage that may occur during loading or unloading. A local holding tank with a 2m^3 capacity will be provided. The outlet valve of the local holding tank will be closed during any tanker unloading operation. If a spillage occurs during a loading or unloading operation, the spilled liquid will be collected in the local holding tank. The contents of the tank will then be pumped out and dealt with appropriately. When the unloading operation has finished, if no spillage has occurred, the valve will be opened and the contents of the tank will drain via a forecourt interceptor to the fire water retention tank.

The surface water attenuation tank and the fire water retention tank will be constructed from reinforced concrete and will be located beside each other beneath the staff car park, which is adjacent to the administration building.

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4.14.3.2 Drainage of Other Areas

Fill will be placed in the western field to raise the ground level. The surface finish to the fill will be crushed stone which is very porous. Rainwater will pass down through the stone before infiltrating into the ground matching the existing drainage regime in the Western Field.

A new infiltration trench will be located at the toe of the embankment for the raised surface to aid with the infiltration.

The storm water drainage in the L2545 road will be improved as part of the road upgrade works as described in Section 4.5.14 above.

4.14.3.3 Storm Water Monitoring

The outlet from the fire water retention tank, into which the storm water run-off from the hardstanding areas and roads will drain, will be continuously monitored. If the monitoring detects that the contents of the tank are within the limits set by the operating licence, the contents will drain to the surface water attenuation tank. Monitoring of all surface water runoff will then take place in the final manhole, SW MH 50, prior to discharge to the public sewer.. If the monitoring station at this final manhole detects contamination, the outlet pumps will be shutoff and the contaminated water will not be discharged from tank 2. The

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contaminated water may be conveyed by tanker to the aqueous waste tank for injection into the process, or removed off site for appropriate disposal.

In the event of the activation of the fire alarm the pumps from tank 2 will be shut off stopping any surface water discharge from the site. In this scenario both tanks combine to provide the fire water retention volume required for the site, 2930m³

It is expected that monitoring will normally show the storm water to be uncontaminated

Table 4.7 shows the operation scenarios for the monitoring and sampling scenarios of Tanks 1 & 2.

Table 4.7 Surface Water Tank Operation Scenarios

Tank Number	All runoff In Specification	Monitoring Station 1 Out of Specification Only	Monitoring Station 2 Out of Specification Only	Fire Alarm
Tank 01	Open	Closed	Open	Open
Tank 02	Open	Open	Closed	Closed

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4.14.3.4 Fire Water Management

Fire water retention, for the retention and control of contaminated water generated when fighting a fire, will be provided for the waste-to-energy facility area. Refer to **Figure 4.19**.

In the event of a fire in the bunker, the water used to fight the fire will be captured in the bunker where it will be stored for disposal. The bunker will have more than adequate capacity for the volume of water used to fight the fire as well as for the waste which will be in it. If there is a fire in any other part of the waste-to-energy facility, the water used to fight the fire will be captured in the recovered water tanks or clean water tank which are located below the building floor. The bunker and the recovered water tanks will be designed as water retaining structures. The fire-fighting water from any fire in an outdoor area will be captured in the storm water drainage system for the yards and roads and will be collected in a combination of the fire water retention and surface water tanks, in which case it can be stored for disposal. The outlet valve from the fire water retention tank will close if there is a trigger level reached by the in-line monitoring equipment. If the fire water retention tank has insufficient capacity, the water will overflow to the surface water attenuation tank using the combined volume for fire water retention.

4.14.3.5 Recovered Water

During the normal operation of the facility the boiler will be required to purge a small quantity of water out of the system in order that the water quality with in the steam cycle can be maintained to a high quality to protect the steam/water side of the boiler tubes and also the turbine. This water will be captured in holding tanks placed below the ground floor slab and will be reused in the process at the wet

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de-slagger. Water that is used in the building to wash down any areas will also be captured in this tank by a series of drainage channels inside the building.

4.15 General Site Services

4.15.1 Water

The mains water supply, piped along the L2545 road, which forms the northern boundary of the site, will be used to supply the facility.

The water main will be diverted to facilitate the road upgrade. Refer to **Chapter 15 Material Assets**.

4.15.2 Sanitary Service

Domestic sewage from toilets, changing and kitchen areas will discharge via the foul drainage system into an on-site wastewater treatment facility. The treated domestic effluent will then be pumped to Irish Water's foul sewer located east of Ringaskiddy Village. Once the Irish Water Lower Harbour sewage treatment facility (Shanbally plant) has been constructed and becomes operational the temporary on-site treatment facility will be decommissioned and untreated sanitary wastewater will be pumped directly to the Irish Water sewer located east of Ringaskiddy Village, which will then be pumped to the Lower Harbour wastewater treatment facility.

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4.15.3 Telecom

Telecom cables including phone lines will be ducted from the site entrance to the main process building where a main switch will be provided. The telecommunications network will extend from the process building to all areas of the site where telemetry or remote monitoring is required. All cables will be underground and ducted.

4.15.4 Gas and Electricity

The gas main which crosses the southern part of the site will be diverted. Discussions have been held with Gas Networks Ireland and they have confirmed that a diversion of the line is to be completed subject to agreement of details at the appropriate time. An indicative layout of the diversion is shown on the planning drawings.

A number of overhead lines traverse or run close to the site. Discussions have been held with ESB networks regarding these and as described in section 4.5.19 above and in **Chapter 15 *Material Assets,*** of this EIS, only one 10kV line requires a diversion. An indicative layout of the diversion is shown on the planning drawings.

4.16 Site Management

When completed and fully operational, the facility will employ approximately 62 permanent personnel, some of whom will work in shifts as the facility will be

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operational 24 hours per day. Employed personnel will be split between the following functions:

- management and administration,
- operations,
- maintenance,
- quality control and assessment,
- shift operators for the waste-to-energy facility.

Initially, senior managerial staff will be sourced from experienced personnel either in Ireland or Belgium. All other staff will be recruited locally prior to start-up.

Key staff will be recruited prior to commissioning and will be trained by experienced personnel at a similar waste-to-energy facility in Ireland or Belgium. Training will also be carried out in co-operation with the waste-to-energy facility contractor and equipment designers and suppliers. As part of the contractual agreement, the incinerator contractor will be required to remain on-site until the facility has been fully commissioned. By doing this, the operators will become familiar with the equipment and learn first hand from the equipment's design engineers.

The facility's staff will be responsible for routine maintenance and inspections of the facility, maintenance budget planning, procurement of services and materials, managing and supervising repairs and overhauls, the upkeep of the management information system (MIS) and updating and renewing environmental and operating permits.

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Major machinery repairs and facility overhauls which cannot be done by the facility's staff will be subcontracted out to either local contractors or to the facility's equipment suppliers. On such occasions the hiring of special expertise or specialised equipment will be required.

Through careful preparation and training, Indaver's staff will be prepared for every stage of construction, commissioning and operation of the proposed facility.

4.16.1 Security

Site security will be provided by a combination of suitable infrastructure and security personnel.

It is proposed that the site entrance will have a security entrance gate. There will be a security fence consisting of palisade fencing (2.4m high) placed along the frontage to main road that forms the northern boundary. The remaining perimeter boundaries of the facility will consist of 2.4m chain link fence. There will be CCTV cameras located at suitable points around the site. Some of these will be mounted on camera towers. The exact number and location of the cameras will be reviewed on an ongoing basis.

A record will be kept of all visitors to the site. Visitors will be monitored and supervised at all times.

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4.16.2 Site Tidiness

Litter patrols will be operated by Indaver staff within the facility, around the site and on the public road adjacent to the facility to ensure that litter will not cause a problem. Waste will not be stored outdoors. Trucks carrying waste will be inspected on arrival to ensure that there will be no waste adhering to the wheels. Trucks carrying waste will discharge their loads in the enclosed tipping hall, which will be under negative air pressure, preventing the emission of odour and litter. A pest control programme will be implemented at the site. These measures will ensure that vermin, scavengers and predators will not be attracted to the facility.

4.17 Health & Safety

4.17.1 Design and Construction Health and Safety

The proposed facility has been designed in accordance with the Safety Health and Welfare at Work Act, 2005 and the Safety, Health and Welfare at Work (Construction) Regulations, 2013. The following principles are incorporated into the design of the proposed facility.

- The facility will be designed by skilled personnel according to internationally recognised standards, design codes, legislation, good practice and experience.
- The design will be reviewed to check for safety hazards in steady and non-steady state conditions and for ease of operability. Backup systems for pumps, control systems, power supply and instruments etc. are provided for critical situations.
- Fire detection and firefighting systems are provided;
- The design will comply with Irish Building Regulations Technical Guidance Document Part B Fire Safety and with Indaver's insurance company's requirements.

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The installation will be validated as part of commissioning procedures and the installation will be well maintained and cleaned.

Indaver will apply strict rules on safety such as a working permit system, training of operators and staff, and provision and use of personal protection equipment where appropriate; and, wherever possible, Indaver will strive to minimise human interaction in safety critical operations in order to eliminate the potential for 'human factors' to initiate or exacerbate major accidents at the site.

It is the policy of Indaver to attach the greatest importance to the health and safety of all persons employed on the project and indirectly affected by the works. All construction projects are carried out, so far as is reasonably practicable, in such a way that the risks to the health and safety of all persons engaged in, or affected by, its construction and maintenance are eliminated or reduced to an acceptable level under current health and safety legislation, namely the Safety, Health and Welfare at Work Act 2005 and good practice.

Indaver employs specialist consultants to act as health and safety co-ordinators on larger projects. Indaver also employs a full time, fully qualified Health and Safety Manager who is responsible for ensuring that relevant legislation is

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adhered to and that best practice in health and safety is employed and enforced during construction.

4.17.2 General Operational Safety

The operation of the waste-to-energy facility will involve hazards associated with the handling of combustible materials, chemicals and high-pressure steam. During the detailed design phase of the facility, hazard and operability studies will be carried out. These studies are a systematic method of identifying hazards and assessing mitigation measures.

Indaver operates a combined Quality, Environmental, Safety and Health (QESH) Management System. The proposed facility will operate to ISO 9001:2000, ISO 14001 and OHSAS 18001, the internationally recognised quality, environmental and health and safety standards.

The QESH policies are the top-level documents of each element of the system. They define Indaver's overall aims and objectives with respect to the provision of a quality service to customers, the provision of a quality workplace to employees and the control over the environmental and health and safety impacts of its activities respectively.

Indaver maintains a Register of Environmental Aspects, which identifies the aspects of Indaver's activities that can interact with the environment and determines where controls are required. Indaver also carries out Health and Safety Risk Assessments in order to identify the health and safety hazards associated with Indaver's activities and to determine where controls are required. Both the Register of Environmental Aspects and the Health and Safety Risk Assessments will be updated to incorporate the activities at the proposed facility.

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Prior to start-up of the Ringaskiddy facility, a comprehensive set of operating procedures covering all aspects of the different activities will be drawn up. The purpose of these procedures is to ensure that Indaver:

- maintains control over the environmental, quality and safety aspects of its activities,
- meets the aims laid down in the Environmental, Quality and Health & Safety Policies, and
- remains compliant with all relevant operating licences, permits and legislative requirements.

In compliance with the Safety, Health and Welfare at Work Act, 2005, Indaver will draw up a safety statement covering the operation of the facility and appoint safety representatives from the facility workforce. Employees represent Indaver's greatest asset. By providing opportunities, facilities and financial resources, Indaver aims to ensure that all members of staff are in possession of the knowledge, skills and experience necessary to perform their jobs to a satisfactory standard.

The incineration process will be controlled manually and automatically by employees and a computerised control system in the control room. Through recruitment, training, performance management, employee development and succession planning, Indaver provides employees with sufficient training,

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experience and knowledge for their roles and ensures that they are competent to perform them.

4.17.3 Fire Safety

4.17.3.1 Design for Fire Safety

The fire safety objectives adopted in the design of the Ringaskiddy Waste-to-Energy facility are to achieve compliance with the Irish Building Regulations with particular reference to Technical Guidance Document Part B Fire Safety, so that a Fire Safety Certificate will be obtained for each building prior to the commencement of construction; and to follow as far as practicable the recommendations in the British Standard BS5588 Code of Practice for Fire Safety in Buildings.

4.17.3.2 Fire Systems

The entire facility will be designed and provided with adequate fire protection and detection systems consistent with the requirements of the Building Regulations and in consultation with Indaver's insurers. The fire protection system will be based on tried and tested systems which are provided in Indaver's existing waste-to-energy facility. The systems for detection and firefighting will include smoke/heat detectors, fire alarm system, on site storage of water for firefighting purposes and manual call points.

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4.17.4 Potential Operating Hazards and Proposed Preventative Safety Measures

Two infrared smoke detectors will be installed in the bunker. The bunker will also be continuously monitored by the crane operator. Any fire would be detected at an early stage by the operator. The automatic detection systems will also monitor the bunker and will activate an alarm in the control room, should the crane operator fail to detect a fire. On activation of an alarm the shift operators will initiate firefighting.

The best practice from the facilities in Meath and Belgium is to lift the part of the waste on fire into the hoppers from whence it will go into the furnace. This waste will then be covered by placing another layer of waste in the hopper.

Two water cannons will be available in the waste bunker. The capacity of each water cannon will be approximately 300 m^3/hr. Local or remote operation of the water cannons will be possible. All firewater, discharged from the water cannons, will be contained within the bunker.

Smoke vents, in the roof over the bunker, will be opened automatically or manually on activation of the sprinkler alarm.

Dry risers will be installed from the outside wall of the building to the hopper platform and to the reception hall level.

The hopper and furnace will be monitored with infrared smoke detectors. Sprinklers over the hopper will be started automatically if fire is detected.

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Fire detection and fire extinguishing systems will be installed along the path of the waste to the furnace as follows:

- The waste feeding hopper will be equipped with sprinklers. In case of fire detection the sprinklers will be activated manually.
- The ram for feeding waste to the furnace will be equipped with a fire damper this will be activated when the temperature exceeds a preset level.
- . Fire detection and firefighting equipment will become active when the fire would break through the waste plug. The damper between the hopper and the feeding ram will be closed as soon as possible as it cannot be closed when the chute is full of waste.

Dedicated ventilation will be provided to avoid the build-up of biogas. The vent air will be drawn into the furnaces for use as combustion air.

There will be 1 lower explosive limit (LEL) detector in the bunker that will generate an alarm. This will give the shift operator the chance to restore safe conditions.

The bunker will be fully constructed in concrete up to the level of the crane bridge supports. Above this level it will be concrete skeleton with steel beams and steel cladding. The wall, separating the bunker area from the incineration section of the facility, will be designed to act as a fire separation wall and the fire protection will extend at least 1m above the adjacent roof of the bunker area.

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4.17.4.1 Furnace

The furnace will be provided with detailed control and safety systems. Interlocks will shut down the installation automatically as soon as a fire risk is detected. In an emergency shutdown (see **Appendix 4.2** for details), all air and waste supply will be stopped to extinguish the fire. In this event all gases will continue to be discharged through the stack via the flue gas cleaning facility. In the event of failure of the main control computer or of the supply of utilities such as air or electricity the facility will be automatically shut down in a safe manner.

4.17.4.2 Steam Production

The design of the steam circuit will be carried out to the best industry standards to minimise hazards. In the event of a power failure the emergency generator will keep one boiler feed water pump in operation to keep the water level in the boiler above a minimum. This will prevent overheating of the boiler.

4.17.4.3 Flue Gas Cleaning System

There is no hazard in the flue gas cleaning. The flue gas cleaning will be designed to withstand the highest flue gas temperature that can come out of the boiler.

The risk of fire from the use of activated carbon or clay will be minimised by the following.

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A dedicated hazard assessment will be undertaken on the storage and dosing system. The flue gas temperature will be monitored and the temperature of the activated carbon/clay will be maintained below 180°C.

In the event of a temperature threshold being exceeded, the facility will automatically shut down.

4.17.5 Emergency Response Planning

A Site Emergency Plan will be prepared prior to operational start-up, which will set out the response measures to be taken by personnel in the event of an emergency. These measures will be designed to ensure maximum protection for the site employees, site visitors and people in other premises near the site, to limit property damage and to minimise the impact on site operations and on the environment. The Site Emergency Plan will have four basic components, as listed below.

4.17.5.1 Prevention

Prevention involves identifying potential hazards and then taking measures to remove the hazard, or reduce the potential for the hazard and its adverse effects.

4.17.5.2 Preparedness

Emergency planning, training programmes, emergency drill and exercise programmes are integral components of an effective preparedness programme. The site will have a dedicated 'emergency response team', which will be given specific training. Evacuation routes will be defined and all personnel will be aware of them.

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4.17.5.3 Response

The site will be manned on a continuous basis. Response activities address the immediate and short-term effects of an emergency.

4.17.5.4 Recovery

Recovery activities and programmes involve restoration of site services and systems to normal status.

4.18 Description of Decommissioning

The facility is expected to have a design life of 25 to 30 years but this could be extended by maintenance, equipment replacement and upgrades.

It is expected that it will be a condition of the industrial emissions licence for the facility that a closure and residuals management plan, including a detailed decommissioning plan, be submitted to the EPA for their approval.

In the event of decommissioning, measures will be undertaken by Indaver to ensure that there will be no environmental impacts from the closed facility. The measures will include:

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- Cancellation of all waste supply contracts,
- All wastes at the facility at time of closure will be incinerated,
- All raw materials, oils, fuels, ash and residues etc. on site at the time of closure will be returned to the supplier, or collected and recycled or disposed of by an authorised waste contractor, as appropriate,
- All process equipment will be decontaminated and decommissioned,
- All equipment from the spare parts warehouse, offices and other facilities will be removed and reused or recycled,
- It is not intended to remove all structures or systems from the site. In general, specialist equipment, pipelines and storage tanks will be sold for reuse, where possible, or disposed of off-site. The process building and external equipment will remain on site and will be in a suitable condition for future site use.
- All buildings will be decontaminated ,
- Retention of roads, hard-standings and site fencing, A monitoring programme of all potential emissions including surface water and dust will be conducted after the decommissioning process in order to ensure that emissions from the facility have ceased. The monitoring programme will consist of two monitoring rounds carried out within two months of decommissioning of the facility.
- When operations have ceased, and assuming confirmation from the monitoring programme that all emissions have ceased, it is expected that there will be no requirement for long-term aftercare management at the site.

The decommissioning measures will have to be implemented to the satisfaction of the EPA.

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4.19 Regulatory Control

4.19.1 Industrial Emissions Licence

Waste disposal in Ireland is controlled primarily through the Waste Management Act of 1996, as amended. Under the act, the EPA has the responsibility for the licensing of all significant waste recovery and disposal activities. In order to operate the waste management facility, Indaver requires a licence from the EPA under the Act. The EPA granted a waste licence to Indaver in November 2005. The licence was amended by the EPA in January 2014 to bring it into conformity with the Industrial Emissions Directive 2010/75/EC. The licence and amendment can be viewed on the EPA website www.epa.ie.

The table of contents for the industrial emissions licence is given below. The licensee must adhere to a wide range of conditions to ensure the satisfactory management of the facility during its operation. The industrial emissions licence also addresses any restoration and aftercare provisions that may be required, once the facility ceases operations.

Decision & Reasons for the Decision

Part I: Activities Licensed

Part II: Activities Refused

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Part III: Glossary of Terms

Condition 1 - Scope

Condition 2 - Management of the Facility

Condition 3 - Infrastructure and Operation

Condition 4 - Interpretation

Condition 5 - Emissions

Condition 6 - Control and Monitoring

Condition 7 - Resource Use and Energy Efficiency

Condition 8 - Materials Handling

Condition 9 - Accident Prevention and Emergency Response

Condition 10 - Decommissioning

Condition 11 - Notifications, Records and Reports

Condition 11 - Financial Charges and Provisions

Schedule A: Limitations

Schedule B: Emission limits

Schedule C: Control & Monitoring

Schedule D: Annual Environmental Report

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4.20 Best Available Techniques (BAT)

4.20.1 Industrial Emissions Directive Definition of BAT

In the Industrial Emissions Directive, Directive 2010/75/EC, best available techniques are required to be used in pollution prevention and control.

The term “best available techniques” is defined in Article 2(10) of Directive as:

> *best available techniques” means the most effective and advanced stage in the development of activities and their methods of operation which indicates the practical suitability of particular techniques for providing the basis for emission limit values and other permit conditions designed to prevent and, where that is not practicable, to reduce emissions and the impact on the environment as a whole:*
>
> *a) “techniques” includes both the technology used and the way in which the installation is designed, built, maintained, operated and decommissioned;*
>
> *b) “available techniques” means those developed on a scale which allows implementation in the relevant industrial sector, under economically and technically viable conditions, taking into consideration the costs and advantages, whether or not the techniques are used or produced inside the Member State in question, as long as they are reasonably accessible to the operator;*
>
> *c) “best” means most effective in achieving a high general level of protection of the environment as a whole;”*

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The EU has prepared a series of reference documents, for different industrial activities, which define BAT for that activity. The final edition of the Best Available Techniques Reference Document (BREF) on Waste Incineration, entitled 'Waste Incineration (WI)', was published by the European Commission in August 2006.

Chapter 5 of the BREF document lists the techniques which are considered BAT with respect to waste to energy facilities. The recommendations of the BREF document on waste incineration have been implemented throughout the design of the facility and will be implemented in it operation. **Appendix 4.4** demonstrates compliance of the Ringaskiddy facility with the relevant provisions of the BREF document.

4.20.2 BAT and the Stockholm Convention on Persistent Organic Pollutants

The concept of BAT is also used in the Stockholm Convention on Persistent Organic Pollutants. PCBs, dioxins and furans are listed in Annex C of the Convention, which addresses persistent organic pollutants which are formed and released unintentionally. The Convention requires best available techniques (BAT) to be used to prevent or reduce the release of these chemicals.

In the Convention, Annex C deals with the use of BAT. In Annex C Part V B, the concept of best available techniques is not aimed at the prescription of any specific technique or technology, but at taking into account the technical characteristics of the installation concerned, its geographical location and the local environmental conditions. In determining best available techniques, consideration should be given to:

> *…(b) General release reduction measures: When considering proposals to construct new facilities or significantly modify existing facilities using processes that release chemicals listed in this Annex, priority consideration should be given to alternative processes, techniques or practices that have similar usefulness but which avoid the formation and release of such chemicals.*

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In cases where such facilities will be constructed or significantly modified, in addition to the prevention measures outlined in section A of Part V the following reduction measures could also be considered in determining best available techniques:

(i) *Use of improved methods for flue-gas cleaning such as thermal or catalytic oxidation, dust precipitation, or adsorption;*

(ii) Treatment of residuals, wastewater, wastes and sewage sludge by, for example, thermal treatment or rendering them inert or chemical processes that detoxify them;

(iii) Process changes that lead to the reduction or elimination of releases, such as moving to closed systems;

(iv) Modification of process designs to improve combustion and prevent formation of the chemicals listed in this Annex, through the control of parameters such as incineration temperature or residence time."

The Convention allows for the participating parties to develop guidance with regard to best environmental practices. Draft guidelines have been prepared and these are also addressed in **Appendix 4.4**.

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4.21 References

European Community (2006) *Integrated Pollution and Control Reference Document on the Best Available Techniques for Waste Incineration*

European Community (2010) *Directive 2010/75/EC on industrial emissions (integrated pollution prevention and control)*

Stockholm Convention (2009) *Stockholm Convention on Persistent Organic Pollutants as amended in 2009*

Stockholm Convention (2006) *Guidelines on best available techniques and guidance on best environmental practices relevant to Article 5 and Annex c of the Stockholm Convention on Persistent Organic Pollutants*

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Appendix 9

Construction Activities

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5. Construction Activities

5.1 Introduction

This chapter describes the construction activities and sequencing for the proposed Ringaskiddy Resource Recovery Centre and outlines the mitigation measures which will be implemented to ensure the potential impacts of the construction activities on the environment are avoided, prevented or reduced.

It is anticipated that, with the proper implementation and management of the construction activities described in this chapter the construction phase of the development will have no significant or long-term impact.

5.2 Geotechnical Investigation

In order to ascertain the undying ground conditions onsite, preliminary soil and hydrogeological investigations were carried out on the site, which included drilling of boreholes and excavating trial pits. The results of the site investigations are described in more detail in **Chapter 13 *Soils, Geology, Hydrogeology, Hydrology and Coastal Recession*** of this EIS*.*

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It seems likely that, in the past, the hillside at the site followed the gentler slope of the surrounding land. Anecdotal evidence suggests that substantial quantities of material were removed from the site and used for reclamation purposes elsewhere in the Ringaskiddy area, thus creating the escarpment now evident on the site.

The topsoil layer is relatively shallow over most of the site. This layer is underlain by soft silty clays, with some fine sands and gravels. Depth to the bedrock varies across the site, from 1.0M below ground level (bgl) at the northern end of the site, where material has been removed in the past, to greater than 9.0m bgl close to the southern boundary.

5.3 Duration and Activities

5.3.1 Overview

The schedule for the construction and commissioning of the Resource Recovery Centre is approximately 31 months.

The road upgrade, associated road drainage and diversions of services will take circa 8 weeks to complete. The diversion to the 220kV underground cables, if required would take circa 4 additional weeks. It is anticipated that the road upgrade, associated road drainage and diversions of services will proceed in advance of the main construction of the Resource Recovery Centre. Refer to Section 5.3.2 below for further details. Of the 12 week duration period, Gobby Beach car park may need to be closed for up to 6 weeks to facilitate the construction works. However, access to the beach will be maintained for the duration of the works.

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The placement of the sacrificial beach material (shingle) required for the coastal protection works will take approximately three weeks to complete. Refer to Section 5.4.3 below for further details. It is envisaged that the coastal protection works will be undertaken towards the end of the construction phase.

It is envisaged that the main stages of construction will be as follows:

- Implement Japanese knotweed management plan for construction phase, fence off infestation area along the western boundary of the site and continue with treatment etc. Note, advance knotweed treatment will commence prior to construction from 2016 onwards. (Refer to Section 5.12.7 below for further details).
- Establish the initial contractor site compound, including the construction phase power supply, fencing and securing of the site,
- Construct temporary road to south of existing L2545 road,
- Upgrading the section of the L2545 road at the northern boundary, including upgrading the drainage and diversion of services
- Construction of new entrance,
- Diversion of existing services within the site, including the gas main, which lies close to the southern and eastern boundaries, and overhead power lines,
- Strip topsoil and vegetation,
- Bulk excavations and general site re-grading, including placing of fill in western field,
- Construction of earth retaining structures, which will happen in tandem with bulk excavations and general site re-grading,
- Establish main contractors' compounds and laydown areas,
- Construction of foundations for main process building,
- Construction of bunker, underground holding tanks and drainage/underground services,
- Erection of superstructure of main process building,
- Construction of ground floor slab of main process building,
- External and internal completions and finishes of main process building,
- Installation of plant and equipment, which will be undertaken in tandem with external and internal completions and finishes,
- Construction of substation, administration building and other ancillary buildings,
- Installation of external plant and equipment,
- Construction of internal roads and parking areas,
- Underground services,
- Surface water drainage system,
- Foul drainage system,
- Connection to existing water and foul services,
- Fit-out and commissioning buildings and equipment,

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- Erection of site fencing.
- Site landscaping.
- Placing of sacrificial material on the beach at the toe of the glacial till face at the eastern boundary of the site.
- Removal of contractor facilities and site hoarding.

5.3.2 L2545 Upgrade and Drainage Upgrade

Introduction

The proposed upgrade works to a section of the L2545 local road, which adjoins the northern boundary of the site, will consist of raising a section of the road to a maximum elevation of 3.45m OD, installing large diameter pipes to provide storm water storage and upgrading the surface water drainage. The likely duration of the works will be 12 weeks in total. This work will be undertaken in advance of the main construction works. The road and drainage upgrade is fully described in Section 4.5.17 of **Chapter 4** ***Description of the Proposed Development,*** of this EIS. A summary is provided below.

Outline description of L2545 upgrade – increase in road levels

The proposed L2545 upgrade works will include raising a 185m section of the road to a maximum height of 3.45m OD between the car park and the eastern end of the Hammond Lane Metal Company. This is approximately 1.0m above the existing road level. The road will be raised over a length of approximately 185m in order to ensure a smooth transition down to existing road levels, in accordance with road design standards. The recently constructed footpath on the northern side of the road will also be raised to the new road level.

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Outline description of L2545 drainage upgrade

The proposed road drainage network upgrade will extend along the entire northern boundary of the Indaver site. The increased storage will be in the form of oversized pipes placed underneath the road. This is described further below.

A 260 metre length of new linear concrete surface water channel will extend from the western boundary (of the western field area) of the Indaver site, running along the southern edge of the L2545 until it meets the entrance to the Hammond Lane Metal Company. This section of the L2545 is currently super-elevated – i.e. the camber on the road falls from north to south, therefore surface water drains to the south. This section of the L2545 will not be raised as the existing levels are already above the predicted 1 in 200 year design tidal level (2.73m OD) and it will be protected to 3.35m OD by the proposed elevated section of road to the east. The new surface water channel will be drained at regular intervals by gullies which will outfall to the existing 450mm diameter surface water sewer beneath the road. Therefore surface water will no longer flow from the road into the Indaver site (western fields) to the south.

The raised section of the L2545 between the car park and the eastern end of the Hammond Lane Metal Company will be drained by a kerb and gully sealed drainage system which will be connected to two new surface water pipes underneath the road. The two 1500mm diameter pipes will be approximately 190m in length and will provide 660m^3 of surface water storage. There will be

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three large concrete chambers constructed on the line of the twin surface water pipes at the start middle and end of the run. The first two chambers will be situated in the road and the terminal chamber will be constructed at the entrance to the car park by Gobby Beach. The recently constructed surface water drainage system on the Haulbowline road will be diverted into the terminal chamber. This chamber will be connected to the existing 450mm diameter surface water sewer via a short length of new 450mm diameter pipe, a new Class 1 bypass hydrocarbon interceptor and a new manhole constructed on the line of the existing pipe. This will allow the upgraded surface water drainage system to discharge to sea via the existing 450mm surface water outfall at Gobby Beach.

All of the above works will be within Indaver ownership, apart from a small area in Hammond Lane ownership. Consent has been given by Hammond Lane to undertake these works.

Outline description of existing services along L2545

The known underground services are a 450mm diameter watermain, 220kV electricity cables, 4 bar gas distribution main, public lighting cables, Eircom underground cables, Enet fibre optic cables, private foul sewer and surface water drainage pipes. There is also an overhead electricity cable crossing the road.

Outline description of construction works required for L2545 upgrade

A construction traffic management plan will be implemented by the appointed Contractor in advance of commencing the works on site. Refer to Section 5.13.5 below for further details.

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Whilst the construction of the road upgrade and associated drainage upgrade can proceed in parallel with the construction of the waste to energy facility, the raising of the levels of the western field lands would require the road drainage works to be complete. Therefore it is anticipated that the road upgrade and drainage works would be commenced at the beginning of the project and progressed to completion as soon as possible.

The first task of the road upgrade will be to construct a temporary two way road, approximately 250m long, to the south of the existing road to create working space for the construction of the raised section of the road, the upgraded drainage system and the diversion of services. The traffic will be diverted onto the temporary road until the upgrade works have been completed. The construction traffic management plan will incorporate a temporary traffic management plan in accordance with Chapter 8 of the Traffic Signs Manual (Department of Transport 2010). An initial site compound and site offices will be provided within the Indaver site to provide facilities for the workforce for the road upgrade works.

The existing services running along and adjacent to the road will be carefully set out and suitable working methods will be employed to ensure that the existing services are protected during construction.

There is an overhead electricity line crossing the road however only a marginal increase in road level (circa 100mm) is proposed at this location. The public lighting columns at the northern edge of the footpath, on the northern edge of the road, will have to be raised to match the new road level and the associated duct chambers will also be raised to match the new footpath level.

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New Eircom ducting is proposed for the northern road verge to allow Eircom cables to be locally diverted within the road. The gas distribution main will also be locally diverted within the road. The existing surface water drainage from the Haulbowline road will be diverted into the new surface water system. The 450mm diameter watermain will also be diverted along the section of road to be raised between the car park and east of Hammond Lane. This work will be undertaken in consultation with Cork County Council, which is acting as an agent for Irish Water. All of the utilities providers have been consulted in relation to the proposed diversions.

The 220kV power lines and corresponding ESB telecoms fibre optics cables beneath the L2545 may need to be raised as a result of the raising of the L2545.The worst case option in terms of potential impacts would involve diverting the cables into new ducts laid at a higher level underneath the raised section of road. Three new joint bays would be required to allow the raised cable to be jointed back to the existing cables at either end and to join the short length of new cable to the recovered length of cable respectively. The joint bays would be located in the existing road.

Diversion works to the remaining services are not envisaged, however some protection measures, such as cover slabs, may need to be employed.

Due to the presence of the existing services, it may not be possible to batter back the excavation for the large drainage pipes and therefore suitable trench supports e.g. sheet piles or large trench boxes may be used.

The 1500mm diameter pipes and the other pipes, road gullies and new underground services, including the new ducts and joint bays for the potential 220kV cable diversion will be installed and the trenches backfilled, and the new road surfacing will be laid using normal construction method and in compliance with the requirements of Cork County Council and Transport Infrastructure Ireland (TII) specifications. A temporary road surface will be provided which will be replaced with the permanent surface once the main construction project has been completed.

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Provision for the site connections to the water main, telecommunications infrastructure and surface water and sanitary sewers will be made during road upgrade works.

Materials required

The road upgrade will involve the following quantities of bulk materials:

- Excavation of circa 3,050m^3 unsuitable material including circa 225m^3 bituminous macadam,
- Importation of 1,400m^3 pipe bed and surround material,
- Import 1,400m^3 select granular fill for new road construction,
- Importation of 370m^3 asphalt for new road.
- Importation of 1000m^3 select granular fill for temporary road construction.

The imported granular fill for the construction of the temporary road may be reused for the construction of internal site roads.

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Uncontaminated soil and stone materials which are not suitable for re-use will be disposed of to an appropriate site which is permitted under the Waste Management (Collection Permit) Regulations 2007 and 2008 to accept soil and stone. There are 13 such permitted sites within a 40km radius of the proposed Resource Recovery Centre site. The environmental impacts associated with the permitted site have already been assessed by the planning authority under the approval process specified in the Waste Management (Collection Permit) Regulations 2007 and 2008. All traffic movements associated with the export of materials have been included in the construction traffic impact assessment. Refer to **Chapter 7** (***Roads and Traffic***) for further details.

Materials required for the road upgrade will be sourced locally where possible. Materials required from quarries will only be sourced from quarries which are listed on the register maintained by the local authority. The environmental impacts associated with the registered quarry have already been assessed by the local authority under Section 261 of the Planning and Development Act 2000, as amended. All traffic movements associated with the import of materials have been included in the construction traffic impact assessment. Refer to **Chapter 7 *Roads and Traffic*** of this EIS for further details.

5.4 Site Preparation Works

Once the road upgrade has been completed, the site preparation will commence with the establishment of safe access and site roads. A perimeter fence will be erected around the construction site. Re-grading work will be required. Where feasible, excavated material will be retained on site, either in the eastern area or western field, for use as bulk fill or for landscaping, with the surplus being sent to an appropriate site which is permitted under the Waste Management (Collection Permit) Regulations 2007 and 2008 to accept soil and stone. The quantities of materials being moved offsite will be minimised. All traffic movements associated with the export of materials have been included in the construction traffic impact assessment. Refer to **Chapter 7, *Roads and Traffic*** of this EIS for further details.

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It is anticipated that the bulk excavation will take approximately six months. The central part of the site for the waste-to-energy facility will require significant earth retaining structures. These will be constructed in tandem with the bulk earthworks and re-grading.

The material to be removed will comprise overburden and rock. Refer to **Chapter 13 *Soils, Geology, Hydrogeology, Hydrology and Coastal Recession*** of this EIS for a description of the soils and geology underlying the site. The bedrock is comprised of sandstone/siltstone and mudstone. The top 0.5m to 1m of the bedrock is weathered and it is expected that it can be removed using a large excavator. It is expected that the remainder can be removed using chisel or hammer-operated rock breakers. It is anticipated that blasting will not be required. Refer to **Chapter 10, *Noise and Vibration*** and **Chapter, 8 *Air Quality*** of this EIS for details on construction noise and dust impacts and mitigation measures.

Rock crushing may be undertaken on site in order to make the excavated rock suitable for re-use as general fill. Crushed stone will need to be imported onto site. Materials required from quarries will only be sourced from quarries which are

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listed on the register maintained by the local authority. The environmental impacts associated with the registered quarry have already been assessed by the local authority under Section 261 of the Planning and Development Act 2000, as amended. All traffic movements associated with the import of materials have been included in the construction traffic impact assessment. Refer to **Chapter 7, *Roads and Traffic*** of this EIS for further details.

Site preparation works will also include the facilities for the contractors and the construction management team. These will include the following:

- Setting up of access control to the site.
- Site offices.
- Site facilities (canteen, toilets, drying rooms, etc.).
- Offices for construction management team.
- Secure compound for the storage of all on-site machinery and materials.
- Temporary car parking facilities.
- Permanent and temporary fencing.
- Site Security.

The western field will be used for the construction laydown areas and the construction facilities, following an initial phase of earthworks to raise the ground levels in this area.

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5.4.1 Main Construction Works

Once site levels have been established by the initial bulk excavation works and construction of the retaining structures, the construction of the waste-to-energy facility will commence with the construction of the foundations for the building and equipment, the bunker and the tanks and services to be located under the ground floor. The upper floors and main building support structures will then be completed. Installation of plant and equipment will be undertaken in parallel. The contractor will work on the construction of the foundations and superstructure and installation of the equipment in the ancillary buildings, and the installation of the external plant and equipment, once construction of the waste-to-energy facility has progressed.

Site roads, car parks and site fencing will be completed and the landscaping will be undertaken, when the main construction and equipment installation is completed and commissioning is underway.

5.4.2 Construction of Grid Connection

The proposed development includes a grid connection to the boundary of the adjacent ESB Networks Lough Beg substation. The ESB Lough Beg substation is located on the eastern boundary of the Hammond Lane Metal Recycling Company Ltd. The lands over which the entire grid connection will be constructed lie within Indaver's ownership (save for a small section comprising associated works on the adjacent substation owned by ESB Networks). These works will be carried out by ESB Networks and do not form part of the planning application.

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The grid connection will be made by running underground cables between the ESB Networks Lough Bed substation and the import/export substation on-site, east of the main site entrance. Underground cables will be laid, using normal construction methods and complying with ESB Networks requirements.

5.4.3 Coastal Defence Works

Approximately 1,100m^3 of imported rounded shingle of appropriate size will be placed, as sacrificial material, at the toe of the glacial till face on Gobby beach which forms the eastern boundary of the site. The works will extend along the beach from near the car park at the northern end of the Indaver site to the southern boundary of the Indaver site. The material will be deposited above the high water mark.

The placement of the sacrificial beach material (shingle) required for the coastal protection works will take approximately three weeks to complete. It is envisaged that the first instalment of the shingle will be undertaken towards the end of the construction phase.

The sacrificial material has been designed to remain on site and help lower the natural erosion rate over a number of years. However, the expected duration of the material cannot be determined since it depends on the occurrence of extreme wave events which are impossible to forecast. Therefore it is anticipated that monitoring of the sacrificial material and the cliff face will take place on an annual basis. Replenishment of the material will be carried out as determined by the monitoring results. It is envisaged that replenishment may be required every two to five years but it depends on the duration of the material remaining on site. The impacts described below for the initial instalment of shingle will be repeated during replenishment.

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The shingle, required for the coastal protection works will be sourced from a quarry which is listed on the register maintained by the local authority. The environmental impacts associated with the registered quarry have already been assessed by the local authority under Section 261 of the Planning and Development Act 2000, as amended. The registered quarry will have similar geological properties to the material found on Gobby Beach so that the shingle chosen will match the existing material on Gobby Beach.

All traffic movements associated with the import of the shingle have been included in the construction traffic impact assessment. Refer to **Chapter 7, *Roads and Traffic*** of this EIS for further details.

The imported shingle will be transported by road and temporarily deposited at the car park at Gobby Beach. A bulldozer will be used to spread the imported shingle in the designated area. It is anticipated that access for construction machinery across the beach will be facilitated by laying down temporary tracks.

To ensure the safety of the general public, it is envisaged that the area of the beach, in which the construction works will take place and the area of the car park in which the materials will be stored, and which will be used by the machinery, will be closed to the public for the duration of the proposed works, approximately three weeks. However, access to the rest of the beach will be maintained for the duration of the works.

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The traffic movements associated with the coastal protection works have been included in the construction traffic impact assessment. Refer to **Chapter 7**, ***Roads and Traffic*** of this EIS for further details).

5.4.4 Construction Methods

The proposed development will be constructed employing best practice in safety and efficiency.

In-situ reinforced concrete will be used to form foundations. In the parts of the site where the ground levels are raised, or where the bearing strata does not have the required geotechnical properties, foundations will be piled. In-situ reinforced concrete will be used to form ground bearing floor slabs, upper floor suspended slabs and earth retaining structures. Soil nailing or rock anchors may be used for some earth retaining structures, where the rock is suitable. Underground tanks, chambers and process areas will be constructed of in-situ concrete and will be designed as water retaining structures to the relevant codes. Where required these structures will be double contained, using a high density polyethylene or polypropylene liner.

It is likely that all concrete will be brought to site ready-mixed in trucks. The concrete may be placed directly from the trucks, or it may be pumped or be placed by skips hoisted by a crane.

It is envisaged that some of the minor structural elements (e.g. non-load bearing walls) may be constructed in concrete block work.

The superstructures for the buildings will be constructed in structural steel. Steel members will be fabricated off site in lengths that are safe to transport, and erected on site. Structural steel will also be used to support the process equipment and to provide access platforms.

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The buildings will be clad in profiled metal cladding and the roofing will consist of profiled metal cladding or a membrane type system on and metal deck. Depending on the function of the buildings, the cladding and roof will be insulated.

Cranes will be a significant element of the construction plant and it is envisaged that various crane systems will be used for lifting materials in to place.

The construction of the proposed development will require considerable movements of materials to and from the site. Most of the materials leaving the site will consist of spoil from the excavation works. It is estimated that almost 74,664m^3 of surplus material will be removed from the site. This material is expected to be suitable for deposition in a permitted site. Almost 30,261m^3 of engineering fill and crushed stone will be imported onto the site. These figures include an allowance for bulking up of material.

Uncontaminated soil and stone materials which are not suitable for re-use will be disposed of to an appropriate site which is permitted under the Waste Management (Collection Permit) Regulations 2007 and 2008 to accept soil and stone. There are 13 such permitted sites within a 40km radius of the proposed resource recovery centre site. The environmental impacts associated with the permitted site have already been assessed by the planning authority under the approval process specified in the Waste Management (Collection Permit)

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Regulations 2007 and 2008. All traffic movements associated with the export of materials have been included in the construction traffic impact assessment. Refer to Chapter 7 (Roads and Traffic) for further details

Materials required for the construction works will be sourced locally where possible. Materials required from quarries will only be sourced from quarries which are listed on the register maintained by the local authority. The environmental impacts associated with the registered quarry have already been assessed by the local authority under Section 261 of the Planning and Development Act 2000, as amended. All traffic movements associated with the import of materials have been included in the construction traffic impact assessment. Refer to Chapter 7 (Roads and Traffic) for further details.

5.5 Material Sources and Transportation

The selection and specification of construction materials will be informed by local availability of these materials. Within the necessary constraints of performance, durability and cost, construction materials will be sourced from local suppliers and manufacturers, where possible. Construction materials will be transported from the suppliers via the national primary route network as far as Ringaskiddy village and will use the L2545 from the Village to the site. Refer to **Chapter 7, *Roads and Traffic*** of this EIS for an assessment of the impact of construction traffic.

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5.6 Services and Utilities Requirements for Construction

5.6.1 Electricity

It is anticipated that the construction work will require a peak load of 300kVA. In liaison with the ESB Networks, a temporary transformer served from local supplies will be installed to provide this.

5.6.2 Water Supply

The construction activities that will require water during the construction phase will be relatively small. The initial estimate of demand is approximately 10m^3 per day, primarily based on the demand requirement for the construction workers and the associated support facilities. In agreement with Irish Water, water will be sourced from the existing water main located in the L2545 road to the north of the site where there is ample supply to meet this demand.

5.6.3 Storm Water and Foul Water Disposal

A dedicated holding tank for storage of construction foul effluent will be constructed prior to commencement of the main construction activities. The effluent will be regularly disposed of off-site by tanker by a licensed contractor to an approved licenced facility.

Storm water will be managed carefully during construction. In general, storm water will be infiltrated to ground via silt traps and managed soakaways. The laydown areas will be suitably drained and any areas which will involve the

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storage of fuel and refuelling will be paved and bunded and hydrocarbon interceptors will be installed to ensure that no spillages will get into the surface water or groundwater.

5.7 Employment and Welfare

Through the construction phase there will be some variation in the numbers working on site. It is anticipated that a maximum of 320 construction workers will be employed on site at any one time with around 250 workers working a daytime shift and 70 working a night shift.

Temporary office accommodation and other construction facilities will be installed on site for the construction phase. All temporary units will be of a high standard in accordance with statutory regulations, as a minimum.

The co-ordination of people and materials on-site will be one of the key activities throughout the construction phases. The construction traffic management plan will designate traffic routes, timings and parking arrangements.

The site start time will ensure that construction workers arrive in the Ringaskiddy area prior to the morning peak hour for traffic on the local network. No construction vehicles will arrive or depart the proposed development site during the morning and evening peak periods (07:00-09:00 and 16:00-18:00) during the construction phase. Typical working hours during the construction phase will be:

Start	Finish	
0600	2000	Monday – Friday
0700	1300	Saturday

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It will be necessary to work overtime (including at weekends) and night shifts at certain critical stages during the project. Consideration of safety, weather or sub-contractor availability is likely to necessitate working outside normal hours. Over the 31 month construction phase there will be up to 8 weeks of night time working. Heavy or noisy construction activities will be avoided outside normal hours and the amount of work outside normal hours will be strictly controlled. Refer to **Chapter 7 *Roads and Traffic*** of this EIS for further details on construction traffic.

5.8 Commissioning Phase

Following completion of construction and installation of equipment, and before operation of the facility commences, there will be a testing and commissioning phase. This phase will comprise:

- Installation compliance checks
- Commissioning tests
- Performance demonstration tests

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5.8.1 Installation Compliance Checks

This will be a process of systematically checking that all systems and equipment have been constructed, assembled, aligned and installed correctly, in accordance with the design specifications and drawings, and that all interconnecting pipe work, cabling and wiring has been installed in compliance with the design specifications and drawings.

5.8.2 Commissioning Tests

The function of each item of equipment and each system will be tested and verified, in a systematic manner, as being in accordance with the design and specifications. All the alarm and control systems and instrumentation will be tested to demonstrate that they are functioning correctly. Following these tests, each system will be checked to ensure that it is ready to be commissioned under operating conditions including using real materials, temperatures, pressures and voltages.

5.8.3 Performance Demonstration Tests

In this commissioning phase, the individual items of equipment and systems will be tested under operating conditions using the materials, temperatures, pressures and voltages to which they will be subjected when in operation. Once the operation of all equipment and systems have been tested and verified individually, they will be integrated and the operation of complete systems will be tested.

The facility's safety and fire prevention systems and the emission monitoring systems will be subject to the same rigorous testing protocols as the other systems in the plant.

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5.8.4 Incineration Plant Test Programme

It is likely to be a requirement of the industrial emissions licence that a test programme is undertaken to demonstrate the performance of the waste-to-energy facility, including operations, control and abatement systems, emissions, monitoring equipment and back-up systems. The test programme must be completed and a report submitted to the EPA before normal operations can commence.

5.9 Construction Site Decommissioning

On completion of construction, all construction facilities and equipment such as plant, materials, signage, contractors' offices and laydown areas, etc. will be removed from site. Some contractor facilities will remain until the end of the guarantee time of the incinerator due to guarantee obligations of the contractors.

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5.10 Potential Construction Impacts

5.10.1 General

The potential impacts identified in this section represent the “worst case” scenario predicted in the absence of any mitigation.

Potential construction phase impacts include emissions to air such as dust, noise and vibration, construction traffic (including oversized deliveries), surface water runoff from the site, leaks or spills from construction plant and equipment, construction waste, disruption to users of Gobby beach during placement of sacrificial material on the beach, and disruption to road users during the road upgrade. Additional traffic on the road network will be generated by the construction works.

There is also the potential for impacts on existing underground services during construction i.e. the gas distribution main and the 220kV underground cables and other services that run in the vicinity of the site and under the L2545 road. In particular, the 450mm diameter water main in the road is understood to be subject to occasional leaks. This watermain runs along the northern side of the road. There is the potential that this could be damaged along the section of road to be raised. It is not expected that the section of the 450mm water main between the western boundary of the Indaver site and Hammond Lane will be impacted as it is located on the northern side of the road whereas the proposed drainage works in this area will be located along the southern side of the road.

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There will be temporary outages and disruption to the services as new connections are made and/or services are relocated.

Potential construction phase impacts are also addressed in other chapters of this EIS. For example, the construction phase impacts on air quality, climate and noise and vibration are evaluated in **Chapters 8 *Air Quality*, 9 *Climate*** and **10 *Noise and Vibration*** of this EIS respectively. Construction traffic is addressed in **Chapter 7 *Roads and Traffic*** of this EIS. There is an evaluation of the construction impacts on flora and fauna in **Chapter 12 *Biodiversity*** of this EIS. The construction impact on the archaeological, architectural and cultural heritage is addressed in **Chapter 14, *Archaeological, Architectural & Cultural Heritage*** of this EIS. Visual impacts and lighting impacts during construction are detailed in **Chapter 11 *Landscape and Visual*** of this EIS. Potential construction phase impacts on Soils, Geology, Hydrogeology and Coastal Recession are addressed in **Chapter 13 *Soils, Geology, Hydrogeology, Hydrology and Coastal Recession*** of this EIS. Specific construction phase mitigation measures are described in the individual chapters and general mitigation measures are described below.

5.10.2 Do Nothing Impacts

If the proposed development did not go ahead, it is likely that the lands would remain the same or would be developed by some other developer for another industrial purpose. The road drainage would not be upgraded and the road levels would not be raised. Consequently, the road would continue to flood following heavy rain and the road would be vulnerable to tidal flooding, particularly following a rise in sea levels due to climate change.

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5.11 Predicted Impacts of Decommissioning Phase

The decommissioning activities are described in Section 4.18 of **Chapter 4** ***Description of the Proposed Development*** of this EIS. These include:

- Incineration of all waste on site,
- Removal off-site of all raw materials, other process materials and residues,
- Decontamination, using chemicals and or power washing, and decommissioning of all plant and equipment,
- Removal of sludge from tanks and inceptors,
- Cleaning of all remaining equipment, pipelines etc.,
- Removal of specialist equipment, tanks, and pipelines from site, and
- Retention of buildings, roads, hard-standings and site fencing.

The site surface water drainage system, site fire safety systems and security systems will remain in place until the decontamination and decommissioning activities have been substantially completed. This will ensure that the decontamination and decommissioning activities will not give rise to a significant risk of environmental pollution.

The decommissioning activities are expected to take six months. Environmental monitoring, testing, validation and reporting will be undertaken for a further six to twelve months. Security will be maintained on site until the decommissioning activities and environmental reporting have been completed.

There will be up to 15 staff and contractors' personnel on site during the six months but the average number on site will be less than this. The decommissioning activities will be undertaken within the hours of 08.00 to 18.00 from Monday to Friday.

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Circa 5,500 tonnes of materials and wash waters will be removed from site during the decontamination phase. This represents 275 truckloads of material to be removed from the site over a three month period of the decontamination phase, which is an average of approximately 5 trucks a day.

The decommissioning activities will involve substantially fewer site activities, a substantially smaller workforce and substantially less truck and car traffic than the construction phase. Consequently, it is expected that the decommissioning will not have a significant impact on the environment or the nearest residential receptors.

5.12 Construction Mitigation Measures

5.12.1 General

Every effort will be made to ensure that any detrimental environmental effects will be avoided, prevented or reduced during the construction phase of this project.

A construction environmental management plan (CEMP) will be prepared prior to construction commencing. The CEMP will comprise all of the construction

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mitigation measures, which are set out in this EIS, and any additional measures which are required by the conditions attached to the Board's decision. Implementation of the CEMP will ensure disruption and nuisance are kept to a minimum. The plan will have regard to the guidance contained in the handbook published by Construction Industry Research and Information Association (CIRIA) in the UK, *Environmental Good Practice on Site Guide, 4th Edition* (CIRIA 2015).

Indaver will appoint a construction management team for the duration of the construction phase. The team will supervise the construction of the project, including monitoring the performance of the contractors to ensure that the proposed construction phase mitigation measures are implemented and that construction impacts and nuisance are minimised. Indaver will liaise with neighbours and the general community during the construction phase to ensure that any disturbance is kept to a minimum.

5.12.2 Dust

The potential for dust to be emitted depends on the type of construction activity being carried out in conjunction with environmental factors including levels of rainfall, wind speeds and wind direction. The potential for impact from dust depends on the distance to potentially sensitive locations and whether the wind can carry the dust to these locations. The majority of dust produced will be deposited close to the generated source. A dust minimisation plan will be formulated for the construction phase of the project, as construction activities are likely to generate some dust emissions.

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In order to ensure that no dust nuisance occurs, a series of measures will be implemented.

- Hard surface roads will be swept to remove mud and aggregate materials from their surface while any un-surfaced roads will be restricted to essential site traffic only apart from the contractor's car park which will be hardcore only.
- Furthermore, any road that has the potential to give rise to fugitive dust must be regularly watered, as appropriate, during dry and/or windy conditions.
- Vehicles using site roads will have their speed restricted, and this speed restriction must be enforced rigidly. On any un-surfaced site road, this will be 20 kph, and on hard surfaced roads as site management dictates.
- Vehicles delivering material with dust potential (soil, aggregates) will be enclosed or covered with tarpaulin at all times to restrict the escape of dust.
- Wheel washing facilities will be provided for vehicle exiting site in order to ensure that mud and other wastes are not tracked onto public roads.
- Public roads outside the site will be regularly inspected for cleanliness, and cleaned as necessary.
- Material handling systems and site stockpiling of materials will be designed and laid out to minimise exposure to wind. Water misting or sprays will be used as required if particularly dusty activities are necessary during dry or windy periods.

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- During movement of materials both on and off-site, trucks will be stringently covered with tarpaulin at all times. Before entrance onto public roads, trucks will be adequately inspected to ensure no potential for dust emissions.

At all times, these procedures will be strictly monitored and assessed. In the event of dust nuisance occurring outside the site boundary, movements of materials likely to raise dust would be curtailed and satisfactory procedures implemented to rectify the problem before the resumption of construction operations. Refer also to **Chapter 8 *Air Quality*** of this EIS

5.12.3 Debris

The following are some of the measures that will be taken to ensure that the site and surroundings are maintained to a high standard of cleanliness:

- Daily inspections will be undertaken to monitor tidiness.
- A regular program of site tidying will be established to ensure a safe and orderly site.
- If necessary, scaffolding will have debris netting attached to prevent materials and equipment being scattered by the wind.
- Food waste will be strictly controlled on all parts of the site.
- Wheel wash facilities will be provided for vehicles exiting the project site. Wheel wash run off will be stored in an on site storage tank and will be disposed of by permitted waste haulage company at a permitted or licensed facility.
- In the unlikely event that mud is carried from the project site to the public road, it will be cleaned as required and will not be allowed to accumulate.
- Loaded Lorries and skips will be covered if required.
- Surrounding roads used by trucks for access to and egress from the site will be inspected regularly and cleaned, using an approved mechanical road sweeper, when required.
- In the event of any fugitive solid waste escaping the site, it will be collected immediately and removed to storage on site, and subsequently disposed of in the normal manner.

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5.12.4 Noise and Vibration

Construction noise will be kept to a minimum in accordance with BS 5228 (2009). Construction-phase noise impacts are addressed in **Chapter 10 *Noise and Vibration*** of this EIS.

The contract documents will specify that the contractor, undertaking the construction of the works, will be obliged to take specific noise abatement measures and will comply with the best practice outlined in British Standard BS 5228 – 1: 2009 +A1 2014: *Code of practice for noise and vibration control on construction and open sites – Noise* and the NRA (now TII) guidelines *Good Practice Guideline for the Treatment of Noise during the planning of National Road Schemes* (NRA 2014).

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There will be no significant construction noise or vibration impacts on neighbouring residences.

Prior to the construction works commencing on site, environmental noise and vibration monitors will be installed at the selected monitoring locations. Refer to **Chapter 10 *Noise and Vibration*** of this EIS for further details.

It is anticipated that no significant vibration will be generated during the construction phases of the proposed development. Piling is likely to be required. It will utilise methods that will minimise the risk of vibration generation and will only be undertaken in daytime. Rock breaking, if required will use methods that will minimise noise and vibration.

5.12.5 Existing Services

The existing services running in and adjacent to the site and the road will be carefully located, identified and suitable working methods will be employed to ensure that these services are protected. Diversion or relocation of services will be undertaken in consultation with the owners of the services and will be undertaken in accordance with the relevant standards and codes of practice. Some protection measures such as cover slabs may be used for the services which will be left in place. Pipeline protection slabs will be used for works carried out in the vicinity of the gas transmission line, once it has been diverted. The section of the 450mm water main, which is located in the part of the road where the level is to be raised, will be replaced. This work will be undertaken in consultation with Cork County Council, which is acting as an agent for Irish Water.

Service users will be notified in advance of any temporary disruption or outages necessitated by the construction works. The disruption to services or outages will be carefully planned so the duration are minimised.

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5.12.6 Biodiversity

Potential impacts of the construction phase on biodiversity are addressed in **Chapter 12 *Biodiversity*** of this EIS.

5.12.7 Invasive Non-native Plant Species Japanese Knotweed

Japanese knotweed is a highly invasive, non-native species which can out-compete native plant species and which can penetrate through small faults in tarmac and concrete and thus can damage roads, footpaths and structures.

At present, there are no specific legislative provisions that directly govern Japanese knotweed control or removal in Ireland.

Ecological surveys recorded a small stand of Japanese knotweed along the western boundary of the site and also outside the site's north-western boundary. Refer to **Figure 12.3** for location details. The site layout of the proposed development has been designed not to directly impact on the stand of Japanese knotweed. As part of the management of the infestation, the site will be

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resurveyed in the spring of 2016 and treatment (spraying) will commence in the summer of 2016.

There is also the potential for Japanese knotweed to be inadvertently brought onsite in imported fill or on the wheels/tracks of construction vehicles. The supplier of fill will be required to provide a guarantee that the fill to be imported does not contain Knotweed. In addition, the fill will be inspected for signs of knotweed, prior to importation to site. The UK Environmental Agency's publication *Managing Japanese knotweed on development sites - The Knotweed Code of Practice* (EA 2013), states that inspection of topsoil brought into the site, should be carried out using the guidance in appendix I-IV of the code BS 3882:2007 *The British Standard Specification for topsoil and requirements for use*. This Standard was replaced subsequently by BS3882:2015 *Specification for Topsoil.* The inspection of fill will be carried out according to this Standard.

The contractor will be required to inspect vehicles before using them on site, and will pay particular attention to caterpillar tracks and where trucks and dumpers are stowed.

Following treatment in 2016, a management plan for the control of Japanese knotweed on the site during construction will be developed with reference to the following codes of practice and guidelines.

- Best Practice Management Guidelines Japanese knotweed Fallopia japonica (2008) - prepared for NIEA and NPWS as part of Invasive Species Ireland.
- NRA Guidelines on The Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads (2008)
- Managing Japanese knotweed on development sites - The Knotweed Code of Practice produced by the Environmental Agency.

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The implementation of the above measures will minimise the risk of Knotweed being spread within the site or outside the site during the construction phase of the proposed development.

5.13 Construction Waste Management

5.13.1 General

Waste generated during the construction phase will be carefully managed according to the accepted waste hierarchy which gives precedence to prevention, minimisation, reuse and recycling over disposal with energy recovery and finally disposal to landfill.

This hierarchy will be implemented by identifying opportunities to firstly prevent waste from being produced, and secondly minimise the amount of waste produced. Where prevention and minimisation will not be feasible, ways to reuse or recycle waste will be sought, preferably on-site to avoid the impacts arising from transportation. If this is not feasible, opportunities to reuse or recycle the waste off-site will be investigated. If this is not feasible, then waste will be sent to an energy recovery facility, and only where there is no alternative, will waste be disposed of to landfill. To achieve this, existing waste management programmes and networks will be used such as the National Waste Prevention Programme, which is implemented by the Environmental Protection Agency.

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All waste removed from the site will be collected only by contractors with valid waste collection permits, under the Waste Management (Collection Permit) Regulations. All facilities to which waste will be taken will have appropriate waste licences or permits, under the Waste Management Act 1996, as amended, and the regulations thereunder, allowing them to accept the type of waste that is to be sent there. Hazardous waste generation will be minimised, and such waste will be recovered where feasible, and only disposed of if recovery is not feasible. Hazardous waste will be managed in accordance with the relevant legislation.

5.13.2 Waste Arising

In general, construction waste materials may include general construction debris, scrap timber and steel, machinery oils and chemical cleaning solutions. The practice of excessive purchase of materials and equipment to allow for anticipated wastage will be avoided.

The excavated material, which is expected to be uncontaminated soil and stone, may be unsuitable, because of its engineering properties, for use as backfill. Typically, this material will be re-used on site as non-structural fill material, or for landscaping and other uses. The excavated material which is not re-used on site may be suitable for use as non-structural fill material, or for landscaping on another site. The excavated material which is not re-used will be disposed of to an appropriate permitted site. This material which would be suitable for disposal [1]at sites, which have permits under the Waste Management (Collection Permit) Regulations 2007 and 2008 to accept soil and stone. There are 13 such sites within a 40km radius of the proposed resource recovery centre site[1]. The environmental impacts associated with the permitted site have already been assessed by the planning authority under the approval process specified in the Waste Management (Collection Permit) Regulations 2007 and 2008.

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In the unlikely event of any evidence of soil contamination being found during work on site, the appropriate remediation measures will be employed. Any work of this nature would be carried out in consultation with, and with the approval of the Environmental Department of Cork County Council. The material would be transported to a permitted site via the national and regional road network.

Timber from trees, felled as part of the site preparation, will be sold to the timber industry.

5.13.3 Waste Management Plan for the Construction Phase

The contractor will be required to develop, implement and maintain a Waste Management Plan during the construction works. A senior manager will be responsible for the waste management plan. The manager will be competent in waste management, and will receive training, where necessary, such as the CIF Site Waste Management and Environmental Awareness course.

1 http://www.corkcoco.ie/co/web/Cork%20County%20Council/Departments/Environment%20%26%20Waste/Publications?did=739025488&pageUrl=/Cork+County+Council/Departments/Environment+%26+Waste/Publications, accessed August 2015.

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The key principles underlying the plan will be to minimise waste generation and to segregate waste at source. The measures to achieve these aims include:

- Ordering of appropriate quantities of materials, with a just-in-time philosophy.
- Immediate and careful storage of materials delivered to the site.
- Storing materials which are vulnerable to damage by rain under cover and raised above the ground.
- Careful handling of materials, using appropriate equipment, to avoid undue damage.
- Designation of separate storage areas for different types of waste, in order to maximise the reuse and recycling potential of the waste.

The Waste Management Plan will outline how residual waste will be handled as follows:

- The identification of disposal sites.
- The identification of quantities to be excavated and disposed of and classification of this material.
- The identification of measures to prevent nuisance, etc.
- The identification of the amounts intended to be stored temporarily on site and the location of such storage.
- The contractor's approach to waste management.
- The names, roles, responsibilities, and authority of the key personnel involved in the waste management.

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The Waste Management Plan will include documented procedures for dealing with waste management including liaison with third parties, statutory undertakers and other companies.

The Waste Management Plan will meet the requirements of the guidelines prepared by the National Construction and Demolition Waste Council (NCDWC), *Best Practice Guidelines on the Preparation of Waste Management Plans for Construction & Demolition Projects*, NCDWC 2006.

5.13.4 Soil, Surface Water and Groundwater

There are no watercourses on site. Cork Harbour lies adjacent to the eastern boundary of the site. The employment of good construction management practices will minimise the risk of pollution of soil, storm water run-off, seawater or groundwater. The Construction Industry Research and Information Association (CIRIA) in the UK has issued a guidance note on the control and management of water pollution from construction sites, *Control of Water Pollution from Construction Sites, guidance for consultants and contractors* (Masters-Williams et al 2001). Additional guidance is provided in the CIRIA technical guidance on *Control of Water Pollution from Linear Construction Projects* (Murnane *et al* 2006).

The guides are written for project promoters, design engineers and site and construction managers. They address the main causes of pollution of soil, groundwater and surface waters from construction sites and describes the

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protection measures required to prevent pollution of groundwater and surface waters and the emergency response procedures to be put in place so that any pollution, which occurs, can be remedied. The guides address developments on green field and potentially contaminated brownfield sites. The construction management of the site will take account of the recommendations of the CIRIA guidance to minimise as far as possible the risk of soil, groundwater and surface water contamination.

Site activities considered in the guidance include the following:

- excavation
- earthmoving
- concreting operations
- spreading of topsoil
- road surfacing
- site drainage, and the control and discharge of surface water runoff from the site
- oil and fuel delivery and storage
- plant maintenance

Measures, as recommended in the guidance above, that will be implemented to minimise the risk of spills and contamination of soils and waters, include:

- Training of site managers, foremen and workforce, including all subcontractors, in pollution risks and preventative measures,
- Careful consideration will be given to the location of any fuel storage facilities. These will be designed in accordance with guidelines produced by CIRIA, and will be fully bunded.
- All vehicles and plant will be regularly inspected for fuel, oil and hydraulic fluid leaks. Suitable equipment to deal with spills will be maintained on site.
- Where feasible, soil excavation will be completed during dry periods and undertaken with excavators and dump trucks. Topsoil and subsoil will not be mixed together.
- Ensure that all areas where liquids are stored or cleaning is carried out are in a designated impermeable area that is isolated from the surrounding area, e.g. by a roll-over bund, raised kerb, ramps or stepped access.
- Use collection systems to prevent any contaminated drainage entering surface water drains, watercourses or groundwater, or draining onto the land.
- Minimise the use of cleaning chemicals.
- Use trigger-operated spray guns, with automatic water-supply cut-off.
- Use settlement lagoons or suitable absorbent material such as flocculent to remove suspended solids such as mud and silt.
- Ensure that all staff are trained and follow vehicle cleaning procedures. Post details of the procedures in the work area for easy reference.

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Best practice, in accordance with relevant codes of practice and guidelines, will be followed to minimise the risk of spreading Japanese knotweed on or off the site (**Section 5.8.1.1 *Japanese Knotweed,*** of this EIS).

The implementation of the above measures will ensure that the risk of pollution of groundwater, soils and surface waters, resulting from the construction activities will be minimised.

5.13.5 Construction Traffic

The impact of the generated traffic on the local road network during the construction of the proposed development is evaluated in **Chapter 7 *Roads and Traffic*** of this EIS***,*** and mitigation measures are proposed where necessary.

The appointed contractor will be required to develop a Construction Stage Traffic Management Plan in advance of commencing the works on site. The plan will be implemented at the commencement of the works. The plan will need to implement all relevant mitigation measures identified in this EIS, together with any additional requirements imposed by conditions attached by An Bord Pleanála to any grant of permission. For example, the Construction Stage Traffic Management Plan will confirm the indicative traffic routes to the site which have been identified in the application documentation. Points of access and egress for the site will be confirmed and management measures identified in the application documentation will be agreed with Cork County Council.

In order to ensure compliance by contractors and suppliers, the requirements of the EIS, and all additional requirements imposed by conditions attached by An Bord Pleanála will be included in all contract tender documents and will be discussed in detail prior to awarding a contract. All traffic movements associated with the import and export of materials have been included in the construction traffic impact assessment. Refer to Chapter 7 (Roads and Traffic) for further details

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The plan will be regularly reviewed and updated to take into account the changing patterns of both the existing traffic and the construction traffic, following consultation with Cork County Council. The routing of any exceptional loads will require liaison with Cork County Council and the Garda Siochána.

During the road upgrade works and the coastal protection works, the traffic management plan will ensure that disruption to local traffic will be minimised.

The implementation of this plan will be monitored by the Indaver Site Management team during the course of the project and will also be reviewed at the main site meetings.

5.13.6 Construction Safety

As required by the *Safety, Health and Welfare at Work (Construction) Regulations 2013*, a Health and Safety Plan will be prepared which will address health and safety issues from the design stages through to the completion of the construction and maintenance phases. This plan will be reviewed as the development progresses. The contents of the Health and Safety Plan will comply with the requirements of the Regulations.

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Safety on site will be of paramount importance. During the selection of the contractors and subcontractors, their safety records will be investigated. Only contractors with high safety standards will be selected.

Prior to working on site, each individual will receive a full safety briefing and will be provided with all of the safety equipment relevant to the tasks the individual will be required to perform during employment on site.

Safety briefings will be held regularly and prior to any onerous or special task. 'Toolbox talks' will be held to ensure all workers are fully aware of the tasks to be undertaken and the parameters required to ensure the task will be successfully and safely completed.

All visitors will be required to wear appropriate personal protective equipment prior to going on to the site and will undergo a safety briefing by a member of the site safety team.

Regular site safety audits will be carried out throughout the construction programme to ensure that the rules and regulations established for the site are complied with at all times.

At any time that a potentially unsafe practice is observed, the site safety manager will have the right as well as the responsibility to halt the work in question, until a safe system of working is again put in place.

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5.14 Potential Cumulative Impacts

The potential for cumulative construction impacts, should the proposed development take place simultaneously with the construction of the proposed projects, which are listed below, was considered.

Proposed projects

- N28 new road
- Haulbowline East Tip and steelworks remediation projects and Spike Island Masterplan
- Port of Cork expansion
- Cork Lower Harbour Main Drainage Scheme sewage treatment plant, Shanbally
- Novartis wind turbine

The potential cumulative impacts arising during the construction phase are addressed in **Chapters *7 Roads and Traffic*, 8 *Air Quality*, 9 *Climate,* 10 *Noise and Vibration, 11 Landscape and Visual,* 12 *Biodiversity,* 13 *Soils, Geology, Hydrogeology, Hydrology and Coastal Recession,* 14 *Archaeological, Architectural and Cultural Heritage,* 15 *Material Assets,* and 16 *Cumulative Impacts, Other Impacts and Interactions*** of this EIS**.**

5.15 Residual Impacts

It is anticipated that, with proper management, the construction phase of the development will not have significant long-term negative impacts.

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The residual construction impacts of the construction phase are addressed in **Chapters 7 *Roads and Traffic,* 8 *Air Quality,* 9 *Climate,* 10 *Noise and Vibration,* 11 *Landscape and Visual,* 12 *Biodiversity,* 13 *Soils, Geology, Hydrogeology, Hydrology and Coastal Recession,* 15 *Material Assets,* 14 *Archaeological, Architectural and Cultural Heritage*** and **16 *Cumulative Impacts, Other Impacts and Interactions*** of this EIS**.**

The residual impacts will last for the duration of the construction phase only and will include:

- temporary closure of access the area of Gobby beach where coastal protection works will take place and a section of the car park for the three week duration of the placing of material on the beach. However, access to the rest of the beach will be maintained for the duration of the works
- disruption to road users and use of the temporary road for the twelve week duration of the road upgrade works. During the twelve week period, the car park may be temporarily closed for up to six weeks however access to the beach will be maintained for the duration of the works,
- additional noise from the site for the duration of the construction phase,
- additional traffic on the road network for the duration of the construction phase, and
- very short term disruption and outages to services as new connections are made and/or services are relocated.

The long term residual impacts will include:

- disposal of surplus excavated material from the site to a permitted site,
- consumption of fuel, natural resources and construction materials such as steel, concrete and imported fill.

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5.16 References

British Standard BS 5228 – 1 (2009 +A1 2014) (*Code of practice for noise and vibration control on construction and open sites – Noise).*

British Standard BS3882 (2015) *Specification for Topsoil.*

Construction Industry Research and Information Association, (2015) *Environmental Good Practice on Site*, CIRIA, London.

Construction Industry Research and Information Association, (2001) *Control of Water Pollution from Construction Sites, guidance for consultants and contractors*, CIRIA, London.

http://www.corkcoco.ie/co/web/Cork%20County%20Council/Departments/Environment%20%26%20Waste/Publications?did=739025488&pageUrl=/Cork+County+Council/Departments/Environment+%26+Waste/Publications

Department of Transport (2010) – Traffic Signs Manual

Environmental Agency, (2006, updated 2013) *Managing Japanese knotweed on development sites - The Knotweed Code of Practice,* Environmental Agency, Bristol.

Kelly, J., Maguire, C.M. and Cosgrove, P.J. (2008) *Best Practice Management Guidelines Japanese knotweed Fallopia japonica*, Prepared for NIEA and NPWS as part of Invasive Species Ireland.

Murnane E., Heap A., Swain A. (2006) *Control of Water Pollution from Linear Construction Projects CIRIA*, London.

National Construction and Demolition Waste Council (2006*), Best Practice Guidelines on the Preparation of Waste Management Plans for Construction & Demolition Projects,* NCDWC, Dublin.

National Roads Authority (2014) *Good Practice Guideline for the Treatment of Noise during the planning of National Road Schemes*, NRA, Dublin.

National Roads Authority (2008) *Guidelines on The Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads, NRA,* Dublin.

Safety, Health and Welfare at Work (Construction) Regulations 2013

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12. Biodiversity

12.1 Introduction

Dixon.Brosnan Environmental Consultants have conducted an appraisal of the potential impacts of the Resource Recovery Centre (including waste to energy facility) on terrestrial and intertidal flora and fauna. This chapter describes and evaluates the habitats with their representative flora and fauna and addresses the impacts of the development on the terrestrial and intertidal ecology of the site.

12.2 Methodology

12.2.1 Introduction

This appraisal is based on surveys of the entire Indaver site and surrounding area and a review of desktop data. A flora and fauna report was prepared previously by the Aquatic Services Unit, University College Cork in 2001 for an EIS for the Indaver Ireland planning application for a Waste Management Facility at this location. DixonBrosnan previously prepared the Flora and Fauna chapters for a similar Indaver EIS submitted in 2008 and an addendum to the EIS prepared in 2010. These reports were consulted during the preparation of this chapter of the EIS.

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In addition to the baseline surveys carried out for previous applications, the following surveys were carried out in 2014/2015:

- Habitat mapping
- Surveys of wintering birds
- Breeding birds surveys
- Common tern breeding survey
- Mammals, with a particular emphasis on badger, otter and bats
- Intertidal survey

The assessment follows the structure and protocols detailed in Advice notes on current practice in the preparation of Environmental Impact Statements (EPA, 2003 and revised draft 2015) and Guidelines on the information to be contained in Environmental Impact Statements (EPA 2002 and revised draft 2015) and Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment (EU Commission, 2013). Potential impacts on designated Natura 2000 or European sites are specifically addressed in a Habitats Screening and Natura Impact Statement (NIS), which has been submitted as part of this application

12.2.2 Desktop Review

The purpose of the desktop study was to identify features of ecological value occurring within the proposed development site and those occurring in close

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proximity to it. A desktop review also allows the key ecological issues to be identified early in the appraisal process and facilitates the planning of surveys. Sources of information utilised for this report include the following:

- National Parks & Wildlife Service (NPWS) - www.npws.ie
- Environmental Protection Agency (EPA) – www.epa.ie
- National Biodiversity Data Centre – www.biodiversityireland.ie
- County Cork Biodiversity Action Plan 2009 2014 (Cork County Council, 2009);
- Ringaskiddy Port Redevelopment EIS (Port of Cork/RPS, 2015)
- Bat Conservation Ireland - http://www.batconservationireland.org
- Birdwatch Ireland
- British Trust for Ornithology (BTO)-www.BTO.ie
- Scottish Natural Heritage Guidelines (Winter Bird Survey Method), 2014
- Natura Impact Statement (Screening Stage 1) at Haulbowline, Ringaskiddy, Co. Cork for proposed bridge remediation works (Dixon Brosnan, 2014)
- Best Practice Guidance for Habitat Survey and Mapping (Heritage Council, 2011)
- Guidance on integrating climate changes and biodiversity into environmental impact assessment (EU Commission, 2013)
- Guidelines for Assessment of Ecological Impacts of National Road Schemes (National Roads Authority, 2009)
- Cork lower Harbour Energy Group EIS and NIS (ARUP, 2011)

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12.2.3 Consultation

Meetings were held with Dr. Jervis Good and Danny O' Keefe (National Parks and Wildlife Service of the Department of Arts, Heritage and the Gaeltacht) on May 27 2015 and September 8 2015. In its letter dated 11 September 2015 the Development Application Unit specifically requested that the following be addressed:

1. Effects on otters (including coastal protection measures and bioaccumulation of pollutants).
2. Effects on Annex 1 bird species and regularly occurring migratory birds, to which the conservation objectives of the SPA do not apply, e.g. little egret (a piscivorous species), whimbrel (in terms of collision risk) etc.
3. Effects on red listed and amber listed bird species (e.g yellow-hammer (habitat removal), barn owl (rodenticide use), etc.
4. Effects of any blasting or pile driving (if required during construction) on marine mammals occurring in the Lower Harbour.
5. Effects of coastal protection measures on the fauna and flora of the shingle beach; a survey for protected flora should be undertaken.

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Issues raised during those pre-application meetings that relate specifically to the Cork Harbour SPA are examined separately in the NIS.

12.2.4 Surveys Overview

The following surveys were carried out at the site:

- Habitat mapping and flora surveys were carried out over several visits in the period from June 2014 to July 2015. (See **Appendix 12.1- Flora Surveys**)
- Six separate winter bird counts were carried out from November 2014 to March 2015 (See **Appendix 12.2 - Bird Surveys**)
- A survey for otters and badgers was carried out over several visits in the period from June 2014 to July 2015. (See **Appendix 12.3 - Mammal Surveys**)
- Bat surveys using standard detectors were carried out in September, 2014 and August 2015. (See **Appendix 12.3 - Mammal Surveys**)
- Breeding bird surveys were carried out in the period from May 2015 to June 2015. (See Appendix **12.2 - Bird Surveys**)
- Breeding bird counts at a common tern colony at Ringaskiddy were carried out from May 2015 to June 2015. (See **Appendix 12.2 - Bird Surveys**)
- An intertidal survey was carried out on June 18-19, 2015. (**See Appendix 12.4 - Intertidal Survey**)

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This report was prepared by Carl Dixon MSc Applied Ecology, Vincent Murphy MSc Ecosystem Conservation and Landscape Management, and Aine Sands BSc Ecology. Bird surveys, general mammal surveys and habitat mapping was carried out at the site by Vincent Murphy. Bat surveys were carried out by Mark Donnelly BSc who has extensive bat surveying experience in Ireland and the UK. The intertidal survey was carried out by Dr. Stiofan Creaven, who has extensive experience in marine biology including surveys in Ireland and internationally.

12.3 Receiving Environment

12.3.1 General Landscape

The Indaver site is approximately 13.55 hectares in size and surrounds the Hammond Lane Metal Company facility. The proposed development area is located in the eastern section of the site.

The Indaver site runs east-west parallel to the L2545 Ringaskiddy Road, an extension of the N28, which leads to Haulbowline Island and runs along the northern boundary of the site. To the south, the study area is bordered by agricultural land dominated by intensive pasture. A Martello Tower is located on the crest of a small hill (43m approx.) in agricultural land to the south of the study area.

To the east, the site extends towards the edge of the Cork Harbour West Channel that separates the mainland from Spike Island. The shoreline here is characterised by shingle beach with steep earthen cliffs. To the west, the site

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adjoins agricultural land (tillage and pasture) and a small group of residential dwellings.

The proposed development area is located in the eastern section of the study area, between the coast and the Hammond Lane facility. A small walkway will be created along the eastern boundary between the public car park and the Martello tower facilitate recreational users. A rectangle of land, used as a public car park, to the northeast of the site is not included in the development area, but is included in the study area.

A high proportion of the study area, including the proposed development site, is covered in scrub, which has become more dominant over time. The remainder of the site consists of pasture and tillage fields that remain under conventional agricultural management. The Indaver site and the proposed development are shown in **Chapter 4, figures 4.1 and 4.3.**

12.3.2 Designated Conservation Areas

Special Areas of Conservation (SACs) and candidate SACs are protected under the Habitats Directive 92/43/EEC and the European Communities (Birds and Natural Habitats) Regulations 2011, as amended. Special Protection Areas (SPAs) are protected under the Birds Directive 2009/147/EC and European Communities (Birds and Natural Habitats) Regulations 2011, as amended. Collectively, these sites are referred to as Natura 2000 or European sites. Natural Heritage Areas (NHAs/pNHAs) are national designations under the Wildlife Act 1976, as amended.

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There are no environmental designations located in the study area. Thus, the site of the proposed development does not form part of any Natural Heritage Area (NHA), Special Protection Area (SPA), Special Area of Conservation (SAC) or candidate Special Area of Conservation (cSAC), Nature Reserve, or National Park.

The proposed development site is located within 20km of a number of these designated sites. Designated sites, along with their distance from the site of the proposed development, are listed in **Table 12.1** and are shown in **Figure 12.1.** Site synopses for the closest Natura 2000 sites (Cork Harbour SPA and Great Island Channel cSAC) are provided in **Appendix 12.5.**

Table 12.1 Designated areas and their location relative to the Indaver site.

Designated site	Distance from site of proposed development
cSAC sites	
Great Island Channel candidate Special Area of Conservation and proposed Natural Heritage Area (Site code 001058)	Approximately 5.6 km north
SPA sites	
Cork Harbour Special Protection Area (Site code 004030)	Approximately 0.5 km south
Ballycotton Bay Special Protection Area (Site code 004022)	Approximately 18.4km east
Sovereign Islands SPA (Site code 004124)	Approximately 19.7km southwest
pNHA sites	

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Designated site	Distance from site of proposed development
Lough Beg proposed Natural Heritage Area (Site code 001066)	Approximately 0.3 km south
Monkstown Creek proposed Natural Heritage Area (Site Code 001979)	Approximately 1.5 km northwest
Whitegate Bay proposed Natural Heritage Area (Site Code 001084)	Approximately 2.8 km east
Owenboy River proposed Natural Heritage Area (Site Code 001990)	Approximately 3 km southwest
Cuskinny Marsh proposed Natural Heritage Area (Site code 001987)	Approximately 3.5 km northeast
Fountainstown Swamp proposed Natural Heritage Area (Site code 000371)	Approximately 6 km south
Rostellan Lough, Aghada Shore and Poulnabibe Inlet proposed Natural Heritage Area (Site Code 001076)	Approximately 5 km east
Minane Bridge Marsh proposed Natural Heritage Area (Site code 001966)	Approximately 8.5 km southwest
Ballynaclashy House, North of Midleton proposed Natural heritage area (Site code 000099)	Approximately 14.2 km northeast
Templebreedy National School, Crosshaven proposed Natural heritage area (Site code 000107)	Approximately 3.3 km south
Lough Aderry and Ballybutler proposed Natural Heritage Area (Site code 000446)	Approximately 15.3km northeast
Carrigahane Hill proposed Natural Heritage Area (Site code 001042)	Approximately 13.1km northeast
Douglas estuary proposed Natural Heritage Area (Site code 001046)	Approximately 6.3 km north
Glanmire Wood proposed Natural Heritage Area (Site code 001054)	Approximately 11.1km N
Great Island Channel proposed Natural Heritage Area (Site code 001058)	Approximately 5.6km N
Leamlara Wood proposed Natural Heritage Area (Site code 001064)	Approximately 13.4 km northeast
Rock farm Quarry, Littleisland proposed Natural Heritage Area (Site code 001074)	Approximately 7.5 km north
Cork Lough proposed Natural Heritage Area (Site code 001081)	Approximately 14km northwest
Dunkettle Shore proposed Natural Heritage Area (Site code 001082)	Approximately 9.6 km north
Carrigacrump Cave proposed Natural Heritage Area (Site code 001408)	Approximately 10.8km east

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Important areas for birds within Cork Harbour are interrelated, with bird populations moving between different areas at different times. The closest Natura 2000 sites are the Cork Harbour SPA, which is located 0.5km to the south of the proposed development site and the Great Island Channel cSAC, which is located 5.6km to the north. The closest pNHA is Lough Beg, 0.3km to the south and Monkstown Creek pNHA, 1.5km northwest. These sites are part of a network of

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sites which support important bird numbers within Cork Harbour and are considered relevant to this proposed development. The remaining sites are located a considerable distance from the proposed development and no potential impact on these other sites has been identified.

12.3.3 Ramsar Sites

The Convention on Wetlands, called the Ramsar Convention, is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. A key commitment of Ramsar Contracting Parties is to identify and place suitable wetlands onto the List of Wetlands of International Importance. Cork Harbour is listed as a Ramsar site, which is a non-statutory designation.

12.3.4 Habitats

Terrestrial habitat mapping was carried out in line with the methodology outlined in the Heritage Council publication *Best Practice Guidance for Habitat Survey and Mapping* (Heritage Council, 2011) in 2014 and 2015. All habitats within the study area were classified to level 3 of the classification scheme outlined in *A Guide to Habitats in Ireland* (Fossit, 2000) and cross-referenced with habitats listed under Annex I of the Habitats Directive. A flora species list is included in **Appendix 12.1.** No rare species were noted, nor are they expected to occur given that the habitats within the study area are common.

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As noted, previous surveys at the site were carried out in 2001 and 2008. These surveys are referred to where relevant. A current habitat map is included as **Figure 12.2** and the habitats recorded on site are described below in **Table 12.2.** The ecological value of habitats is defined by the classification scheme outlined in *Guidelines for Assessment of Ecological Impacts of National Road Schemes* (National Roads Authority, 2009) which is included in **Appendix 12.6.**

Table 12.2. Terrestrial Habitat Values

Habitat	Description/ Habitats Directive Annex I Status	Ecological value (NRA guidelines)
Hedgerow WL1/Treelines WL2	The southern boundary of the site consists of native hedgerow dominated by Hawthorn and Blackthorn, with Gorse and Bramble also noted. The width of the hedge ranges from approximately 1-4m. The western boundary, which is more sheltered, consists primarily of semi-mature Ash.	Local importance (Low value)
Dry meadow and grassy verge GS2/Wet grassland GS4	The survey in 2008 recorded Neutral Grassland GS1 and Wet Grassland GS4 in a mosaic with scrub in the eastern section of the site. Since then, in the absence of active management, scrub has come to dominate most of this area. Grey Sedge, which is classified as having an occasional occurrence in Ireland (Webb *et al*., 1996), was recorded within the proposed development area in 2001 and 2008 but is now absent. Grassland habitat is now confined to small pockets. Dry Meadows and Grassy Verge GS2 habitat occurs primarily on an old track and is dominated by tall tussocky species such as False Oat Grass and Yorkshire Fog. Herb species	Local importance (Low value)

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Habitat	Description/ Habitats Directive Annex I Status	Ecological value (NRA guidelines)
	include Knapweed, Yellow-wort, Cat's Ear, Meadow, Goat Vetchling and Birds-foot Trefoil. In places dry meadow and grassy verge occurs with remnants of wet grassland with Soft Rush, Rosebay Willowherb and Mint. Bee orchid was also recorded within this habitat for the first time during the 2014/2015 surveys. Dry meadow and grassy verge GS2 corresponds to the Habitats Directive Annex I habitat: 'lowland hay meadows (*Alopecurus pratensis, Sanguisorba officinalis*) (6510)'. However the dry meadow and grassy verge habitat within the site is very common locally and does not represent a valuable example of this Annex 1 habitat type.	
Scrub WS1	The proposed development will be concentrated in the eastern part of the study area. This area which previously supported grassland communities (in 2001 and 2008), is now almost entirely dominated by scrub. The scrub has developed due to the absence of grazing or other forms of agricultural management. Species noted include Gorse, Bramble, Hawthorn, Blackthorn, Willow and Elder. The encroachment of scrub has resulted in the loss of some grassland.	Local importance (Low value)
Immature woodland WS2	Immature trees are developing within the scrub habitat in the eastern section of the site and on the western boundary of the Hammond Lane site. Willow species (White Willow, Grey Willow and Goat Willow) are predominant. Other species include Pedunculate Oak, Ash, Beech and Sycamore. In the absence of changes in site management, these areas would probably develop into mature woodland.	Local importance (Low value)
Broadleaved woodland WD1	An area of semi-mature broadleaved woodland occupies the north western part of the site along an escarpment. The woodland has developed because this area has not been grazed for a number of years. The area has been colonised by a number of species from the surrounding hedges including Sycamore, Ash and Elm.	Local importance (Low value)
Improved agricultural grassland GA1	This habitat occupies the higher, relatively level area close to the southern boundary. It is dominated by Rye Grass and common herbaceous species such as Creeping Thistle, White Clover and Meadow Buttercup. It also occurs along the border of the L2545 Ringaskiddy Road. This habitat is of limited ecological value.	Negligible
Conifer woodland WD3	A small area of planted conifers was recorded, which consists of Sitka Spruce and Monterey Cypress. The trees are approximately 15-20 years old.	Negligible
Dense bracken HD1	Bracken occurs scattered throughout the study area as a minor component of scrub and hedgerows. However there are significant areas of dense bracken to the west of the Hammond Lane facility and at the south east corner of the Indaver site. In places trees are starting to become established within this dense bracken including Elder and Hawthorn	Negligible
Arable crops BC1	Two low -lying fields were amalgamated and converted from permanent pasture to arable crops (fodder beet in	Negligible

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Habitat	Description/ Habitats Directive Annex I Status	Ecological value (NRA guidelines)
	2015). Very few arable weeds or other wild flora were noted, and this habitat is of low ecological value.	

12.3.5 Flora

The site of the proposed development lies within Ordnance Survey National Grid 10km square W76. The National Parks and Wildlife Service (NPWS) rare plant database notes the presence four protected plant species within W76; Meadow Barley *Hordeum secalium,* Penny Royal *Mentha pulegium*, Lesser Snapdragon *Misopates orontium* and Annual Knawel *Scleranthus annus*. These species are protected by the Flora Protection Order 2015 (S.I. No. 356 of 2015)). These species were not recorded within study area during site surveys.

Grey Sedge (*Carex divulsa*), which is classified as having an occasional occurrence in Ireland (Webb *et al*., 1996), was recorded within the site on previous occasions (2001 and 2008), but was not recorded on the site during 2014/2015. Bee Orchid (*Ophrys apifera*) has a scattered distribution in Ireland and was recorded in the study area in 2014/2015. Neither of these species are protected by the Flora Protection Order 2015 (S.I. No. 356 of 2015**)**

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12.3.6 Invasive species

Non-native plants are defined as those plants which have been introduced outside of their native range by humans and their activities, either purposefully or accidentally. Invasive non-native species are so-called as they typically display one or more of the following characteristics or features: (1) prolific reproduction through seed dispersal and/or re-growth from plant fragments; (2) rapid growth patterns; and, (3) resistance to standard weed control methods.

Where a non-native species displays invasive qualities and is not managed it can potentially: (1) out compete native vegetation, affecting plant community structure and habitat for wildlife; (2) cause damage to infrastructure including road carriageways, footpaths, walls and foundations; and, (3) have an adverse effect on landscape quality.

The non-native invasive species Japanese Knotweed, Montbretia, Snowberry, Buddleia, Winter Heliotrope, Cotoneaster, Sycamore and Travellers' Joy were recorded within and adjacent to the study area. Of these species Japanese Knotweed is listed on both the "Most Unwanted: Established Threat" and on the "High Risk: Recorded Species" list compiled by Invasive Species Ireland a joint initiative by the Northern Ireland Environment Agency and NPWS. Sycamore, Montbretia, Snowberry, Cotoneaster are on the "Amber List: Recorded Species" (which under the right conditions could represent a significant impact on native species or habitats) while Buddleia, Traveller's Joy and Winter Heliotrope are on the "Amber List: Uncertain Risk" (their ecological impact remains uncertain due to lack of data showing impact or lack of impact). Japanese Knotweed, Montbretia, Buddleia, Winter Heliotrope, Cotoneaster and Travellers' Joy are also included in the NRA Guidelines on the Management of Noxious Weeds and Non-native Species on National Roads (NRA, 2010) as these species have been shown to

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have an adverse impact on landscape quality, native biodiversity or infrastructure; and are likely to be encountered during road schemes.

There is a statutory obligation under S.I. 477 of 2011 of the European Communities (Birds and Natural Habitats) Regulations 2011 to address invasive species in Ireland. Japanese Knotweed is the only species recorded in the study area which is listed under the *3rd Schedule: Part 1 – Plants; Non-native species subject to restrictions under Regulations 49 & 50*. Regulation 49 deals with the '*Prohibition on introduction and dispersal*' while Regulation 50 deals with the '*Prohibition on dealing with and keeping certain species*'. Regulation 50 has yet to be brought into Irish law. Regulation 74 is a transitional provision in relation to Regulation 49 and 50.

Montbretia, Cotoneaster, Snowberry were recorded in the immediate verge or roadside hedgerow on the southern side of the L2545 Ringaskiddy Road just outside the study area. These species are likely garden escapees from a derelict cottage. Winter Heliotrope was found present in the immediate verge on both the northern and southern side of the L2545 Ringaskiddy Road. The southern infestation is within the study area. Cotoneaster, Buddleia and Sycamore were recorded from the scrub areas within the development site, while Travellers' Joy, Sycamore and Buddleia were found to have invaded hedgerows throughout the study area. Sycamore and Travellers' Joy were observed in the broadleaved woodland on the escarpment while Buddleia was noted present on the steep earthen cliffs at the coast within the study area.

A number of mature stands and scattered emerging shoots of Japanese Knotweed were recorded within and adjacent to the western end of the study area. One mature dense stand of Japanese Knotweed was recorded in a hedgerow on the boundary of the study area between the two fields of arable crops (beet fodder) and the adjoining roadside hedgerow while a second younger stand was recorded within scrub just inside the study area. The remaining infestations are located outside of the study area within hedgerows adjoining the beet crops and along the southern and northern boundaries of L2545 Ringaskiddy Road. Japanese Knotweed was also recorded in the headlands and towards the centre of beet crop.

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Given statutory obligations in relation to Japanese Knotweed, the extent of this species within the study area is shown on **Figure 12.3** with details of the infestations provided below in **Table 12.3.** Specific measures relating to the control of this species are included in the mitigation measures section (**Section 12.7.3)** below.

Table 12.3 Infestations of Japanese Knotweed

Japanese Knotweed	Description (Origin, Maturity & Nature)	Area
1 (inside study area)	Large continuous mature dense linear stand on the boundary of the study area. Located within a hedgerow between the two fields of arable crops (beet fodder) and the adjoining roadside hedgerow boundary. Number of plants/crowns unknown due to density. Approximately 8-10yrs old and on average of 2.5m high. In flower at time of survey; no evidence of senescence. Likely source of infestation is plant fragments from the adjacent hedgerow infestation.	

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Japanese Knotweed	Description (Origin, Maturity & Nature)	Area
2 (inside study area)	Small stand within scrub just inside the boundary of the study area. Twelve plants/crowns recorded along with emerging shoots. Approximately 4-6yrs old and on average 1.5m high. No evidence of flowering under shade of scrub canopy. Flowering present where it emerges through canopy. No evidence of senescence. Likely source are plant fragments from crop cultivation.	
3	Large fragmented mature dense linear stand within a hedgerow boundary shared by a derelict cottage and a field of beet fodder. Number of plants/crowns unknown due to density. Approximately 8-10yrs old and on average 2.0m high. In flower at time of survey; no evidence of senescence. Likely source are plant fragments from the infestation along the adjacent L2545 Ringaskiddy Road (more mature).	
4	Large fragmented mature dense linear stand within a roadside hedgerow boundary along the southern side of the L2545 Ringaskiddy Road behind which is the field of beet fodder. Number of plants/crowns unknown due to density. Approximately 8-10yrs old and on average of 2.5m high. In flower at time of survey; no evidence of senescence. This is the most mature infestation recorded and probably the source of the infestation within and adjacent to the study area. Likely origin of this infestation is plant fragments distributed along the roadside by tyres and tracks of passing vehicles.	
5	Three small stands on an embankment on the northern side of the L2545 Ringaskiddy Road. Approximately 4-6yrs old and on average 1.5m high. In flower at time of survey; no evidence of senescence. Likely source are plant fragments from the infestation on opposite side of the road.	< $2m^2$ x 3 = $6m^2$
6	Scattered emerging shoots recorded in abundance along the headlands of the beet fodder crop and occasional towards the centre of the crop field. Likely sources are shoots emerging from lateral rhizome growth from parent plant and plant fragments from the mature stands in the hedgerow which have been distributed by mechanical methods during crop cultivation.	
7	Scattered emerging shoots within the immediate verge on the southernside of the L2545 Ringaskiddy Road. Likely sources are shoots emerging from lateral rhizome growth from parent plant and plant fragments distributed by mechanical methods during maintenance of the adjacent roadside hedgerow.	< $3m^2$

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12.3.7 Mammals

The NPWS species record database notes the presence of five protected mammal species in 10km Grid square W76. These species are Hedgehog, Stoat, Red Squirrel, Otter and Pygmy Shrew. Of these species Otter, Hedgehog, Pygmy Shrew could potentially occur. Badger and Common Pipistrelle Bat were previously recorded from the site and Grey and Harbour Seal are known to occur

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within Cork Harbour. Cetaceans have also been recorded from Cork Harbour. Relevant species are discussed in more detail below.

12.3.7.1 Badgers

Badgers and their setts are protected under the provisions of the Wildlife Act 1976, as amended, and it is an offence to intentionally, knowingly or unknowingly kill or injure a protected species, or to wilfully interfere with or destroy the breeding site or resting place of a protected wild animal. Badger setts are formed by a complex group of interlinked tunnels, and therefore works in proximity to setts can potentially cause damage.

A survey of the study area in 2001 recorded an active badger sett in the northern section of the site adjoining an area of pasture. A survey by DixonBrosnan in 2008 found that this sett remained in active use although the adjoining field had been changed from pasture to arable land. Evidence of activity was recorded at this sett, with one large latrine located in close proximity to an active burrow entrance. A short distance to the west of the active sett, there are further entrances close to a small thicket. A disused sett entrance was also located to the south of the active sett, and signs of badger activity including tracks, feeding signs and a latrine were recorded in pasture in the southern section of the site.

Surveys in 2014 and 2015 did not record any signs of badger activity, and the previously identified sett is no longer in active use (refer to **Appendix 12.3 Mammal surveys**). The reasons for this change are uncertain. However it is possible that over time the site has become less valuable for badgers due to the incremental change from large areas of grassland to a predominance of tillage and scrub, which is of less value as feeding habitat. It is noted that only one active sett entrance was recorded at the site in 2008; this may have been a subsidiary sett which is no longer used. Lack of usage does not necessarily mean that this population of badgers is no longer present in the wider landscape A pre-construction survey and further monitoring surveys during construction for badgers are recommended to confirm the absence of badgers and monitor any potential badger activity or re-establishment in the development area. This will minimise any potential impacts on the species.

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12.3.7.2 Bats

All bat species in Ireland are protected under the Wildlife Act 1976, as amended, and the Habitats Directive and Irish implementing legislation. Ireland is also a signatory to the Bonn convention (Convention on the conservation of migratory species of wild animals, Bonn 1979) and the Bern convention, 1982 (The Convention on the Conservation of European Wildlife and Natural Habitats), and it has a commitment to the “Eurobats” agreement (Agreement on the Conservation of Bats in Europe, 1991).

Bat Conservation Ireland has recorded seven of the ten Irish bat species within the general Ringaskiddy area (Common Pipistrelle, Soprano Pipistrelle, Leisler’s Bat, Brown Long-eared, Daubenton’s, Natterer’s and Whiskered). There are no records of Lesser Horseshoe Bat, which is listed on Annex II of the Habitats Directive, in the Ringaskiddy area nor is this species likely to occur. Lesser Horseshoe Bat has a limited distribution and is generally confined to the western

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counties of Ireland, the closest known roost is located in Ballincollig, County Cork (Port of Cork, 2014).

Bat surveys were undertaken in 2012 for the Ringaskiddy Port Redevelopment EIS (Port of Cork/RPS, 2014). Three bat species were recorded; Common pipistrelle, Soprano Pipistrelle and Leisler's Bat. Both Pipistrelle species were recorded foraging within woodland areas at the base of a training wall and jetty and along hedgerows, treelines and scrub habitats 1500m west from the Indaver site.

Bat activity was assessed at the DePuy site in 2011, in relation to the development of a wind turbine. This site is located approximately 240m south of the Indaver site. Three species of bat were recorded within the DePuy site, namely Common Pipistrelle, Soprano Pipistrelle and Leisler's Bat. However activity within the site was relatively low. (DePuy Ireland, 2011.)

Surveys by DixonBrosnan in 2014 and 2015 indicated that there are no suitable roosting sites for bats within the Indaver site boundary. There are no structures which could potentially support roosts, and the trees are all relatively young and lack the structural complexity (i.e. rotten wood, holes etc), that would provide suitable roosting sites for bats. The EIS prepared for the Hammond Lane development (Doherty Environmental, 2012) likewise did not record any high value roosting habitat. In conclusion, the hedgerows and treelines on external boundaries are of some local value for feeding bats, but do not provide roosting habitat.

Dixon.Brosnan carried out night-time bat activity surveys using standard heterodyne bat monitors (Batbox III and Batbox Duet) at different areas within the site in May 2008. The survey recorded foraging Common Pipistrelle and commuting activity at different areas within the site, including the hedgerows/treelines along northern, western and southern site boundaries. As expected, most activity occurred close to better quality hedgerows. No other species were detected.

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DixonBrosnan resurveyed the site in September 2014 and August 2015. A transect was walked along the perimeter of the site and bat activity monitored using a Bat Box Duet heterodyne/frequency division detector. (See **Appendix 12.3**). The following were recorded:

- Common Pipistrelle were recorded feeding along the hedgerow which runs along the southern boundary (2014 and 2015).
- Common Pipistrelle feeding along the southern boundary in the southwest corner of the site and along the woodland boundary. (2015).
- Soprano Pipistrelle fly-over along the shoreline boundary (2015)
- Common Pipistrelle flyover/feeding over the proposed development site close to the boundary with Hammond Lane. (2015).

The highest level of activity was along the external hedgerow along the southern boundary and the scrub/woodland in the western section of the site. These results are broadly similar to those obtained in 2008. The surveys found that bat activity was low, with only limited Common and Soprano Pipistrelle activity recorded. Only small numbers of individuals were recorded. In conclusion, the

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hedgerows and treelines on external boundaries are of some local value for feeding bats, but do not provide roosting habitat.

12.3.7.3 Otters

Otters, along with their breeding and resting places, are protected under the provisions of the Wildlife Act 1976, as amended. Otters have additional protection because of their inclusion in Annex II and Annex IV of the Habitats Directive, as transposed into Irish law. Otters are also listed as requiring strict protection in Appendix II of the Berne Convention on the Conservation of European Wildlife and Natural Habitats and are included in the Convention on International Trade of Endangered Species (CITES).

Otters are common along the Irish coastline however they are shy and generally nocturnal in areas subject to disturbance. Signs of their presence are readily identifiable, and include spraints, tracks, holts, resting areas, slides and feeding signs. Due to the proximity of the seashore, the site could potentially be used by otters.

Signs of otter activity were recorded during surveys for the Ringaskiddy Port Redevelopment EIS (Port of Cork/RPS 2014). These included the following:

- Signs of otter were noted along the ADM Training Wall, including old spraints and an active trail
- Otter activity was widespread at the base of the ADM Jetty.
- A single sighting of an otter leaving the eastern side of the ADM Training Wall
- A large amount of fresh spraint and three well-used sprainting sites were identified at the point where the existing ADM Jetty leaves the land.
- The spaces between boulders to the north of the existing ADM Jetty are extremely large and well-connected right down to low water level. An otter couch is likely present within these boulders.
- The most likely holt location was identified off-site, further to the west of Paddy's Point, where boulders were larger. This off-site area was surveyed in 2014 and a potential temporary holt/lying-up site was identified here within rocks at sea level.
- It was noted in 2012 that, despite human disturbance at Ringaskiddy East (the area being regularly used for boating, swimming and dog walking), evidence of otter presence was widespread along the shoreline; however, a holt was not identified.

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It is noted that these areas are a considerable distance from the proposed development site. Paddy's Point and the ADM jetty are located approximately 550m and 1500m respectively from the Indaver site boundary.

Surveys by DixonBrosnan in 2014 and 2015 did not record the presence of otter within a radius of 150m from the study area, although some sprainting activity was recorded 300m north of the site. It is noted that the upper shore of the beach, which adjoins the site, is extensively used by the general public, and that usage is highest in proximity to the car park that is located immediately adjacent to the proposed development site. These circumstances, particularly where dogs

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are also present, may reduce usage of the area by otter. Whilst otters may use the shore areas in proximity to the site on occasions, no holts were noted in this area, nor are they likely to occur in the area affected by beach nourishment works in the future.

12.3.7.4 Seals

Harbour Seal and Grey Seal are listed on Annex II of the Habitats Directive, and both are known to occur and feed within Cork Harbour. There are no known haul-out sites for Grey Seal in Cork Harbour; generally this species uses more exposed sites (Kiely, 1998).

Haul-out sites for harbour seals may occur inshore, for example on estuaries, coves, islands etc. and this species tends to forage within a relatively short distance of such haul-out sites. Over half of foraging trips may be within 5km of the haul-out sites (Cronin *et al*., 2007; Cronin *et al*., 2008). Although there is no evidence for significant haul-out sites or breeding sites in Cork Harbour, there are several small haul-out sites in this general area, as noted below. The beach adjoining the proposed development site is not of value as a haul-out site due to high levels of disturbance by walkers and dogs.

- A small haul-out site near Haulbowline Island (RPS, Port of Cork, 2014)
- An adult Harbour Seal occasionally uses a partially submerged tyre to haul-out on at mid-high tide approx. 10m from the shoreline adjacent to the National Maritime College in Ringaskiddy
- Approximately six Harbour Seals were recorded using the slipway at the National Maritime College (DixonBrosnan, 2014, RPS/Port of Cork, 2014)
- During winter bird counts by DixonBrosnan in 2014/2015, four Harbour Seals were recorded in the channel between the mainland and Spike Island

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Although there is nothing to indicate that the area in the immediate vicinity of the Indaver site is of particular value for seals, it is within the feeding range for local Harbour Seal populations. Given the distance of the recorded haul-out sites from the proposed development site, no direct disturbance of haul-out sites will occur, and any impact on feeding areas will be minimal.

12.3.7.5 Cetaceans

Species that have been recorded by the Irish Whale and Dolphin Group within the overall harbour include Bottlenose Dolphin (*Tursiops truncatus*), Harbour Porpoise (*Phocoena phocoena*), Common Dolphin (*Delphinus delphis*), Risso's dolphin (*Grampus griseus),* Killer Whale (*Orcinus orca*) and Minke Whales (*Balaenoptera acutorostrata*). Of these, it is the smaller species such as harbour porpoise which are most likely to occur in the channel offshore from the site. No impact on cetaceans is predicted.

12.3.8 Other Mammals

Rabbits are numerous and signs of fox were noted on site. Small mammal surveys in the study area in 2001 and 2008 recorded the presence of Field Mouse, Bank Vole and Brown Rat. Such species are common in the Irish

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countryside. Pygmy Shrew, Hedgehog and Stoat were not recorded, but may be present.

12.3.9 Reptiles and Amphibians

No habitat suitable for amphibians was recorded. Common Lizard is unlikely to be present.

12.3.10 Birds

12.3.10.1 Breeding Bird and site usage

Breeding bird surveys were carried out by DixonBrosnan during May 2008 using transect and point count methods (Bibby *et al*., 1992). A total of 35 bird species were recorded during site visits. These results were largely comparable with those from surveys carried out at the same site in 2001. In 2008 the mosaic of grassland and scrub was noted as particularly beneficial for warblers, with Blackcap, Whitethroat, Willow Warbler and Chiffchaff recorded. Stonechat was also noted and suitable habitat for ground nesting species such as Skylark and Meadow Pipit was also recorded.

A breeding bird survey was carried also carried out by DixonBrosnan in May and June 2010 using similar transect methods to Bibby *et al.*, (1992), covering the area of shoreline potentially affected by coastal works and adjoining areas of habitat. Areas of scrub and grassland was found to support a mixture of typical countryside birds including Chaffinch, Willow Warbler, Wood Pigeon, Blackbird and corvid species.

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As the coastal area in proximity to the site does not have extensive mudflats, there was a preponderance of species associated with rocky/shingle shore habitats. Such species include Rock Pipit, Ringed Plover and Oystercatcher. Other species noted include piscivorous species such as Common Tern, Cormorant, Grey Heron and Little Egret. Four gull species namely Herring Gull, Greater Blackbacked Gull, Common Gull and Blackheaded Gull were also recorded.

Of the species recorded during the survey, six species (Oystercatcher, Cormorant, Common Tern, Grey Heron, Blackheaded Gull and Common Gull) are listed as birds of special conservation interest for the Cork Harbour SPA.

Certain bird species are listed by BirdWatch Ireland as Birds of Conservation Concern in Ireland (Lynas et al., 2007). Red List bird species are of high conservation concern, and Amber List species are of medium conservation concern. Two Red Listed species were recorded (Herring Gull and Black Headed Gull) and five amber listed species were recorded. (Swallow, Starling, Greater Black-Backed Gull, Cormorant and Common Gull).

In 2015, breeding bird surveys were undertaken over three visits in May and June using a adapted version of the British Trust for Ornithology's (BTO) Common Bird Census Technique (Bibby *et al*., 2000 & Gilbert *et al*., 1998), with aspects of species specific survey methodologies employed where required (Gilbert *et al*., 1998). More detail on the methodology and the results of the survey are provided in **Appendix 12.2**

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A total of 28 species were recorded in the breeding bird survey. However it is noted that not all of these species were breeding within the site. The results indicate that the bird community currently using the site is similar to that recorded previously. The reduction in bird species diversity (35 species in 2008 in comparison to 28 species in 2015) may be due to increased dominance of scrub and a reduction in areas of semi-natural grassland.

Although the area of semi-natural grassland within the site has reduced, Skylark was still recorded within the site boundary. Common Gull was recorded flying over the site and utilising the adjoining shore area. No high tide roosts for gulls or other waders/waterfowl were recorded within the study area. No nest sites for marine birds such as gulls or Ringed Plover were located within, or along the coast in proximity to the shore. Eight species recorded are Amber listed; of these species five are terrestrial species (Skylark, Kestrel, Starling, Swallow and Tree Sparrow). The remaining three species (Common Tern, Oystercatcher and Common Gull) are associated with marine habitats and do not breed within the study area.

A list of the bird species recorded during winter surveys in 2014/2015 is provided in **Table 12.3** (refer also to **Table 12.4** for the relevant BTO breeding bird survey codes).

Table 12.3. Breeding bird survey results (refer also to Table 12.4 for explanation of codes)

Bird species	Breeding status	Estimated No. of Pairs	Conservation status
Blackbird	Br-FF	2	
Blue tit	Br-FL	3	
Bullfinches	Pr- A	1	
Chaffinch	Br-FL	2	
Chiffchaff	Pr-D	2-3	
Common gull	N-F	0	Amber List
Dunnock	Po- S	1	
Goldcrest	Pr-D	1	
Goldfinch	PR-N	1	
Great tit	Br-DD	1	
Greenfinch	Pr-P	1	
Heron	N-F	0	
Hooded crow	N-F	0	
Kestrel	Pr-P	1	Amber Listed
Long tailed tits	Pr-P	1	
Oyster catcher	N-F	0	Amber Listed
Robin	Br-UN	1	
Rook	N-F	0	
Sedge warbler	Po-H	0-1	
Skylark	Po-S	1-2	Amber Listed

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Bird species	Breeding status	Estimated No. of Pairs	Conservation status
Song thrush	Pr-N	1	
Starling	N-F	0	Amber Listed
Swallow	N-F	0	Amber Listed
Common tern	N-F	0	Amber Listed/Annex I
Tree sparrow	Po-H	0-1	Amber Listed
Common Whitethroat	Pr-A	1	
Wood pigeon	Pr-D	2-3	
Wren	Br-ff	2	

Table 12.4. British Trust for Ornithology breeding bird survey codes

Breeding status	Confirmed breeder (Br)	Probable breeder (Pr)	Possible breeder (Po)	Non-breeder (N)
Observed behaviours	Distraction-display or injury feigning (DD)	Pair in suitable nesting habitat (P)	Observed in suitable nesting habitat (H)	Flying Over (F)
	Used nest or eggshells found from current season (UN)	Permanent Territory (T)	Singing Male (S)	Migrant (M)
	Recently fledged young or downy young (FL)	Courtship and Display (D)		Summering non-breeder (U)
	Adults entering or leaving nest-site indicating occupied nest (ON)	visiting probable nest site (N)		
	Adult carrying faecal sac or food for young (FF)	Agitated Behaviour (A)		
	Nest containing eggs (NE)	Brood patch of incubating bird (I)		
	Nest with young seen or heard (NY)	Nest Building or excavating nest-hole (B)		

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12.3.11 Survey of Common tern-breeding

A breeding population of Common Tern is known to occur near the entrance to the Port of Cork approximately 750km from the proposed development area. A previous survey for the Ringaskiddy Port Redevelopment EIS (Port of Cork/RPS, 2014) recorded 45-50 breeding pairs on concrete structures (dolphins) adjacent to the entrance of the Port of Cork. DixonBrosnan resurveyed this Common Tern

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breeding colony over three days in May and June 2015, as this is the most significant breeding bird colony in the surrounding landscape. Approximately 50-55 breeding pairs were recorded (mean 53 breeding pairs) (refer to **Appendix 12.2** *Bird Surveys*).

12.3.12 Winter bird surveys

The winter bird surveys were undertaken on six dates between October 2014 and March 2015 (refer to **Appendix 12.2** *Bird Surveys*). The survey methodology was based on that used by the British Trust for Ornithology's (BTO) Wetland Bird Survey (WeBS) and also that for the Irish Wetland Bird Survey (I-WeBS), as outlined in Gilbert *et al.* (1998). Ninety minute counts were undertaken monthly at either high tide, mid tide and low tide. Survey vantage point locations for the winter bird counts are shown in **Appendix 12.2. Table 12.5** lists the bird species observed and the total number of birds recorded.

A total of 38 bird species were recorded during the 2014/2015 winter bird surveys as detailed below in **Table 12.5**. It is noted that many of these birds were recorded overflying the channel, and that the survey covered a radius of approximately 300m from each vantage point. The conservation status/designation of birds recorded during winter bird counts is also shown in **Table 12.5**.

Birds species listed in Annex I of the Birds Directive are considered a conservation priority. Five species (Mediterranean Gull, Dunlin, Little Egret, Great Northern Diver and Common Tern) are listed on Annex 1 of the Birds Directive. Certain bird species are listed by BirdWatch Ireland as Birds of Conservation Concern in Ireland. Red List bird species are of high conservation concern and the Amber List species are of medium conservation. Six red listed species were recorded namely Herring Gull, Curlew, Redshank, Black-Headed Gull, Dunlin and Knot. Thirteen species are Amber listed. Twenty four bird species are listed under the Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA), to which Ireland is a signatory. Refer to **Table 12.5**, which gives the conservation status for each species recorded.

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Table 12.5. Conservation status for species recorded.

Species		Birds Directive Annex					Bird Red	Bird Amber	AEWA
		I	II(I)	II(II)	III(I)	III(II)			
Cepphus grylle	Black Guillemot							X	X
Haematopus ostralegus	Oystercatcher							X	X
Columba palumbus	Woodpigeon		II(I)		III(I)				
Larus canus	Common Gull							X	X
Larus melanocephalus	Mediterranean Gull	I						X	X
Larus argentatus	Herring Gull						X		X
Larus fuscus	Lesser black-backed Gull							X	X
Larus marinus	Great black-backed Gull							X	X

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Species		Birds Directive Annex					Bird Red	Bird Amber	AEWA
Phalacrocorax carbo	Cormorant							X	X
Numenius arquata	Curlew			II(II)			X		X
Tringa totanus	Redshank						X		X
Larus ridibundus	Black-headed Gull						X		X
Calidris alpina schinzii	Dunlin	I					X		X
Anas platyrhynchos	Mallard		II(I)		III(I)				X
Ardea cinerea	Grey Heron								X
Passer montanus	Tree Sparrow							X	
Egretta garzetta	Little Egret	I							X
Tringa nebularia	Greenshank							X	X
Anas crecca	Teal		II(I)			III(II)		X	X
Podiceps cristatus	Great-crested Grebe							X	X
Branta bernicla	Brent Goose							X	X
Calidris alba	Sanderling								X
Arenaria interpres	Ruddy Turnstone								X
Calidris canutus	Knot						X		X
Gavia immer	Great Northern Diver	I							X
Sturnus vulgaris	Starling							X	
Hirundo rustica	Swallow							X	
Alauda arvensis	Skylark		II(II)					X	
Sterna hirundo	Common Tern	I						X	X
Falco tinnunculus	Kestrel							X	

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EU habitats and birds directive annexation descriptions		
Symbol	Meaning	Brief definition
I	Annex I bird species	Endangered species
II(I)	Annex II, section I bird species	Species may be legally hunted in all EU member states
II(II)	Annex II, section II bird species	Species may be legally hunted in named EU member states
III(I)	Annex III, section I bird species	Species may be deliberately killed or captured, nests disturbed or eggs taken, and traded live or dead in all EU member states
III(II)	Annex III, section II bird species	Species may be deliberately killed or captured, nests disturbed or eggs taken, and traded live or dead in named EU member states

The closest Special Protection Area (SPA) to the proposed development is the Cork Harbour SPA (Site Code 004030). A total of thirteen species listed as qualifying interests for the Cork Harbour SPA were recorded, namely, Cormorant, Oystercatcher, Dunlin, Curlew, Redshank, Greenshank, Great Crested Grebe, Grey Heron, Teal, Blackheaded Gull, Common Gull, Lesser Blackbacked Gull

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and Common Tern. The Natura Impact Statement (NIS), which accompanies this application, provides a more detailed appraisal of the impact of the proposed development on Natura 2000 sites including the Cork Harbour SPA.

Table 12.6 Cork Harbour SPA –Special Conservation Interests for the Cork Harbour SPA and Qualifying Populations

Cork Harbour SPA [IE0004030]			Season
[A004]	Little Grebe	*Tachybaptus ruficollis*	Wintering
[A005]	Great Crested Grebe	*Podiceps cristatus*	Wintering
[A017]	Cormorant	*Phalacrocorax carbo*	Wintering
[A028]	Grey Heron	*Ardea cinerea*	Wintering
[A048]	Shelduck	*Tadorna tadorna*	Wintering
[A050]	Wigeon	*Anas penelope*	Wintering
[A052]	Teal	*Anas crecca*	Wintering
[A056]	Pintail	*Anas acuta*	Wintering
[A065]	Shoveler	*Anas cylpeata*	Wintering
[A069]	Red-breasted Merganser	*Mergus serrator*	Wintering
[A130]	Oystercatcher	*Haematopus ostralegus*	Wintering
[A140]*	Golden Plover	*Pluvialis apricaria*	Wintering
[A141]	Grey Plover	*Pluvialis squatarola*	Wintering
[A142]	Lapwing	*Vanellus vanellus*	Wintering
[A149]*	Dunlin	*Calidris alpina*	Wintering
[A156]	Black-tailed Godwit	*Limosa limosa*	Wintering
[A157]*	Bar-tailed Godwit	*Limosa lapponica*	Wintering
[A160]	Curlew	*Numenius arquata*	Wintering
[A162]	Redshank	*Tringa totanus*	Wintering
[A179]	Black-headed Gull	*Larus ridibundus*	Wintering
[A182]	Common Gull	*Larus canus*	Wintering
[A183]	Lesser Black-backed Gull	*Larus fuscus*	Wintering
[A193]*	Common Tern	*Sterna hirundo*	Breeding
[999]	Wetlands		

* Indicates a priority species under the Habitats Directive.

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12.3.13 Winter roost cormorant

A night-time tree-roosting Cormorant survey was undertaken within Monkstown Creek during the 2011/12 and 2013/14 wintering seasons as part of the Ringaskiddy Port Redevelopment, Environmental Impact Statement (Port of Cork, 2014). The surveys recorded that during both wintering periods the Monkstown Creek tree-roost regularly supported nationally important numbers of roosting Cormorants. The number of cormorants using the Monkstown Creek tree-roost rose through late summer and autumn, peaking in October/November. The total peak number of birds recorded using the tree-roost was 334 birds, representing 2.45% of the most recently published Irish wintering population of

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13,710 and 54.19% of the Cork Harbour SPA qualifying population at the time of designation (620 wintering individuals). The peak count also represents 133% of the most recently 5-year mean for Cork Harbour (252 individuals). The closest site, included within this night-time tree-roosting Cormorant survey, is located 1km from the proposed development area within the Indaver site.

12.3.14 Birds summary

Overall, the study area is of local value for a range of terrestrial bird species that are relatively common in the Irish countryside. The study area is of more value than the intensively agriculturally managed land in this area due to the presence of a greater diversity of habitats and semi-natural habitat. These have arisen due to an absence of active management of parts of the site. However, the study area does not support a community of birds or individual species that would be considered significant conservation priorities, and the study area, which is small, does not provide critical resources for such communities and/or species.

The coastal area adjoining the site consists primarily of rock and shingle, and therefore does not support the high numbers of wintering waders that are characteristic of high value mudflats with high densities of macro-invertebrates. Some species that are considered of high conservation value (Annex I of the Birds Directive, qualifying species for the Cork Harbour SPA and Red List) were noted in this general area. Many of these birds were recorded overflying the channel, and the site itself and the shoreline adjoining the site, did not support high numbers of these species.

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12.3.15 Invertebrates

The complexity and diversity of vegetation types within the site provides a mixture of habitats for insects, although encroachment by scrub has reduced the available grassland habitat.

A specialised moth survey was carried out during August 2008 using a mercury vapour lamp trap survey and butterflies were identified during walkover surveys. In total 33 moth and butterfly species were recorded. No species of particular rarity were recorded, although some of the moth species do have specialised or localised distributions. All species recorded are dependent on scrub/semi-natural grassland with the exception of Wainscot Moth, which are associated with wetland reed beds. Reedbed habitat does not occur within the proposed development site but does occur within the vicinity of the site.

A previous survey of the site carried out by the Aquatic Services Unit in 2001 recorded 30 moth and butterfly species. A single species of Odonata (Dragonfly and Damselfly species) was recorded. None of the species recorded on the site during the 2001 survey were considered of special conservation significance, and the report concluded that “the species recorded strongly suggest that the site is of little entomological interest.”

Given the above background information, specialised surveys were not considered necessary in 2014/2015. Overall it can be concluded that the site supports a mixture of common invertebrate species that would be typical for the habitats noted within this general area. The presence of rare or uncommon species is unlikely, and some reduction in species diversity may have occurred

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since the previous survey in 2008 due to an increased dominance of scrub habitat.

12.3.16 Marine Ecology

As a coastal protection measure, it is intended to place approximately 1,100m^3 of imported rounded shingle of appropriate size on Gobby beach at the base of the cliff at the eastern boundary of the site. This beach nourishment scheme will extend from the car park at the northern end to the southern boundary of the Indaver site. The material will be deposited above the high water mark.

A survey of the intertidal area in proximity to the proposed development was carried out by Dr. Stiofan Creaven on Thursday 18th and Friday 19th June, 2015. The survey report is included as **Appendix 12.4** of this EIS. The marine flora and fauna was examined with survey effort timed to correspond with low water on a Spring tide when as much of the shore as possible is exposed. The survey consisted of the following:

- a general walkover of the shore parallel to the waterline
- the examination of three shore transects perpendicular to the waterline extending to the low tide mark including the collection of six sediment core samples for faunal analysis
- an excursion to a large boulder on the lower shore
- the recording of a GPS track of the survey route
- the creation of a photographic record of the shoreline as encountered. Two cameras were used to record details of the shore – both cameras were synchronised (to within a second) with GPS time immediately prior to the start of the survey

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The survey classified the habitats encountered during the survey as follows:

The upper shore here can be classed as Barren Littoral Shingle (EUNIS habitat code A2.111). This substrate typically supports virtually no macrofauna. There is often a temporary cover of the green seaweeds *Enteromorpha* spp. or *Ulva* spp. during periods of stability in the summer - as was observed during the current survey. This area is likely to be influenced by variable salinity. Energy (exposure) for the site is likely to vary considerably with the seasons.

Bedrock and boulders were found scattered throughout the mid and lower shore. Vertical surfaces on these were characterised by a barnacle-limpet community (EUNIS habitat code A1.1131) *Semibalanus balanoides* and *Patella vulgata* dominated community on bedrock. Occasional cracks and crevices in the rock provided a refuge for small individuals of the mussel *Mytilus edulis*, the winkle *Littorina saxatilis* and the dog whelk *Nucella lapillus*. This habitat was found in crevices on the prominent glacial erratic and in crevices found in the limestone bedrock outcrop seen on Transect 3.

Boulder tops, dominated by *Fucus spiralis*, can be classified as *Fucus spiralis* on sheltered upper eulittoral rock (EUNIS habitat code A1.312). In summer, the green alga *Ulva intestinalis* can become very common – as seen on the shore at Ringaskiddy. Vertical surfaces often lack the fucoid cover and are characterised

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by the barnacle-limpet community (EUNIS habitat code A1.1131) also seen on this beach.

The presence of a substantial deposit of decaying algal matter in the mid shore complicates the allocation of a habitat type to this zone though the floral and faunal community encountered closely resembles *Fucus vesiculosus* on variable salinity mid eulittoral boulders and stable mixed substrata (EUNIS habitat code A1.323). The presence of ephemeral seaweeds (green algae here) occupying available space and patches of sediment found between the hard substrata containing the lugworm *Arenicola marina* and the sand mason *Lanice conchilega*, support this classification. The exposure level of this shore probably changes seasonally from sheltered to moderately exposed/exposed during storm events.

The lower shore is characterised by littoral muddy sands with the habitat falling into a Polychaete/Bivalve-dominated muddy sand shore (EUNIS habitat code A2.24). Based on analysis of infaunal samples taken during the transects, this most closely resembles a *Macoma balthica* and *Arenicola marina* in muddy sand shores biotope (EUNIS habitat code A2.241) though with *Abra* present instead of *Macoma*. It also has elements of *Lanice conchilega* in littoral sand (EUNIS habitat code A2.245).

An attempt was made to obtain faunal samples at all stations visited. Due to the rocky nature of the substrate it was only possible to obtain samples at two stations namely at Station 5 on Transect 1 and at Station 5 on Transect 3. Using a spade, digovers to a depth of 30cm were carried out at those stations where coring for fauna was not possible. The assemblage recorded is close to the EUNIS LS.LSa.MuSa.Lan Lanice conchilega in littoral sand grouping but instead of *Macoma balthica*, *Abra* is present (EUNIS code A2.24 – Polychaete/bivalve dominated muddy sand shores). The common cockle (*Cerastoderma edule*) was also present here.

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The report concluded that these habitats are all commonly encountered in an Irish context. Samples were faunally poor with only ten taxa present. All species found are typical of fine grained sediments of the North East Atlantic. No rare or uncommon species were recorded.

12.4 Characteristics of the Proposed Development Site

The proposed development will be located on the Ringaskiddy Peninsula, overlooking Cork's inner harbour approximately 800m east of the village of Ringaskiddy in County Cork. The site of the proposed development is currently a greenfield site of approximately 13.55 hectares and is located on the northern slopes of the Ringaskiddy peninsula at its eastern end. The location of the site is shown in **Figure 1.1 of this EIS**.

The main element of the proposed Ringaskiddy Resource Recovery Centre project is a waste-to-energy facility (waste incinerator). Other elements include an upgrade of a section of the L2545 road, coastal protection measures on Gobby beach, a connection to the national electrical grid, and raising the ground levels in part of the site. Refer to **Figure 1.3** for the overall site layout. The proposed development is described in detail in Chapter 4 **Project Description** of this EIS**.**

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12.5 Evaluation of Potential Impacts

During construction, potential impacts could arise from increased noise and disturbance during works on land and from spreading of the invasive species Japanese Knotweed during site works. On the adjoining beach, impacts could arise from increased noise and disturbance associated with the coastal protection works. Impacts on the marine environment could arise during construction from increased run-off of suspended solids or from inadvertent spillages of hydrocarbons during construction works.

During the operation phase of the proposed development, there will be a net, permanent loss of an area of semi-natural terrestrial habitat and potential impacts on the ecology of the upper shore from the beach nourishment scheme. Increased traffic and noise associated with the site could potentially increase levels of disturbance which could result in the disturbance/displacement of birds and mammals such as otter and seals. The stack of the main process building could theoretically create a collision risk for birds thus leading to a risk of increased bird mortality and potential subsequent impacts on bird populations. Emissions to air could theoretically have eco-toxicological impacts particularly on piscivorous birds, otters and seals due to bioaccumulation. The importation of organic waste could attract increased predator numbers which in turn could have implications for nesting success for birds and for ground nesting birds in particular. Accidents during operation or during the transport of ash and flue gas residues could theoretically impact on marine ecology.

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12.5.1 Impact Appraisal

When describing changes/activities and impacts on ecosystem structure and function, important elements to consider include magnitude, duration and probability of occurrence (IEEM, 2006).

Magnitude refers to the 'size' or 'amount' of an impact, determined on a quantitative basis if possible. Duration refers to the time for which the impact is expected to last prior to recovery or replacement of the resource or feature. This should be defined in relation to ecological characteristics (for example species' lifecycles) rather than human timeframes. Appropriate criteria for the assessment of magnitude and duration for this project are provided in **Tables 12.7 and 12.8** below.

Table 12.7: Criteria for Determining the Magnitude of Ecological Impacts

Magnitude	Examples
Very High	e.g. The proposal (either on its own or with other proposals) will result in – The total loss of or very major alteration to key elements/features of the baseline conditions such that post-development/character/composition/attributes will be fundamentally changed and may be lost from the site altogether.
High	e.g. The proposal (either on its own or with other proposals) will result in – Major alterations to key elements/features of the baseline (predevelopment) conditions such that post-development/character/composition/attributes will be fundamentally changed.
Medium	e.g. The proposal (either on its own or with other proposal) will result in – The loss of or alteration to one or more key elements/features of the baseline conditions such that post-

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	development/character/composition/attributes of baseline would be partially changed.
Low	e.g. The proposal (either on its own or with other proposals) will result in – A minor shift away from baseline conditions. Change arising from the loss/alteration will be discernible but underlying character/composition/attributes of baseline conditions would be similar to predevelopment circumstances/patterns.
Negligible	e.g. The proposal (either on its own or with other proposals) will result in – A very slight change from baseline condition. Change barely distinguished approximating to the “no change” situation.

Table 12.8 Criteria for assessment of duration.

Duration	Criteria
Permanent	Effects continuing beyond one human generation (c.25 years) are expected. There is likely to be a substantial improvement after this period, whereby these would be described as "very long term effects."
Temporary	Long term-(15-25 years) Medium (5-15 years) Short term (0-5 years)

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Probability of occurrence

It is important to consider the likelihood that a change/activity will occur as predicted and also the degree of confidence in the assessment of the impact on ecological structure and function. The following scale (IEEM, 2006) is often utilised in ecological assessment:

- Certain/near-Certain: probability estimated at 95% chance or higher.
- Probable: probability estimated above 50% but below 95%.
- Unlikely: probability estimated above 5% but less than 50%.
- Extremely Unlikely: probability estimated at less than 5%

Significance of impacts

Based on the above and the value of habitats and species a matrix of significance can be used to determine specific impacts. This matrix is shown below in **Table 12.9.**

Table 12.9: Impact Significance Matrix

Impact Significance		Ecological Value				
		Very High	High	Medium	Low	Negligible
Magnitude	Very High	Major	Major	Major	Moderate	Minor
	High	Major	Major	Moderate	Minor	Negligible
	Medium	Major	Moderate	Minor	Minor	Negligible
	Low	Moderate	Minor	Minor	Negligible	Negligible
	Negligible	Minor	Negligible	Negligible	Negligible	Negligible

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12.5.2 Do nothing scenario

In the absence of development it is expected that the small areas which are currently managed intensively for agriculture (arable and pasture) would remain under the same management regime. The general pattern of succession from scrub with patches of grassland to woodland would be expected to continue on areas that are not currently grazed. If sufficient time elapsed without development, the unused areas of the site would be expected to develop a covering of woodland with a mix of native and introduced species. However Japanese Knotweed is likely to spread if active control measures are not implemented.

12.6 Predicted Impacts on Terrestrial Habitats

12.6.1 Predicted Impacts on Terrestrial Habitats

Impacts on terrestrial habitats are generally restricted to direct removal of habitats and possible impacts from the spread of invasive species. Levels of dust during construction are predicted to be low and effectively managed by mitigation. The impact on vegetation in adjoining habitats from wind-blown dust is predicted to be negligible. Based on the criteria outlined by the IEEM, as described above, the predicted impacts are detailed in **Table 12.10.**

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Table 12.10 Impacts on Terrestrial Habitats

Habitat	Ecological value (NRA guidelines)	Predicted Impact
Hedgerow WL1/Treelines WL2	Local importance (Low value)	Minor
Dry meadow and grassy verge GS2/Wet grassland GS4	Local importance (Low value)	Minor
Scrub WS1	Local importance (Low value)	Minor
Immature woodland WS2	Local importance (Low value)	Minor
Broadleaved woodland WD1	Local importance (Low value)	Negligible
Improved agricultural grassland GA1	Negligible	Negligible
Conifer woodland WD3	Negligible	Negligible
Dense bracken HD1	Negligible	Negligible
Arable crops BC1	Negligible	Negligible

12.6.2 Non-native invasive species

Following best practice guidance Montbretia, Snowberry, Buddleia, Winter Heliotrope, Cotoneaster and Travellers' Joy can be readily managed through standard eradication/control methods. On the basis of their invasive qualities, the

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ecological value and types of habitats recorded during the walkover survey and their Amber Listing by Invasive Species Ireland, these species are unlikely to result in a significant effect. If not eradicated, however, prior to construction they are likely to further invade adjacent semi-natural habitats and disturbed ground associated with construction activities and cause long-term landscape maintenance issues relative to the proposed development with associated costs. For this reason, these species should be included in an invasive species management plan for the site. Given the dominance of Sycamore in the Irish landscape it is not considered feasible to include this species in the management plan for the site.

Given its invasive qualities, the high risk categorisation by Invasive Species Ireland, statutory obligations and the potential for significant effects arising from this species, Japanese Knotweed will be carried forward for further assessment.

Introduced into Ireland in the early part of the 19th Century, Japanese Knotweed is a highly invasive herbaceous perennial which grows up to 3m tall. The leaves and stems die back during winter, but growth is extremely rapid during spring. It can grow on almost any substrate and has invaded semi-natural riparian habitats including riverbanks, roadside and railway verges, coastal habitats, disturbed ground and waste areas and gardens in both urban and rural landscapes in Ireland. From an ecological viewpoint, its early emergence, great height and density of stands combine to shade out and suppress native plants. It has been shown to reduce species diversity of invertebrate populations and is therefore likely to reduce the quality of ecosystems for amphibians, reptiles, birds and mammals, whose diets are largely composed of arthropods.

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The plant can spread rapidly to form dense stands 1 to 3 acres in area by sending shoots up from an extensive radial rhizome network (root-like structures). When established the rhizomes can extend several metres (up to 7m) from the parent plant and deep into the soil up to 3m (depending on ground conditions and disturbance regimes). As plants mature plants a large central bulbous rhizome crown develops from which the main stems emerge. Spreading out from this central region are a number of radial penetrating rhizomes that twist together to form a sizeable and considerable penetrating force. It is this characteristic of the plant which gives it the ability to penetrate weak points in structures, break through bituminous materials and concrete thus damaging footpaths, hard standing areas, road surfaces, services and foundations.

The major issue with this species is its ability to disperse by plant fragments and to colonise and invade disturbed land. Japanese Knotweed can regenerate from less than 0.7g of rhizome. Stem material cannot regenerate once it has dried, but rhizome material may be viable for up to 20 years in the soil. During flood events fragments of rhizomes may be broken off and washed downstream establishing new populations. Vegetation management, landscaping and construction activities can disturb Japanese Knotweed and it may spread within or off site in the form of plant fragments in the soil load or on the tyres of machinery and dumpsters, especially on machinery with tracks. Mowing or strimming can distribute fragments, which can then be carried along road corridors by wind or on the tyres of vehicles including cars (see Wace, 1977; Wilcox, 1989) or downstream where they can further invade riparian vegetation. Thus control of this species is therefore very difficult and requires a detailed non-native invasive species management plan (Invasive Species Ireland, 2008).

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The potential for impacts arising from Japanese Knotweed are dependent on a do nothing or a do something scenario. The do something scenario refers to the eradication of Japanese Knotweed prior to construction stage of the proposed development. Under a do nothing scenario the infestation will continue to spread due to lateral rhizome growth and through disturbance from road maintenance and arable crop cultivation into adjacent lands with potential for significant impacts on

In this instance it is proposed to control invasive species including Japanese Knotweed adjacent to the site prior to the commencement of construction and thus any impact from invasive species will be negligible.

12.6.3 Impacts on Marine Habitats

Potentially, impacts on marine habitats could arise due to the deposition of the shingle above the foreshore on Gobby Beach. This will impact on the physical structure of the upper shore above the high tide line and on any flora/fauna occupying this zone. Some of this material could impact on the intertidal zone if the material moves position during storm surges. Depending on the chemical composition of the deposited material and its similarity to the existing beach material, there could be changes in floral communities. However, it is noted that no rare or uncommon species or habitats have been recorded within the area of the proposed coastal protection works and re-colonisation of this area is expected to proceed quickly. The material to be deposited will be similar to the existing material in this area and thus no changes in flora/fauna communities will occur. Similarly, if any of this material reaches the intertidal zone during storm surges, it will be rapidly re-colonised and will not have a significant impact on marine ecology. Any direct impacts on marine ecology arising from the beach nourishment scheme are predicted to be negligible.

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Again, potentially, impacts could arise from any inadvertent spills of hydrocarbons or other chemicals during construction. High levels of suspended solids in surface water run-off could potentially have localised impacts on marine ecology. It is noted that such impacts are easily prevented by standard mitigation measures, which will be implemented during construction, and which are set out in detail in **Chapter 5** of the EIS. No habitats of high sensitivity to pollutants or high conservation value occur in close proximity to the development site and the marine environment provides a high level of dilution in relation to possible inadvertent minor spills of hydrocarbons or other chemicals. Any indirect impacts on water quality and marine ecology during construction are predicted to be negligible.

No significant impacts on water quality in the marine environment are predicted during operation of the facility. All trucks carrying solid waste will be covered. Aqueous waste will come in tankers. All trucks will have to comply with the road transport legislation and regulations.

Circa 2,000 tonnes per annum of boiler ash and circa 9104 tonnes per annum of flue gas cleaning residues will be produced in the waste-to-energy plant. The boiler ash and flue gas cleaning residues will be in the form of fine particles and will contain heavy metals.

These residues will be disposed of to a landfill for hazardous waste after treatment if necessary or to a salt mine, either in Ireland, if one is available, or

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abroad. The regulation of the transport of the ash would be subject to Trans Frontier Shipment (TFS) licence which is a licence which must be approved by the origin/destination/transit authorities consenting to the movement/transit and acceptance of wastes between EU member states. The regulation governing this is EU Regulation 1013/2006. This licence tracks waste from origin to destination and ensures that each authority is aware of the status of the waste until final recovery when the individual TFS notification annex consigned with each shipment is signed off as having been received and treated by the receiver. This completed licence is then circulated back to us as the producer as well as all relevant authorities.

Similar residues from Indaver's Meath facility are currently being shipped to salt mines in Germany where the residues are solidified and used to back-fill the mine instead of using other raw materials. There are no landfills for hazardous waste or salt mines in Ireland at present. The residues will be collected on the site in sealed silos. The silos are emptied into a tanker via a sealed connection. This will ensure there are no fugitive releases on the site.

It is noted that the accident risk during shipping is low. Van Den Bosch are the preferred international logistic services provider which transports such residues for Indaver. They note that in the 51 years of their history no container has ever fallen overboard and no ship has sank with their containers on board.

The addition of water leads to the residues solidifying. Thus in event of a shipping accident and if the transport container were to lose integrity, the residues would solidify on contact with water and solidified residues will be salvaged from the sea bed.

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Given the extremely low risk of an accident, the low risk of leakage from the transport containers, the fact that the residues will solidify on contact with water, the impacts on marine or terrestrial ecology from the disposal of this material are expected to be negligible.

Wastewater will be directed to Irish Water sewer. Any process effluent will be recycled for use in the process and will not be discharged off site. Storm water will be monitored and discharged off site only if monitoring determines that it is uncontaminated. In the unlikely event of a fire, the fire-fighting water will be captured in the storm water drainage system and will be collected in the holding tank, where it can be stored for disposal. The outlet valve from the holding tank will close if there is a fire alarm. If the holding tank has insufficient capacity, the water will overflow to the attenuation tank, in which it can be retained pending testing and disposal. Detailed information on potential impacts from accidents is provided in the HAZID report (**Appendix 6.1 of this EIS**).

The potential impacts on air quality from emissions are specifically addressed in **Chapter 9, *Climate*** of this EIS, which concluded that, based on the results of air dispersion modelling of process emissions, the air quality impact of the proposed facility will be insignificant. Therefore, any impact from the bioaccumulation of potentially toxic compounds in macro-invertebrate and fish populations is predicted to be negligible.

Based on the above information, impacts on the marine environment during operation are predicted to be negligible.

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12.6.3 Predicted Impacts on Fauna

12.6.3.1 Otters

A survey by DixonBrosnan in 2014 and 2015 did not record the presence of otter within a radius of 150m from the study area, although some sprainting activity was recorded 300m north of the site. No holts were recorded. It is noted that the upper shore of the beach, which adjoins the site, is extensively used by the general public, and that usage is highest in proximity to the car park that is located immediately adjacent to the proposed development site. These circumstances, particularly where dogs are also present, may reduce usage of the area by otter.

During construction works there will be increased noise and activity associated with the site works. It is noted that this part of Cork Harbour is already subject to high levels of disturbance from traffic and human activity and otters readily habituate in these circumstances. The deposition of material on the upper shore during the beach nourishment process will be short in duration and will occur during daylight hours. Any impact on otter during the construction phase will be negligible.

No significant impacts on water quality in the marine environment or significant impacts on prey availability for otters have been identified. The impacts on air quality from emissions are specifically addressed in Chapter 9 of this EIS which concluded that *based on the results of air dispersion modelling of process emissions, the air quality impact of the proposed facility will be insignificant.* Therefore no impact on otter via air emissions or subsequently via bioaccumulation of potentially toxic compounds is predicted to occur.

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12.6.3.2 Seals

Harbour Seal and Grey Seal are listed on Annex II of the Habitats Directive, and both are known to occur within Cork Harbour. Harbour seals have been recorded from within the channel which adjoins the site and small haul out sites have been recorded at Haulbowline Island and at the slipway at the National Maritime College. Although there is nothing to indicate that the particular area in the immediate vicinity the study area is of particular value for seals, it is within the feeding range for local Harbour Seal populations that forage within this general area. Given that the haul out locations are at least 0.5km from the development area and that seals are mobile and can readily move away from short-term disturbance, any impact on seals will be negligible. The impacts on air quality from emissions are specifically addressed in Chapter 9 of this EIS which concluded that *based on the results of air dispersion modelling of process emissions, the air quality impact of the proposed facility will be insignificant.* Therefore no impact on otter via air emissions or subsequently via bioaccumulation of potentially toxic compounds is predicted to occur.

12.6.3.3 Cetaceans

A number of cetacean species have been recorded within the overall harbour. Harbour Porpoise is considered the species most likely to occur in the channel offshore from the site. It is anticipated that no significant vibration will be

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generated during the construction phase of the proposed development. Piling is likely to be required. It will utilise methods that will minimise the risk of vibration generation and will only be undertaken in daytime. Rock breaking, if required will use methods that will minimise noise and vibration. Impacts on cetaceans during site works are predicted to be negligible.

No significant impacts on water quality in the marine environment or significant impacts on prey availability for cetaceans have been identified. The impacts on air quality from emissions are specifically addressed in Chapter 8 of this EIS which concluded that *based on the results of air dispersion modelling of process emissions, the air quality impact of the proposed facility will be insignificant.* Therefore, no impact on cetaceans via air emissions or subsequently via bioaccumulation of potentially toxic compounds is predicted to occur.

12.6.3.4 Bats

Bat surveys did detect limited usage of the site of the proposed development by Common and Soprano Pipistrelle within the proposed development area with most activity confined to the external boundaries. No potential roosting sites were identified within the site. The native hedgerow along the southern boundary will be retained. The treeline of Hornbeam and Sycamore along the northern boundary will be removed with replacement planting proposed. Whilst the loss of scrub and small areas of grassland will reduce the net feeding area available for bats, there will be no significant loss of the more important feeding habitat along external boundaries and of linear routes which may provide commuting routes within the wider landscape. It is also noted that it is intended to develop semi-natural grassland habitat within the site boundary which is likely to be of value for feeding bats. Overall the impact is predicted to be permanent and of low significance. However the impact will be localised and is unlikely to significantly impact on overall bat populations as there will no loss of critical resources for bats.

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12.6.3.5 Badgers

There is no longer any evidence that the Indaver site is utilised by badgers. Habitats such as scrub and arable land, which will be removed by the development, do not generally provide critical feeding resources for badgers and the areas of semi-natural grassland to be removed are very small in extent. Overall the impact on badgers is predicted to be negligible.

12.6.3.6 Impacts on birds associated with terrestrial habitats

The terrestrial bird species recorded during bird surveys are typical of the types of habitat noted on site and are generally common. No rare or uncommon species or species of high conservation value were recorded. There will be a net loss of semi-natural habitats within the proposed development area (arable land, scrub and grassland) and the loss of scrub in particular will have a localised impact on nesting and feeding resources for these species. However, the scrub habitat is often an ephemeral habitat within the wider agricultural/industrial landscape and the scrub on the site has largely developed because sections of the site have not been utilised. Small areas of this type of scrub are commonly lost or recreated within the wider landscape. Only very small areas of semi-

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natural grassland will be lost and the habitat quality of improved agricultural grassland which remains within the site, will be enhanced to provide replacement habitat. Overall, the loss of habitat for breeding birds within the development site is considered a permanent minor impact.

Some disturbance/displacement of terrestrial birds may occur during construction due to increased noise and disturbance. However this will be short in duration. The impact is therefore predicted to be short-term and of low significance. During the operational phase, the levels of activity will stabilise and birds in the surrounding landscape will be expected to habitualise to the volume of activity proposed. The impact on birds in habitats adjoining the proposed development site is therefore predicted to be permanent and negligible during operation.

12.6.3.7 Construction Impacts on birds associated with marine/shoreline habitats

The Cork Harbour Special Protection Area (Site code 004030) is located approximately 0.5km to the south of the proposed development area. The closest Natural Heritage Area/proposed Natural Heritage Area is the Lough Beg proposed Natural Heritage Area (Site code 001066), which is located 0.3km to the south, and which is also designated on the basis of its bird populations.

The schedule for the construction and commissioning of the resource recovery centre is approximately 31 months and thus there will be works taking place during the peak season for wintering birds which runs from October to March inclusive. Deliveries of shingle and the placement of shingle for the coastal protection works will take place over a period of three weeks and will be undertaken outside of the main bird wintering season.

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Bird surveys were carried out to determine the degree to which the shoreline/marine habitats in proximity to the proposed development site are utilised by birds and in particular important populations of overwintering waders and waterfowl. A total of 38 bird species were recorded during the winter bird surveys carried out in 2014/2015. Birds species listed in Annex I of the Birds Directive are considered a conservation priority and five such species were recorded. (Mediterranean Gull, Dunlin, Little Egret, Great Northern Diver and Common Tern). Six red listed species were recorded namely Herring Gull, Curlew, Redshank, Black-Headed Gull, Dunlin and Knot. A total of thirteen species listed as qualifying interests for the Cork Harbour SPA were recorded, namely, Cormorant, Oystercatcher, Dunlin, Curlew, Redshank, Greenshank, Great Crested Grebe, Grey Heron, Teal, Blackheaded Gull, Common Gull, Lesser Blackbacked Gull and Common Tern.

As a number of bird species were recorded feeding along the shoreline in proximity to the proposed development or overflying the channel, there is the potential for more localised impacts on birds, including species listed as qualifying interests for the Cork Harbour SPA where they occur outside the SPA site boundaries. Similarly there could potentially be impacts on birds which are otherwise considered of high conservation value.

Impacts on birds in close proximity to the proposed development area could potentially arise during construction when levels of noise will increase. There will be increased activity during works, although only activities in close proximity to the shoreline or at height will be visible to birds along the shoreline. For the

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period of the coastal protection works there will be obvious disturbance along the shoreline.

It is noted that the area of shoreline adjoining the proposed development is subject to high levels of disturbance and that, to a degree, any birds which utilise this area will have habitualised to high levels of daytime disturbance. During construction on land the impact on birds is predicted to be short-term and negligible. The coastal protection works will take place outside the main wintering season and will not impact directly on intertidal habitat, thus the impact will be short-term and minor.

No nests for birds such as Ringed Plover were recorded on the upper shore adjoining the development site boundary. A breeding population of Common Tern is known to occur near the entrance to the Port of Cork approximately 750m west of the proposed development area. Given the distance of this colony from the development area, any impacts on this species due to increased noise and disturbance during construction or operation is predicted to be negligible.

An important winter roost of Cormorants is known to occur in trees at Monkstown Creek which is located approximately 1km from the proposed development site. Given the distance of this colony from the development area, any impacts on this species due to increased noise and disturbance during construction or operation is predicted to be negligible.

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12.6.3.8 Operational Impacts on birds associated with marine/shoreline habitats

During the operational phase, noise disturbance and traffic levels will increase in the context of an area where there are already moderate levels of background noise and traffic. Any impacts on birds from disturbance due to increased traffic and noise are predicted to be permanent and minor.

The impacts on air quality from emissions are specifically addressed in Chapter 9 of this EIS which concluded that based on the results of air dispersion modelling of process emissions, the air quality impact of the proposed facility will be insignificant. A literature review, which forms **Appendix 3** of the NIS which accompanies this application, looked at the potential for bioaccumulation in piscivorous birds. Based on the information provided in these assessments including the insignificant levels of potentially toxic substances in emissions and the low background levels in marine sediments any direct impact on birds and mammals via direct emissions or from bioaccumulation are predicted to be negligible.

A literature review was carried out to assess the potential collision risk to birds created by the stack which will be 75m in height. This literature review forms **Appendix 4** of the NIS which accompanies this application. The review notes that, information on the potential collision risk created by such stacks is scarce, however, there is evidence to suggest that towers lower than 60m pose a lower risk to migrating birds. The review notes that a recent radar study was commissioned by the Cork Lower Harbour Energy Group in order to identify nocturnal bird movement and interconnectivity within the Cork Harbour SPA (Simms *et al.* 2011). This study did not reveal any distinct flight patterns over the proposed development site. The literature review indicates that, while any light source has the potential to attract birds and therefore increase collision risk,

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flashing lights are involved in significantly fewer collisions than continuous lights. There is also some indication that white lights are less attractive than red lights, although the results to date are inconclusive. While bird vision does differ from human vision on the lower UV end of the spectrum, infra-red light is also invisible to birds. Therefore the proposal for a combination of white flashing and infra-red lights on the stack, is the most favourable choice and does not pose a significant collision risk to birds.

Based on the above, and the bird surveys carried out in relation to this application for permission, a significant collision risk to birds is considered unlikely.

Local ecological impacts could arise due to increased predator activity if species such as rats or gull species were attracted into the area due to the presence of waste. Both species can prey on nests for ground nesting birds such as common tern and ringed plover. However, it is noted that, during the operational phase of the proposed development, trucks with organic waste will discharge their loads within a sealed building and that there will no storage of waste in outside spaces. Trucks are inspected on arrival to ensure that there is no waste adhering to wheels. A standard pest control programme will be implemented at the site, which will include the use of standard bait boxes and ongoing monitoring as part of a annual service contract. The stack does not create suitable perches for predatory birds and thus does not increase the predation risk for nesting birds. It is also noted that the closest nesting colony of high conservation value (Common Terns) is located approximately 750m away. Under these circumstances any impact from increased predator density or increased predator activity is predicted to be negligible.

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In relation to the Cork Harbour Special Protection Area, for the reasons set out in detail in the NIS submitted with the application, there will be no adverse effects on the integrity of that designated European site having regard to its conservation interests.

In relation to the pNHA, the impact due to increased noise and disturbance during the operational phase is predicted to be permanent and negligible.

12.6.3.9 Impacts on other fauna

Rabbit, Fox, Field Mouse, Pygmy Shrew and Bank Vole have all been recorded from the site. Mammal species which are protected under the Irish Wildlife Act 1976, as amended, such as Pygmy Shrew, Hedgehog and Stoat could potentially occur within the proposed development site, although no signs of these species were recorded. No habitats suitable for amphibians or reptiles was recorded and a survey in 2008 for butterflies and moths did not record any rare or uncommon species. Given that no rare species were detected in 2008 and the common nature of the habitats to be removed, it was not considered necessary to repeat this survey in 2014/2015. Given that small areas of relatively common habitats that will be affected any impact on these species will be negligible.

12.6.3.10 Climate change and biodiversity

The EU Commission guidance document on integrating climate change and biodiversity into environmental impact assessment (EU Commission, 2013) aims

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to improve the way in which climate change and biodiversity are integrated into Environmental Impact Assessment. Key principles specified by the document when considering impacts include the following:

- Consider climate change at the outset
- Analyse the evolving environmental baseline trends
- Taking an integrated approach
- Seek to avoid biodiversity and climate change effects from the start
- For biodiversity, EIA should focus on ensuring 'no net-loss'
- Assess alternatives that make a difference in terms of climate change and biodiversity
- Use ecosystem-based approaches and green infrastructure as part of the project design and/or mitigation measures.
- Assess climate change and biodiversity synergies and cumulative effects which can be significant

The potential impacts from the proposed development on climate have been specifically addressed by **Chapter 9 *Climate*** of this EIS. No significant interactions between the impacts on biodiversity resulting from this development and climate change have been identified.

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In relation to biodiversity, it is important to adopt an “ecosystem approach which considers all of the different ecological elements and how they interact with each other. The site of the proposed development consists of a mixture of semi-natural habitats with native hedgerow along the southern boundary forming a connective element within the local landscape. Dense hedgerows can connect different ecological elements within a landscape which allows mammals, birds and invertebrates a means of moving through the landscape under cover. In this instance, the hedgerow connects a small area of woodland and scrub in the east of the Indaver site to coastal habitats. A hedgerow running at right angles from this hedge connects to the additional woodland habitat in proximity to the Lough Beg industrial estate. In addition this boundary hedgerow provides nesting and feeding habitat for birds and other fauna and is of value as feeding habitat for bats. The retention and enhancement of this hedgerow is therefore considered important in maintaining ecological value within the site.

A review of aerial photography and surveys, carried out on the site since 2001, indicates that areas which have not been managed for conventional agriculture have gradually changed over time. In particular, scrub has gradually encroached on grassland habitat within the proposed development area in place of semi-natural grassland. Scrub is now the dominant habitat within the proposed development area, with grassland reduced to small fragments.

It is proposed therefore to enhance the habitat value of an area of improved grassland in the southwest corner of the site, which is approximately 3ha in size (see **Figure 12.2**). This will be achieved by introducing specialist grass seed mixes based on the naturally occurring plant species found in this area, the introduction of species such as the parasitic yellow rattle and of key species such as knapweed that are important attractors for butterflies and other invertebrates.

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The species mix will include species found within the site and locality and will take into account prevailing ground conditions and the coastal environment. A specific, long-term management programme that includes a grazing and/or cutting regime to maintain diversity within the sward will be implemented. Fertiliser applications will be discontinued. In line with the “no net loss” principle of the EU commission guidance on integrating climate change and biodiversity into EIA, the long-term aim will be the establishment of a species rich grassland (i.e. a combination of Dry Meadow and Grassy Verge GS2, Wet Grassland GS4 and Neutral Grassland GS1) as a replacement for grassland areas which have become dominated by scrub. It is noted that the creation of a sustainable diverse grassland on high fertility grassland is a long-term process which requires specialist expertise.

It is noted that scrub will be retained within the site to the south west of the Hammond Lane site. Areas of dense bracken within this area will be treated to reduce the dominance of bracken which tends to suppress ground flora. This will also serve to increase biodiversity within the remaining areas of semi-natural habitat which will be retained within the site boundary.

12.7 Potential Cumulative Impacts

Cumulative impacts on fauna chiefly relate to increased noise and activity levels and the possibility of increased collision risk. Although increases in noise/disturbance could occur arise from several different projects in-combination the impact is likely to be most pronounced during construction. This is a short term impact which will be localised. Given the nature of the projects proposed and distances between them, significant impacts during operation are unlikely. Given the distance between the wind turbines, Aghada stack and the proposed Indaver stack the cumulative collision risk or disturbance risk are predicted to be low. The potential cumulative impacts which are considered relevant to this proposal are listed below.

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12.7.1 Hammond Lane

The existing Hammond Lane Metal Company is accessed from the L2545 and is surrounded by the Indaver site. Planning permission was granted in 2012 for demolition, new build, upgraded facilities and a new processing plant. Whilst there is some noise and traffic associated with the facility, it is set back by approximately 240m from the coastline and no potential impact on birds, otters or seals utilising coastal habitats has been identified. Impacts on ecology within the Indaver site are predicted to be negligible. Therefore, no impacts have been identified arising from the Hammond Lane development which would cause an effect in-combination with the development of the proposed Resource Recovery Centre (including waste to energy facility).

12.7.2 Wind turbines with Lower Cork Harbour.

Currently in the Cork Lower Harbour there are three existing wind turbines and a further turbine planning permission, with a maximum rotor tip height of 150m. The closest turbine is located approximately 400m south of the proposed stack for the Ringaskiddy Resource Recovery centre at the DePuy facility (Loughbeg). The other constructed wind turbines are located at GlaxoSmithKline

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(Curraghbinny) and at Janssen (Barnahely) located 1.7km and 2.5km from the proposed Indaver stack respectively. Another permitted, but unbuilt, wind turbine has been proposed for close to the Novartis pharmaceutical plant at Barnahely, 2.5km from the proposed stack at the Indaver site. De Puy are proposing to construct a new 3MW turbine on their site at Loughbeg, Ringskiddy. The proposed turbine will be similar in appearance to the existing 3MW turbine on the site. The proposed turbine will be located to the south of the existing turbine, and is expected to be at least 1km from the proposed stack on the Indaver site. It is expected that a planning application for the proposed wind turbine will be submitted to Cork County Council in December 2015.

The built turbines themselves are separated from each other by distances ranging from 1.7km to 2.5km and all four turbines are in excess of 5km from the ESB Power Station Stack at Whitegate. When the Novartis Turbine is constructed, it will be approximately 700m from the closest existing turbine at Janssen and in excess of 5km from the ESB Power Station Stack at Whitegate.

Given the distance between the Indaver stack and wind turbines and the ESB Power Station Stack at Whitegate, the limited size of the proposed stack and the limited bird usage of shoreline habitats adjoining the site, there will no, significant in-combination impact on birds. No additional impact is predicted from the new planned turbine at the De Puy site.

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12.7.3 Whitegate Power Station Stack

Approximately 5km east of the proposed development is the Aghada ESB Power Station Stack at Whitegate, with a stack height of 152m. As noted this site is considered a considerable distance from the Indaver site and no cumulative disturbance impacts or collision risk in relation to the proposed Indaver Stack have been identified.

12.7.4 The Port of Cork development

The EIS submitted to An Bord Pleanála as part of the application for permission in respect of the Port of Cork development at Ringaskiddy was reviewed during the preparation of this chapter. In the absence of any predicted impact on marine ecology or bird usage of the area from the Indaver development, no potential cumulative impacts have been identified.

12.7.5 Haulbowline Development and Masterplan

Remediation works and the subsequent redevelopment of Haulbowline Island, which is located 870m north of the proposed development, could potentially increase traffic levels along local roads. However increased traffic levels are unlikely to have a significant impact on bird populations and no other cumulative impacts have been identified.

12.7.6 Spike Island Masterplan

Increased boat traffic to Spike Island and increased activity on the island, which is separated from the Indaver site by a 770m marine channel, could potentially impact on bird populations. However, given the distance involved and the lack of

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any significant impacts on birds arising from the Indaver development, no likely significant cumulative impacts have been identified.

12.7.7 M28 Cork to Ringaskiddy Motorway Scheme

Increased noise and activity levels could arise due to the proposed N28 scheme particularly during construction. Whilst there may be localised disturbance/displacement of fauna, the cumulative impact is not predicted to be significant.

12.7.8 IMERC Campus Masterplan Area

A Masterplan for the Irish Maritime and Energy Resource Cluster (IMERC) adjacent to the National Maritime College of Ireland (NMCI) aims to deliver research and enterprise campus in Ringaskiddy, Cork. Construction of the Beaufort Building was completed by UCC in 2015. It is proposed to expand the campus and to develop a marine and energy cluster focussing on research, development, commercialisation and innovation. In the absence of any predicted impact on the ecology of the area from the Indaver development, no potential cumulative impacts have been identified.

12.8 Mitigation Measures

The likely success of the proposed mitigation measures is high, either in their current form or as they will be adapted on-site to achieve the desired result. The mitigation measures have been drawn up in line with current best practice and include an avoidance of sensitive habitats at the design stage. It is clear in what the mitigation measures are designed to achieve in lowering or reducing the risk of impact to acceptable levels. Whilst the proposed methods of mitigation may be amended and supplemented the risk that the mitigation measures will not function effectively in preventing significant ecological impacts is low. The following mitigation measures will be implemented:

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12.8.1 Construction Phase Mitigation Measures

A Construction Environmental Management Plan (CEMP) will implement *all* the construction phase mitigation measures identified in the EIS, NIS.

A construction environmental management plan (CEMP) will be prepared prior to construction commencing. The CEMP will comprise all of the construction mitigation measures, which are set out in this EIS and NIS, and any additional measures which are required by the conditions attached to the Board's decision. The principal measures which will be set out in the CEMP are summarised below:

Protection of habitats

- To prevent incidental damage by machinery or by the deposition of spoil during the site clearance stage, any trees /habitats earmarked for retention will be securely fenced early in the construction phase. The fencing will be clearly visible to machine operators.
- To prevent Japanese Knotweed from outside the site being inadvertently being brought in to the site, the contractor will be required to inspect vehicles

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before using them on site, and will pay particular attention to caterpillar tracks and where trucks and dumpers are stowed. The supplier of fill will be required to provide a guarantee that the fill to be imported does not contain knotweed. In addition, the fill will be inspected for signs of knotweed, prior to importation to site. The UK Environmental Agency's publication *Managing Japanese knotweed on development sites - The Knotweed Code of Practice* (EA 2013), states that inspection of topsoil brought into the site, should be carried out using the guidance in appendix I-IV of the code BS 3882:2007 '*The British Standard Specification for topsoil and requirements for use*'. This Standard was replaced subsequently by BS3882:2015 *Specification for Topsoil.* The inspection of fill will be carried out according to this Standard.

Protection of water quality

- A dedicated holding tank for storage of construction foul effluent will be constructed prior to commencement of the main construction activities. The effluent will be regularly disposed of off-site by tanker by a licensed contractor to an approved licensed facility
- Storm water will be managed carefully during construction. In general, storm water will be infiltrated to ground via silt traps and managed soakaways. The laydown areas will be suitably drained and any areas which will involve the storage of fuel and refuelling will be paved and bunded and hydrocarbon interceptors will be installed to ensure that no spillages will get into the surface water or groundwater.

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The employment of good construction management practices will minimise the risk of pollution of soil, storm water run-off, seawater or groundwater. The Construction Industry Research and Information Association (CIR*IA) in the UK has issued a guidance note on the control and management of water pollution f*rom construction sites, *Control of Water Pollution from Construction Sites, guidance for consultants and contractors (Masters-Williams et al 2001). Additional g*uidance is *provi*ded in the CIRIA technical guidance on *Control of Water Pollution from Linear Construction Projects* (Murnane *et al* 2006). Construction mitigation measures are further outlined in **Section 5.8** of the EIS.

Measures, as recommended in the guidance above, that will be implemented to minimise the risk of spills and contamination of soils and waters, include:

- Training of site managers, foremen and workforce, including all subcontractors, in pollution risks and preventative measures,
- Careful consideration will be given to the location of any fuel storage facilities. These will be designed in accordance with guidelines produced by CIRIA, and will be fully bunded.
- All vehicles and plant will be regularly inspected for fuel, oil and hydraulic fluid leaks. Suitable equipment to deal with spills will be maintained on site.
- Where feasible, soil excavation will be completed during dry periods and undertaken with excavators and dump trucks. Topsoil and subsoil will not be mixed together. Specific measures will be implemented, as specified by the Invasive Species Management, Plan to ensure that Japanese Knotweed is not spread within the site or outside the site boundaries.

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- Ensure that all areas where liquids are stored or cleaning is carried out are in a designated impermeable area that is isolated from the surrounding area, e.g. by a roll-over bund, raised kerb, ramps or stepped access.
- Use collection systems to prevent any contaminated drainage entering surface water drains, watercourses or groundwater, or draining onto the land.
- Minimise the use of cleaning chemicals.
- Use trigger-operated spray guns, with automatic water-supply cut-off.
- Use settlement lagoons or suitable absorbent material such as flocculent to remove suspended solids such as mud and silt.
- Ensure that all staff are trained and follow vehicle cleaning procedures. Post details of the procedures in the work area for easy reference.

Air quality

Construction activities have the potential to generate dust emissions, particularly during the site clearance and excavation stages. The potential for dust to be emitted depends on the type of construction activity being carried out in conjunction with ambient conditions, including rainfall, wind speed, wind direction and on the distance to potentially sensitive locations. Most of the dust would be deposited close to the potential source and any impacts from dust deposition would typically be within a hundred metres or so of the construction area. A dust minimisation plan will be prepared and implemented by the building contractor during the construction phase of the project. The following avoidance, remedial or reductive measures will be implemented as part of the dust minimisation plan:

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- During very dry periods when dust generation is likely, construction areas will be sprayed with water.
- Exhaust emissions from vehicles operating within the site, including trucks, excavators, diesel generators or other plant equipment, will be controlled by the contractor through regular servicing of machinery.
- Vehicle speeds will be limited in the construction site.
- Surrounding roads used by trucks for access to and egress from the site will be cleaned regularly using an approved mechanical road sweeper. Roads will be cleaned subject to local authority requirements. Site roads will be cleaned on a daily basis.
- During construction wheel-wash facilities will be provided with rumble grids to remove excess mud from wheels. These facilities will be located at the exit from the site and away from sensitive receptors, where possible. Wheel wash run off will be stored in an onsite storage tank and will be disposed of by permitted waste haulage company at a permitted or licensed facility
- Internal haul roads will be paved at the earliest possible opportunity and inspected regularly for cleanliness.
- Materials carried on vehicles to site will be enclosed or covered with tarpaulins.
- Daily visual inspections will be carried out at locations around the site boundary as required. These inspections will monitor the effectiveness of dust mitigation measures.

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- Material handling systems and site stockpiling of materials will be designed and laid out to minimise exposure to wind.

Waste management

- Waste generated during the construction phase will be carefully managed according to the accepted waste hierarchy which gives precedence to prevention, minimisation, reuse and recycling over disposal with energy recovery and finally disposal to landfill.
- All waste removed from the site will be collected only by contractors with valid waste collection permits, under the Waste Management (Collection Permit) Regulations 2007 and 2008. All facilities to which waste will be taken will be audited in advance, to ensure that they have appropriate waste licences or permits, under the Waste Management Act 1996 as amended by the Protection of the Environment Act 2003, and the regulations thereunder, allowing them to accept the type of waste that is to be sent there. Hazardous waste generation will be minimised, and such waste will be recovered where feasible, and only disposed of if recovery is not feasible. Hazardous waste will be managed in accordance with the relevant legislation.

12.8.2 Mitigation - during operation

Woodland and scrub and other areas of semi-natural vegetation outside the proposed development area will be retained.

Where practicable, the boundary landscape planting will be predominantly of Irish native species that reflect the existing vegetation of the area. These will be derived from local native-origin stocks where possible.

The pasture in the south-western corner of the site will be managed to allow semi-natural grassland to develop.

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12.8.3 Mitigation - Invasive species

The method for the elimination of Japanese knotweed on the site will be implemented with reference to the relevant codes of practice and guidelines: Best Practice Management Guidelines – Invasive Species Ireland (Maguire *et al*. 2008), NRA (2010) and EA (2007) Managing Japanese Knotweed on Development Sites: The Knotweed Code of Practice. There is an adequate lead in time to accommodate a 3 year spraying and monitoring programme for Japanese Knotweed and it is noted that this species was recorded outside the boundary of the proposed works area. This eradication/control method is more cost effective and poses less risk of causing further spread of the species than other potential methods where time allows. No impediment to the successful eradication of invasive species from the site has been identified.

1. A detailed up to date survey for invasive species will be carried out immediately prior to the commencement of the management programme. The mitigation measures outlined below can then be incorporated into a specific non-invasive species management plan based on the most up to date information prior to the commencement of treatment.

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2. Any areas of JKW will be identified and marked to within 7m of each individual stand or plant using hazard tape. It is noted that the proposed works will not impact directly on existing stands of this species.
3. In Ireland, spraying of Japanese Knotweed usually proceeds between mid-August and mid-September, however, the exact timing of spraying a particular infestation is site-specific as it is dependent on temperature and growth stage/physiology of the plant.
4. The entire plant canopy will be treated with a systemic (translocated) herbicide via a backpack cowled knapsack sprayer.
5. A treatment dye will be utilised with the herbicide to ensure that all plants are treated. While the upper surface of the leaves will be easier to treat, it is also important to treat the leaf under surface as Japanese Knotweed possesses many stomata openings on the leaf under surface. A second similar treatment is required in the days following this initial treatment. The timing of the second treatment is also dependent on weather and day and night temperatures. The timing of the first and second spray will be determined on site by an experienced invasive species specialist.
6. Appropriate site hygiene protocols should be deployed throughout the process. Elevated work platforms and a telescopic lance should be deployed to ensure that vehicles and equipment will not come into contact with the plants.
7. If machinery and equipment (including footwear) used during this procedure d come into contact with with the plants they will be power washed prior to leaving the site at the designated wash area.
8. The spraying programme will take into account the following: Presence of ecological receptors i.e. native hedgerows and trees within and adjacent to the infestations, bird nesting season, traffic management in relation to management of roadside infestations, future arable crop harvesting and cultivation, presence of other non-native invasive species, roadside vegetation maintenance on the L2545 Ringaskiddy Road and overhead cables along the L2545 Ringaskiddy Road which may cause hinder treatment of roadside infestations and gaining access to the infestation within the scrub vegetation.

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12.8.4 Badger Mitigation Measures

Although badgers have been previously recorded from the site, no active setts were recorded within this area. The sett that was previously located within the study area, but outside the proposed development area, is no longer utilised. As a precautionary measure it is recommended that the site be surveyed for badgers immediately prior to the commencement of site works, so as to confirm the absence of badgers. If badgers are discovered at that time, the mitigation measures outlined in the NRA publication, *Guidelines for the Treatment of Badgers Prior to the Construction of a National Road Scheme* (NRA, 2006c), should be followed. If necessary, the following measures will be employed for all construction works where badger issues arise.

- Badger sett tunnel systems can extend up to *c*. 20m from sett entrances. Therefore, no heavy machinery should be used within 30m of badger setts (unless carried out under licence); lighter machinery (generally wheeled

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vehicles) should not be used within 20m of a sett entrance; light work, such as digging by hand or scrub clearance should not take place within 10m of sett entrances.

- During the breeding season (December to June inclusive), none of the above works should be undertaken within 50m of active setts nor blasting or pile driving within 150m of active setts.
- Following consultation with the NPWS and badger experts, works closer to any active setts may take place during the breeding season provided appropriate mitigation measures are in place, e.g. sett screening, restricted working hours, etc.
- All affected badger setts will be clearly marked and the extent of bounds prohibited for vehicles clearly marked by fencing and signage. Bunting is an option on a temporary basis. Hazard tape is inadequate as it is prone to deterioration and damage by wind or cattle etc.
- All contractors/operators on site should be made fully aware of the procedures pertaining to each sett on site.
- Construction activities within the vicinity of affected setts may commence once these setts have been evacuated and destroyed under licence from the NPWS. Where affected setts do not require destruction, construction works may commence once recommended alternative mitigation measures to address the badger issues have been complied with.
- Works close to badger setts or removal of badgers from a site may only be carried out under the supervision of a qualified expert under licence from the NPWS.

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12.8.5 Bird Mitigation Measures

The Wildlife Act 1976, as amended, provides that it is an offence to cut, grub, burn or destroy any vegetation on uncultivated land, or any such growing in any hedge or ditch from the 1st of March to the 31st of August. Exemptions include the clearance of vegetation in the course of road or other construction works or in the development or preparation of sites on which any building or other structure is intended to be provided. Nonetheless, it is recommended that vegetation be removed outside of the breeding season.

Retention of the native hedges along the southern boundaries will reduce the loss of breeding and nesting habitat for birds. Some new hedgerow will also be planted along this boundary, a treeline along the northern boundary will be removed, however replacement planting is proposed. NRA guidelines on the protection of trees and hedges prior to and during construction should be followed (NRA, 2006b). Primarily native species will be utilised for new planting at the site. The development of a more species rich sward on grassland in the southwest of the site will in time provide additional feeding resources for birds.

12.8.6 Otter Mitigation Measures

No otter signs or holts were noted within 300m of the proposed development. However, otters do occur within the wider landscape and are common within

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Cork Harbour. A detailed pre-construction survey will confirm the absence of otter holts within 300m of the proposed development area.

Any holts found to be present will be subject to monitoring and mitigation as set out in the NRA *Guidelines for the Treatment of Otter prior to the Construction of National Road Schemes (2006b)*. If found to be inactive, exclusion of holts may be carried out during any season. No wheeled or tracked vehicles (of any kind) will be used within 20m of active, but non-breeding, otter holts. Light work, such as digging by hand or scrub clearance will also not take place within 15m of such holts, except under licence. The prohibited working area associated with otter holts will be fenced and appropriate signage erected. Where breeding females and cubs are present no evacuation procedures of any kind will be undertaken until after the otters have left the holt, as determined by a specialist ecologist. Breeding may take place at any season, so activity at a holt must be adjudged on a case by case basis. The exclusion process, if required, involves the installation of one-way gates on the entrances to the holt and a monitoring period of 21 days to ensure the otters have left the holt prior to removal.

12.8.7 Marine Mitigation Measures

Coastal protection works will take place outside the main wintering season for birds (October to March).

It is anticipated that monitoring of the sacrificial material placed on the beach and of the cliff face will take place every year. If such material is to be replaced in the future, an ecological survey will be carried out in advance to ensure that ecological conditions have not changed in the intervening period.

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12.8.8 Residual Impacts

Emissions from the facility are predicted to have a negligible impact on marine ecology or on important bird populations within Cork Harbour. No significant collision risk has been identified. There will be removal of an area of habitat including scrub and remnants of semi-natural grassland, however, hedgerows and areas of semi-natural vegetation outside the proposed development area will be retained and the biodiversity value of intensive grassland in the northwest corner of the site will be significantly increased. Invasive species will be eradicated. No significant long-term impact on mammals will occur. No significant cumulative impacts have been identified. The impact on designated sites is predicted to be negligible.

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12.9 References

Bibby, C.J., Burgess, N.D. and Hill, D.A. (1992). Bird census techniques. BTO

Bibby, C.J., Burgess, N.D., Hill, D.A. & Mustoe, S.H. (2000). *Bird Census Techniques*. Academic Press, London.

CIRIA (2001). Control of water pollution from construction sites. E. Murnane, A. Heap, A. Swain (eds).

Coastal & Marine Resources Centre (CMRC), University College Cork and the Planning Policy Unit in Cork County Council (2008) Cork Harbour Integrated Management Strategy EU Interreg Project, COREPOINT (Coastal Research & Policy Integration).

Crowe, O. (2005). Ireland's Wetlands and their Waterbirds: Status and Distribution. BirdWatch Ireland, Newcastle, County Wicklow

Cronin, M., Duck, C., Cadhla, O., Nairn, R., Strong, D. & O'Keeffe, C. (2007). An assessment of population size and distribution of Harbour seals in Republic of Ireland during the moult season in August 2003. Journal of Zoology.

Cronin, M. & McConnell, B. (2008) SMS seal: A new technique to measure haul-out behaviour in marine vertebrates. Journal of Experimental Marine Biology and Ecology.

EPA (2003) Advice notes on current practice in the preparation of Environmental Impact Statements. Environmental Protection Agency.

EPA (2002) Guidelines on the information to be contained in Environmental Impact Statements. Environmental Protection Agency.

EPA (2015) Revised Guidelines on the Information to be Contained in Environmental Impact Statements (Environmental Protection Agency, draft September 2015);

EPA (2015) Advice Notes for Preparing Environmental Impact Statements Draft September 2015

European Union (2013) Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment

Fossitt J A (2000) A Guide to Habitats in Ireland .The Heritage Council, Kilkenny

Gilbert, G., Gibbons, D.W. & Evans, J. (1998) *Bird Monitoring Methods - a Manual of Techniques for Key UK Species.* RSPB: Sandy.

Best Practice Guidance for Habitat Survey and Mapping (Heritage Council, 2011)

Kelleher, C. & Marnell, F. (2006) Bat mitigation guidelines for Ireland. Irish Wildlife Manuals No. 25

Lynas, P., Newton, S.F. and Robinson, J.A. (2007). *The status of birds in Ireland: an analysis of conservation concern 2008-2013*. Irish Birds 8:149-166

NRA (2005a). Best Practice Guidelines for the Conservation of Bats in the Planning of National Road Schemes. National Road Authority.

NRA (2005b). Guidelines for the Treatment of Otters Prior to the Construction of National Road Schemes. National Road Authority.

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EPA Export 20-07-2019:03:56:32

NRA (2005c). Guidelines for treatment of bats during construction of National Road Schemes. National Road Authority

NRA (2009). Guidelines for assessment of ecological impacts of National Road Schemes. National Road Authority.

NRA. (2006b). Guidelines for the protection and preservation of trees, hedgerows and scrub prior to, during and post construction of national road schemes. National Roads Authority.

NRA (2006c). Guidelines for the treatment of badgers prior to the construction of national road schemes. National Road Authority.

Port of Cork /RPS (2014) Ringaskiddy Port Redevelopment. Environmental Impact Statement. RPS

Reuther, C. & Dolev, A. (2000). New findings of otters (Lutra lutra) in Israel. IUCN Otter Spec. Group Bull. 17: 80-82.

Webb, D.A., Parnell, J. & Doogue, D. (1996) An Irish flora. Seventh edition. Dundalgan Press (W. Tempest), Dundalk.

Dixon.Brosnan, (2014). Natura Impact Statement (Screening Stage 1) at Haulbowline, Ringaskiddy, Co. Cork for proposed bridge remediation works.

IEEM (2006) Guidelines for ecological impact assessment in the United Kingdom.

Port of Cork (2014). Ringaskiddy Port Redevelopment, Environmental Impact Statement.

Dixon.Brosnan (2015). Nature Impact Statement. Appropriate Assessment report for a proposed Resource Recovery Centre and associated works at Ringaskiddy, Co. Cork

Invasive Species Ireland (2008). Best Practice Management Guidelines Japanese knotweed *Fallopia japonica*.

DePuy Ireland, 2011. Wind Energy Project Environmental Impact Statement – Volume 1

Webb *et al*., 1996 (Kiely, 1998), (Cronin *et al*., 2007; Cronin *et al*., 2008).

Ringaskiddy Port Redevelopment EIS (Port of Cork/RPS, 2014)

Doherty Environmental (2012).Hammond Lane Metal Co, Ringaskiddy EIS Flora and Fauna Chapter

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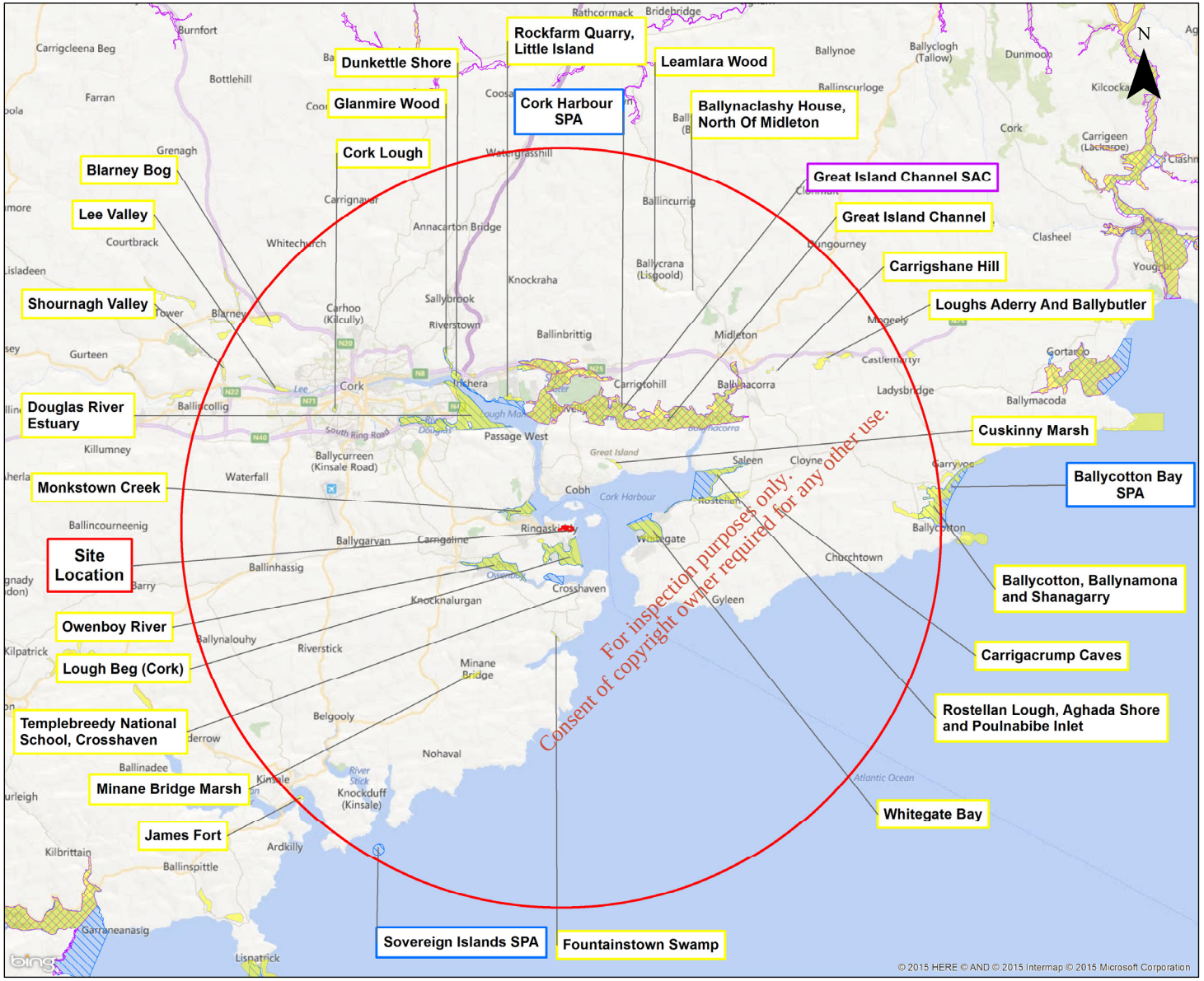

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Designated sites within a 20km radius

Ringaskiddy Resource Recovery Centre

238129-00 | January 2016 | Figure 12.1

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Land ownership area
Spoil and bare ground ED2
Built land and artificial surfaces BL3
Mixed Broadleaf woodland
Improved agricultural grassland GA1
Dense bracken HD1
Immature woodland WS2
Scrub WS1
Hedgerow WL1
Treeline WL2
Access track
Dry meadows and grassy verge GS2
Dry meadows and grassy verge/ wet grassland GS4
Arable Crops BC1
Conifer plantation WD3

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Habitat Map

Ringaskiddy Resource Recovery Centre

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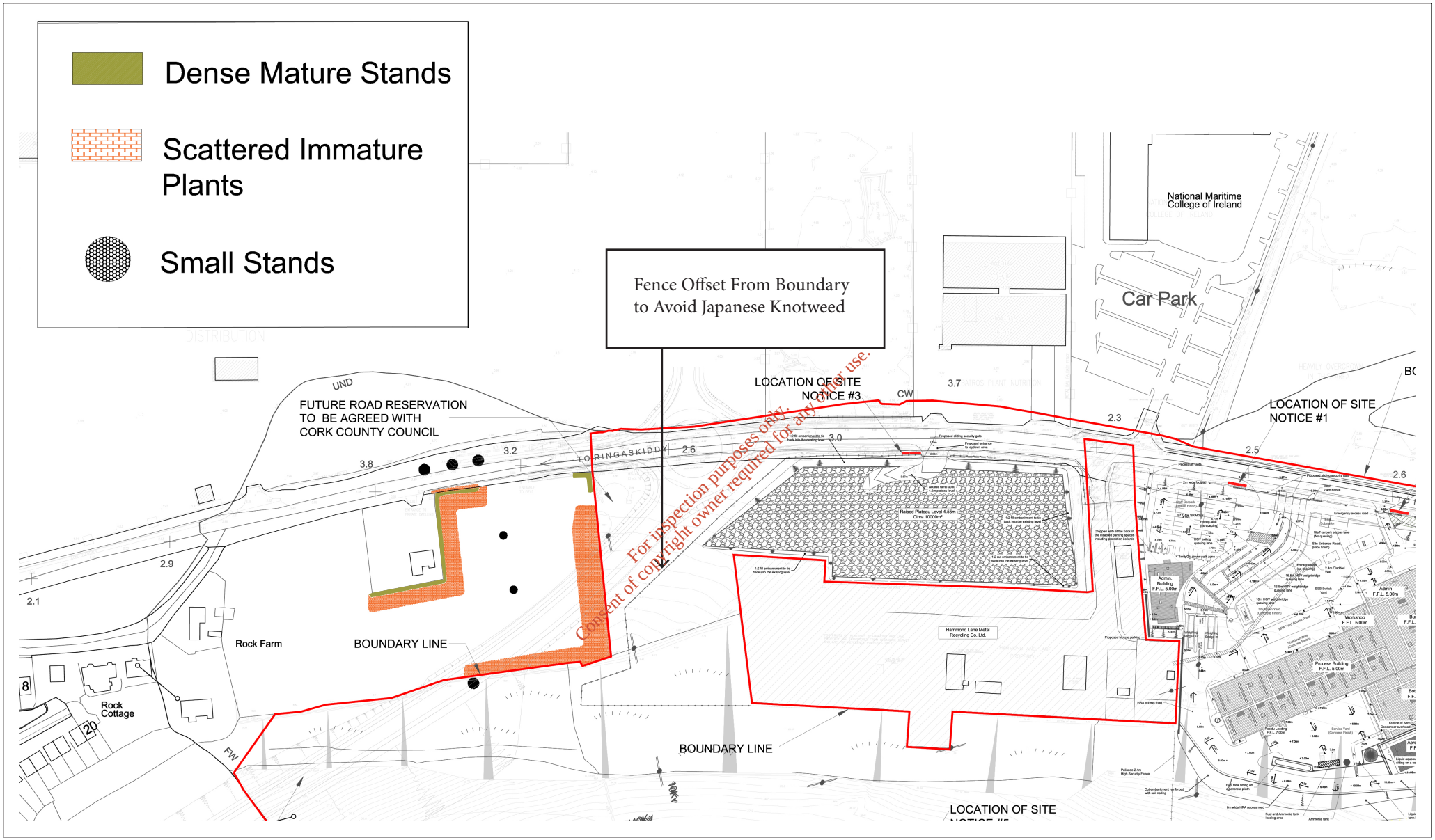

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Japanese Knotweed Survey – September 2015

Ringaskiddy Resource Recovery Centre

238129-00 | January 2016 | Figure 12.3

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Appendix 12.1

Flora species list 2015

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English Name	Scientific Name
Ash	*Fraxinus excelsior*
Birch	*Betula pubescens*
Sycamore	*Acer pseudoplatanus*
Hawthorn	*Crataegus monogyna*
Sessile oak	*Quercus petraea*
Blackthorn	*Prunus spinosa*
Cracked willow	*Salix fragilis*
Common elm	*Ulmus procera*
Crab apple	*Malus sylvestris*
Grey willow	*Salix cinerea*
Elder	*Sambucus nigra*
Dog rose	*Rosa canina*
Bramble	*Rubus fruticosus agg*
Soft rush	*Juncos effusus*
Bracken	*Pteridium aquilinum*
Lesser stickwort	*Stellaria graminea*
Barren strawberry	*Potentilla sterilis*
Red clover	*Trifolium pratense*
Stinging nettle	*Urtica dioica*
Hop trefoil	*Trifolium campestre*
Common sorrel	*Rumex acetosa*
Bush vetch	*Vicia sepium*
Common mouse-ear	*Cerastium fontanum*
Meadow buttercup	*Ranunculus acris*
Red leg	*Persicaria maculosa*
Pineappleweed	*Matricaria discoidea*
Field speedwell	*Veronica persica*
Common knapweed	*Centaurea nigra*
Meadowsweet	*Filipendula ulmaria*
Butterfly bush	*Buddleja davidii*
Greater plantain	*Plantago major*
Hogweed	*Heracleum sphondylium*
Broad-leaved dock	*Rumex obtusifolius*
Gorse	*Ulex europaeus*
Ribwort plantain	*Plantago lanceolata*
Sea beet	*Beta vulgaris spp. maritima*
White Clover	*Trifolium repens*
Creeping buttercup	*Ranunculus acris*
Wood anemone	*Anemone nemorosa*
Mouse-eared hawk-weed	*Pilosella officinarum*

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Dog violet	*Viola riviniana*
Wood sage	*Teucrium scorodonia*
Rosebay willowherb	*Epilobium angustifolium*
Birdsfoot trefoil	*Lotus corniculatus*
Greater birdsfoot trefoil	*Lotus pedunculatus*
Kidney vetch	*Anthyllis vulneraria*
Daisy	*Bellis perennis*
Spear thistle	*Cirsium vulgare*
Corn spurrey	*Spergula arvensis*
Creeping thistle	*Cirsium arvense*
Smooth hawkbeard	*Crepis capillaris*
Dandelion	*Taraxacem officinale agg.*
Common ragwort	*Senecio jacobaea*
Marsh cudweed	*Gnaphalium uliginosum*
Yarrow	*Achillea millefolium*
Ivy	*Hedera helix*
Tormentil	*Portentilla erecta*
Silverweed	*Potentilla anserina*
Bindweed	*Convolvulus arvensis*
Cleavers	*Galium aparine*
Honeysuckle	*Lonicera periclymenum*
Ox eye daisy	*Leucanthemum vulgare*
Cut-leaved cranesbills	*Geranium dissectum*
Western marsh orchid	*Dactylorhiza majalis*
Common sedge	*Carex nigra*
Cocks foot	*Dactylis glomerata*
Red fescue	*Festuca rubra*
Common bent	*Agrostis Capillaris*
Brown bent	*Agrostis vinealis*
Jointed rush	*Juncus acutiflora*
Yellow sedge	*Carex viridula*
Yorkshire fog	*Holcus lanatus*
Greater tussock sedge	*Carex paniculata*
Rye grass	*Lolium multiflorum*
Hard rush	*Juncus inflexus*
Bee orchid	*Ophyrs apifera*
Japanese knotweed	*Fallopia japonica*
Yellow wort	*Blackstonia pperfoliata*
Sitka spruce	*Picea sitchensis*
Hornbeam	*Carpinus betulus*
False oat grass	*Arrhenatherum elatius*
Water mint	*Mentha aquatica*

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White willow	*Salix alba*
Beach	*Fagus sylvatica*
Monterey cypress	*Cupressus macrocarpa*
Fodder beet	*Beta vulgaris spp.*
Agrimony	*Agrimonia eupatoria*
Field Horsetail	*Equisetum arvense*
Bittersweet	*Solanum dulcamara*
Selfheal	*Prunella vulgaris*
Scarlet pimpernel	*Anagallis arvensis*
Lawn moss	*Caligeron cuspidata*
Lady fern	*Athyrium filix-femina*
Japanese rose	*Rosa rugosa*
Herb Robert	*Geranium robertianum*
Foxglove	*Digitalis purpurea*
Cat's ear	*Hypochaeris radicata*
Meadow vetchling	*Lathyrus pratensis*
Goat vetchling	*Lathyrus linifolius*
Goat willow	*Salix caprea*
Pendunculate oak	*Quercus robur*
Montbretia	*Crocosmia x crocosmiiflora*
Snowberry	*Symphoricarpos albus*
Winter Heliotrope	*Petasites fragrans*
Cotoneaster	*Cotoneaster spp.*
Travellers' Joy	*Clematis vitalba*

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Appendix 12.2

Winter and breeding bird surveys for a proposed Ringaskiddy Resource Recovery Centre at Ringaskiddy, Co. Cork.

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A1 Introduction

Dixon.Brosnan Environmental Consultants carried out an appraisal of the potential impacts of the proposed development of the Ringaskiddy Resource Recovery Centre at Ringaskiddy, County Cork on birds utilising the development site and the coastal areas adjacent to it. The information in this report was used to help determine the impacts on bird populations in **Chapter 12 (***Biodiversity***)** of the EIS and also informed the conclusions of the NIS which specifically addresses impacts on designated Natura 2000 sites including the Cork Harbour SPA.

A2 Methodology

A2.1 Desktop Review

A desktop review was carried out to identify designated SPAs in the surrounding landscape and to assess information from other surveys in this general area. From the information provided in the desktop review and based on the information provided by previous reports, it was decided to carry out winter bird surveys and breeding bird surveys.

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A2.2 Winter bird survey - methodology

The winter bird surveys were undertaken on the following dates: 25th October 2014, 22nd November 2014, 22nd December, 2014, 21st January 2015, 19th February 2015 and 20th March 2015. The survey methodology was based on that used by the British Trust for Ornithology (BTO), Wetland Bird Survey (WeBS) and also that for the Irish Wetland Bird Survey (I-WeBS), as outlined in Gilbert et al. (1998). The winter bird survey and breeding bird survey were undertaken using Nicon ProStaff-7 10X42 binoculars and Safari 20-60 X 80 spotting scope. Ninety minute counts were undertaken monthly at either high tide, mid tide and low tide. Survey vantage point locations for the winter bird counts are shown in **Figure 1**. It is noted that many of these birds were recorded overflying the channel and that the survey covered a radius of approximately 300m from each vantage point.

Figure 1. Vantage point count locations.

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A2.3 Breeding bird surveys - methodology

The breeding bird survey was undertaken on the 27th May 2015, 12th June 2015 and 19th June 2015. The survey methodology utilised a scaled down version of the British Trust for Ornithology's (BTO) Common Bird Census (CBC) Technique (Bibby et al., 2000 & Gilbert et al., 1998), with aspects of species specific survey methodologies employed where required (Gilbert et al., 1998). All bird locations, numbers, behaviour were recorded by annotating field maps and by taking notes.

All bird species encountered during the survey were mapped and coded using standard BTO 'Species Codes' and 'Categories of Breeding Evidence' e.g. singing male, agitated behaviour, carrying food, recently fledged downy young. No attempts were made to locate nests as bird behaviour is generally sufficient to determine probable or confirmed breeding. Survey visits commenced shortly after dawn and were completed before mid-day to coincide with the peak bird activity period. Visits were not made during adverse weather conditions and a route was chosen to ensure all parts of the proposed development area were effectively surveyed. The survey route through and around the proposed development area is shown in **Figure 2**. The breeding bird surveys focused primarily on the proposed development area where there is the potential for permanent impacts due to the removal of nesting habitat.

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Figure 2. Breeding bird survey- routes outlined in red.

A3 Designated sites.

The closest Special Protection Area for birds is the Cork Harbour SPA (Site code 004030) which is located 0.5km south of the study area at its closest point. The closed proposed Natural Heritage Area is the Lough Beg pNHA (Site code 001066) which is located 0.3km south of the study area. Large areas of Cork Harbour have received formal designations, primarily on the basis of important bird populations. These areas are interrelated, with bird populations moving between different areas at different times. Table 1 below lists the Special Conservation Interests for the Cork Harbour SPA. A site synopsis for the Cork Harbour SPA is attached as Appendix 12.5 of the EIS.

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Table 1. Cork Harbour SPA –Special Conservation Interest for Cork Harbour SPA and Qualifying Populations.

Cork Harbour SPA [IE0004030] SCIs			Season
[A004]	Little Grebe	*Tachybaptus ruficollis*	Wintering
[A005]	Great Crested Grebe	*Podiceps cristatus*	Wintering
[A017]	Cormorant	*Phalacrocorax carbo*	Wintering
[A028]	Grey Heron	*Ardea cinerea*	Wintering
[A048]	Shelduck	*Tadorna tadorna*	Wintering
[A050]	Wigeon	*Anas penelope*	Wintering
[A052]	Teal	*Anas crecca*	Wintering
[A056]	Pintail	*Anas acuta*	Wintering
[A065]	Shoveler	*Anas cylpeata*	Wintering
[A069]	Red-breasted Merganser	*Mergus serrator*	Wintering
[A130]	Oystercatcher	*Haematopus ostralegus*	Wintering
[A140]*	Golden Plover	*Pluvialis apricaria*	Wintering
[A141]	Grey Plover	*Pluvialis squatarola*	Wintering
[A142]	Lapwing	*Vanellus vanellus*	Wintering
[A149]*	Dunlin	*Calidris alpina*	Wintering
[A156]	Black-tailed Godwit	*Limosa limosa*	Wintering
[A157]*	Bar-tailed Godwit	*Limosa lapponica*	Wintering
[A160]	Curlew	*Numenius arquata*	Wintering
[A162]	Redshank	*Tringa totanus*	Wintering
[A179]	Black-headed Gull	*Larus ridibundus*	Wintering
[A182]	Common Gull	*Larus canus*	Wintering
[A183]	Lesser Black-backed Gull	*Larus fuscus*	Wintering
[A193]*	Common Tern	*Sterna hirundo*	Breeding
[A999]	Wetlands & Waterbirds		

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A4 Results

A4.1 Winter bird surveys

Four vantage point count locations were utilised for the winter bird survey 2014/15, as shown in **Figure 1**. These all overlooked the open estuarine habitat and the Cork Harbour West Channel between Ringaskiddy and Spike Island. The cobble beach and terrestrial habitats along the eastern boundary of the study area were also covered. Tides and weather conditions for each day are described in **Table 2.** Tide times at Ringaskiddy are based on the tidal tables for Cobh.

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Table 2. Tide and survey conditions – winter bird survey

Date	Tides	Weather	Notes
25/10/2014	Low 13.12 High 19.08	Sea state 1. Mild bright day, with high cloud cover. Wind East 10kph. Cloud 7/8. 13^{0}C	-
22/11/2014	Low 11.18 High 17.11	Sea state 1. Dry bright warm day. Wind West, 2-8kph. Cloud 2/8. Temp 12^{0}C	High numbers of walkers and dogs. Disturbance level high on Saturdays.
22/12/2014	Low 11.45 High 17.35	Sea state 1. Pleasant day with some gusts to 20kph. Wind West Northwest 8-12kph. Cloud 4/8. Temp 8^{0}C.	-
21/01/2015	High 05.48 Low 12.17 High 18.07	Sea state 0-1. Very calm day. Wind South 1-2kph. Cloud 1/8. Temp 7^{0}C	-
19/02/2015	Low 12.01 High 17.51	Sea state 1. Mild breezy day, slight rain showers. Wind West, 4-8kph. Cloud 8/8. Temp 12^{0}C.	-
20/03/2015	Low 11.41 High 17.31	Sea state 0-1. Dry, bright and warm day. Wind North 0-1kph. Cloud 6/8. Temp 14^{0}C.	-

Summarised recordings from the winter bird surveys in 2014/15 are shown in **Table 3**. Complete results from this survey are included in **Appendix A.**

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Table 3. Species recorded at Ringaskiddy, winter bird survey 2014/2015.

Species	High tide count (total)	Mid tide count (total)	Low tide count (total)
Oystercatcher	20	52	109
Blackheaded Gull		3	53
Herring Gull		4	17
Black Guillemot			3
Lesser Blackbacked gull	3	1	6
Cormorant	9	9	14
Common Gull	10	27	64
Redshank	2	4	11
Curlew		4	7
Mallard	3		
Glaucous Gull	1	1	5
Grey Heron	1	3	10
Hooded Crow	9	9	28
Wood Pigeon	23	3	12
Rook	234	31	10
Blackbird	2		8
Robin			2
Tree Sparrow	6		
Thrush		1	
Little Egret		4	7
Greater Blackbacked Gull	3	6	2
Greenshank		3	14
Mediterranean Gull			1
Teal			4
Great Crested Grebe		1	2
Brent Goose		69	107
Sanderling		2	
Goldfinch	1		2
Grey Wagtail	1	2	7
Meadow Pipit		1	2
Wren			1
Blue Tit		1	3
Turnstone			4
Knot			4
Great Northern Diver	2	1	1
Dunlin		225	
Jackdaw	7		
Starling		30	

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A4.2 Breeding bird surveys

The breeding bird survey was undertaken on the beach front, adjoining roadside and in all of the accessible tracks within the development area, as shown in **Figure 2**. The majority of the development area has developed a scrub habitat dominated by gorse and bramble with small areas of semi-natural grassland. The tracks through the site are generally open, and the most southerly section of track provides good vantage points over the entire site as it is on an elevated position. The British Trust for Ornithology (BTO) breeding bird codes are shown in **Table 4**. The breeding status of all species encountered during surveys were classified into four categories: Confirmed (Br), Probable (Pr), Possible (Po) and Non-breeder (N), based on BTO categories of breeding evidence. A full list of bird species recorded during the 2015 surveys is provided in **Table 5**.

Table 4. British Trust for Ornithology breeding bird survey codes

Breeding status	Confirmed breeder (Br)	Probable breeder (Pr)	Possible breeder (Po)	Non-breeder (N)
Observed behaviours	Distraction-display or injury feigning (DD)	Pair in suitable nesting habitat (P)	Observed in suitable nesting habitat (H)	Flying Over (F)
	Used nest or eggshells found from current season (UN)	Permanent Territory (T)	Singing Male (S)	Migrant (M)
	Recently fledged young or downy young (FL)	Courtship and Display (D)		Summering non-breeder (U)
	Adults entering or leaving nest-site indicating occupied nest (ON)	Visiting probable nest site (N)		
	Adult carrying faecal sac or food for young (FF)	Agitated Behaviour (A)		
	Nest containing eggs (NE)	Brood patch of incubating bird (I)		
	Nest with young seen or heard (NY)	Nest Building or excavating nest-hole (B)		

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Table 5. Breeding bird survey results

Bird species	Breeding status	Estimated No. of Pairs	No. Birds recorded per visit		
			27/05/2015	12/06/2015	19/06/2015
Blackbird	Br-FF	2	3	3	3
Blue Tit	Br-FL	3	4	4	12
Bullfinch	Pr- A	1	2	0	0
Chaffinch	Br-FL	2	0	6	3
Chiffchaff	Pr-D	2-3	3	0	7
Common Gull	N-F	0	0	0	14
Dunnock	Po- S	1	2	1	2
Goldcrest	Pr-D	1	1	0	0
Goldfinch	PR-N	1	2	0	0
Great tit	Br-DD	1	1	0	2
Greenfinch	Pr-P	1	1	2	2
Heron	N	0	0	0	1
Hooded Crow	N-F	0	0	0	3
Kestrel	Pr-FL	1	1	0	3
Long-tailed Tit	Pr-P	1	2	0	0
Oystercatcher	N	0	0	0	3
Robin	Br-UN	1	3	0	0
Rook	N-F	0	0	1	0
Sedge Warbler	Po-H	0-1	0	0	3
Skylark	Po-S	1-2	4	0	1
Song Thrush	Pr-N	1	1	0	1
Starling	N-F	0	39	17	0
Swallow	N-F	0	4	2	4
Common Tern	N-F	0	3	0	0
Tree Sparrow	Po-H	0-1	1	0	0
Common Whitethroat	Pr-A	1	1	0	1
Wood Pigeon	Pr-D	2-3	6	3	4
Wren	Br-ff	2	2	1	1

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A4.3 Common Tern-Breeding surveys

No breeding terns occur within or in immediate proximity to the study area. A breeding population of Common Tern are known to occur near the entrance to the Port of Cork, approximately 750m west of the study area. This colony was identified by the Port of Cork Environmental Impact Statement (Port of Cork/RPS, 2014), which recorded 45-50 breeding pairs on concrete structures (mooring dolphins) adjacent to the entrance to the Port of Cork. This common tern breeding colony was resurveyed as part of this current assessment as they are the most significant breeding bird colony in the surrounding landscape. Counts of

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terns were undertaken from a vantage point to the west of the mooring dolphins adjacent to the entrance to the Port of Cork. Counts were undertaken of (i) all of the birds present in the area both sitting, perching and flying, and (ii) only the birds sitting on nests/eggs. An average of the number of birds sitting on nests/eggs was used to derive the number of pairs present. Results are shown in **Table 6.** Approximately 50-55 breeding pairs were recorded (mean 53 breeding pairs).

Table 6. Common Tern Survey

Date	Total birds counted	No. birds sitting on nests/eggs
27/05/15	93	51
12/06/15	97	55
19/06/15	89	53
Overall average	**93**	**53**

A4.4 Seals and cetaceans

A total of four harbour seals were observed during the winter bird surveys. The seals were recorded moving through the channel between Ringaskiddy and Spike Island.

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A5 Discussion of results

A5.1 Birds considered of conservation value.

Thirty bird species were recorded that have received some form of conservation designation as shown in **Table 7.** Birds species listed in Annex I of the Birds Directive are considered a conservation priority. Five species (Mediterranean Gull, Dunlin, Little Egret, Great Northern Diver and Common Tern) are listed on Annex 1 of the Birds Directive. Certain bird species are listed by BirdWatch Ireland as Birds of Conservation Concern in Ireland. Red List bird species are of high conservation concern and the Amber List species are of medium conservation. Six red listed species were recorded namely Herring Gull, Curlew, Redshank, Black-Headed Gull, Dunlin and Knot. Seventeen species are Amber listed. Twenty four bird species are listed under the Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA), to which Ireland is a signatory.

Table 7. Conservation status for species recorded.

Species		Birds Directive Annex					Red List	Amber List	AEWA
		I	II(I)	II(II)	III(I)	III(II)			
Cepphus grylle	Black Guillemot							X	X
Haematopus ostralegus	Oystercatcher							X	X
Columba palumbus	Woodpigeon		II(I)		III(I)				
Larus canus	Common Gull							X	X
Larus melanocephalus	Mediterranean Gull							X	X
Larus argentatus	Herring Gull						X		X
Larus fuscus	Lesser black-backed Gull							X	X
Larus marinus	Great black-backed Gull							X	X
Phalacrocorax carbo	Cormorant							X	X
Numenius arquata	Curlew			II(II)			X		X
Tringa totanus	Redshank						X		X
Larus ridibundus	Black-headed Gull						X		X
Calidris alpina schinzii	Dunlin	I					X		X
Anas platyrhynchos	Mallard		II(I)		III(I)				X
Ardea cinerea	Grey Heron								X
Passer montanus	Tree Sparrow							X	
Egretta garzetta	Little Egret	I							X
Tringa nebularia	Greenshank							X	X
Anas crecca	Teal		II(I)			III(II)		X	X
Podiceps cristatus	Great-crested Grebe							X	X
Branta bernicla	Brent Goose							X	X
Calidris alba	Sanderling								X
Arenaria interpres	Ruddy Turnstone								X
Calidris canutus	Knot						X		X
Gavia immer	Great Northern Diver	I							X
Sturnus vulgaris	Starling							X	
Hirundo rustica	Swallow							X	

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Species		Birds Directive Annex					Red List	Amber List	AEWA
Alauda arvensis	Skylark		II(II)					X	
Sterna hirundo	Common Tern	I						X	X
Falco tinnunculus	Kestrel							X	

EU habitats and birds directive annexation descriptions		
Symbol	**Meaning**	**Brief definition**
I	Annex I bird species	Endangered species
II(I)	Annex II, section I bird species	Species may be legally hunted in all EU member states
II(II)	Annex II, section II bird species	Species may be legally hunted in named EU member states
III(I)	Annex III, section I bird species	Species may be deliberately killed or captured, nests disturbed or eggs taken, and traded live or dead in all EU member states
III(II)	Annex III, section II bird species	Species may be deliberately killed or captured, nests disturbed or eggs taken, and traded live or dead in named EU member states

A5.2 Results in relation to designated sites

Only the one Special Protection Area (Cork Harbour SPA Site Code 004030) is located within 5km of the proposed Ringaskiddy Resource Recovery Centre. This SPA is shown in **Figure 3.** The qualifying interests for Cork Harbour SPA are shown in **Table 8** together with the conservation objectives for each species. A total of thirteen species listed as qualifying interests for the Cork Harbour SPA were recorded, namely, Cormorant, Oystercatcher, Dunlin, Curlew, Redshank, Greenshank, Great Crested Grebe, Grey Heron, Teal, Blackheaded Gull, Common Gull, Lesser Blackbacked Gull and Common Tern. Common Tern was recorded during the breeding bird survey overflying the channel. This species does not breed in proximity to the site.

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Figure 3. Cork Harbour SPA in relation to the study area (red circle).

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A6 Summary

- A total of 1,354 birds from 38 species were recorded from 6 site visits during the winter bird survey. A total of 196 birds were recorded from 28 different bird species on three site visits during the breeding bird survey.
- Five Annex I bird species were recorded (Mediterranean Gull, Dunlin, Little Egret, Great Northern Diver and Common Tern). Six Red Listed species were recorded, namely Blackheaded Gull, Herring Gull, Redshank, Curlew, Knot and Dunlin.
- A total of thirteen species listed as qualifying interests for the Cork Harbour SPA were recorded, namely, Cormorant, Oystercatcher, Dunlin, Curlew, Redshank, Greenshank, Great Crested Grebe, Grey Heron, Teal, Blackheaded Gull, Common Gull, Lesser Blackbacked Gull and Common Tern.
- An important breeding colony of Common Tern is located approximately 750m from the development site on concrete structures adjacent to the Port of Cork entrance.
- None of the wintering birds recorded by vantage point counts in proximity to the proposed development site were recorded in high numbers and numbers were low in-comparison to the figures which would be considered nationally significant (i.e. 1% or more of the all-Ireland population of an Annex I species or 1% or more of the bio-geographical population of a migratory species)

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A7 Conclusions

A7.1 Conclusions- Breeding bird surveys

Six breeding species (Blackbird, Blue Tit, Chaffinch, Great Tit, Robin, Wren) were recorded within the proposed development area. Nine species (Bullfinch, Chiffchaff, Goldcrest, Goldfinch, Greenfinch, Kestrel, Song Thrush, Common Whitethroat, Wood pigeon) were identified as possible breeders. The mix of species recording during the surveys are considered typical of this type of landscape. Eight of the recorded species are Amber listed; of these species five are terrestrial species (Skylark, Kestrel, Starling, Swallow and Tree Sparrow). The remaining three species (Common Tern, Oystercatcher and Common Gull) are associated with marine habitats and do not breed within the study area. No rare or uncommon species were noted as breeders or potential breeders.

A7.2 Conclusions - Winter bird surveys

A total of 38 bird species were recorded during the 2014/2015 winter bird surveys. Some species that are considered of high conservation value (Annex I of the Birds Directive, qualifying species for the Cork Harbour SPA and Red List species) were noted in this general area. It is noted that many the survey covered a radius of approximately 300m from each vantage point. Many of these birds were recorded overflying the channel, and the site itself and the shoreline adjoining the site, did not support high numbers of these species. The coastal area adjoining the site consists primarily of rock and shingle, and therefore does not support the high numbers of wintering waders that are characteristic of high value mudflats with high densities of macro-invertebrates.

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A8 References

Bibby, C.J., Burgess, N.D., Hill, D.A. & Mustoe, S.H. 2000. Bird Census Techniques. Academic Press, London.

Gilbert, G., Gibbons, D.W. & Evans, J. (1998) *Bird Monitoring Methods - a Manual of Techniques for Key UK Species.* RSPB: Sandy.

Ringaskiddy Port Redevelopment EIS (Port of Cork/RPS, 2014)

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A9 Appendix A.

Winter Survey Results - 25/10/2014

Date	Time	Tide	Harbour seal	Oystercatcher	Blackheaded gull	herring gull	Black guillemot	Lesser Blackbacked gull	Cormorant	Common gull	Red shank	Curlew
25/10/2014	13.00-14.30	low		15		4		1	3	22	2	3
25/10/2014	14.30-16.00	mid		13					1	4	1	3
25/10/2014	16.00-17.30	high		2					1			

Winter Survey Results - 25/10/2014 (continued)

Date	Time	Tide	Mallard	Glaucous gull	Heron	Hooded Crow	Wood pigeon	Rook	Blackbird	Robin	Tree sparrow	Thrush
25/10/2014	13.00-14.30	low			3	3		2				
25/10/2014	14.30-16.00	mid			1	3		15				1
25/10/2014	16.00-17.30	high				2	14	175			6	

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Winter Survey Results - 25/10/2014 (continued)

Date	Time	Tide	Little Egret	Greater Blackbacked	Greenshank	Mediterranean Gull	Teal	Great Crested Grebe	Brent Goose	Sanderling	Goldfinch	Grey Wagtail
25/10/2014	13.00-14.30	low	1	1	1	1						
25/10/2014	14.30-16.00	mid	1	3								
25/10/2014	16.00-17.30	high		1								

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Winter Survey Results - 25/10/2014 (continued)

Date	Time	Tide	Meadow Pipit	Wren	Blue Tit	Turnstone	Knot	Great Northern Diver	Dunlin	Jackdaw	Starling
25/10/2014	13.00-14.30	low									
25/10/2014	14.30-16.00	mid									
25/10/2014	16.00-17.30	high									

Winter Survey Results - 22/11/2014

Date	Time	Tide	Harbour seal	Oystercatcher	Blackheaded gull	herring gull	Black guillemot	Lesser Blackbacked gull	Cormorant	Common gull	Red shank	Curlew
22/11/2014	13.00-14.30	low		4			3	2	8	6	2	
22/11/2014	14.30-15.30	mid						1	3	2		
22/11/2014	15.30-16.30	high							4	3		
19/02/2015	13.00-14.30	low		11	4	1				4		

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Winter Survey Results - 22/11/2014 (continued)

Date	Time	Tide	Mallard	Glaucous gull	Heron	Hooded Crow	Wood pigeon	Rook	Blackbird	Robin	Tree sparrow	Thrush
22/11/2014	13.00-14.30	low			1							
22/11/2014	14.30-15.30	mid				1	2	1				
22/11/2014	15.30-16.30	high	3				7	5				

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Winter Survey Results - 22/11/2014 (continued)

Date	Time	Tide	Little Egret	Greater Blackbacked Gull	Greenshank	Mediterranean Gull	Teal	Great Crested Grebe	Brent Goose	Sanderling	Goldfinch	Grey Wagtail
22/11/2014	13.00-14.30	low			8		4	1				
22/11/2014	14.30-15.30	mid										
22/11/2014	15.30-16.30	high										

Winter Survey Results - 22/11/2014 (continued)

Date	Time	Tide	Meadow Pipit	Wren	Blue Tit	Turnstone	Knot	Great Northern Diver	Dunlin	Jackdaw	Starling
22/11/2014	13.00-14.30	low									
22/11/2014	14.30-15.30	mid									
22/11/2014	15.30-16.30	high									

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Winter Survey Results - 22/12/2014

Date	Time	Tide	Harbour seal	Oystercatcher	Blackheaded gull	herring gull	Black guillemot	Lesser Blackbacked gull	Cormorant	Common gull	Red shank	Curlew
22/12/2014	10.30-12.00	low	1	14		9		2		9		1
22/12/2014	12.00-13.30	mid		12	3	4				13		1
22/12/2014	13.30-15.00	high	1	18						2	1	

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Winter Survey Results - 22/12/2014 (continued)

Date	Time	Tide	Mallard	Glaucous gull	Heron	Hooded Crow	Wood pigeon	Rook	Blackbird	Robin	Tree sparrow	Thrush
22/12/2014	10.30-12.00	low			1	2	12	3	1			
22/12/2014	12.00-13.30	mid		1	1	2		14				
22/12/2014	13.30-15.00	high		1		3		45				

Winter Survey Results - 22/12/2014 (continued)

Date	Time	Tide	Little Egret	Greater Blackbacked Gull	Greenshank	Mediterranean Gull	Teal	Great Crested Grebe	Brent Goose	Sanderling	Goldfinch	Grey Wagtail
22/12/2014	10.30-12.00	low	1	1					34			
22/12/2014	12.00-13.30	mid	1	3					33	2		
22/12/2014	13.30-15.00	high		2								

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Winter Survey Results - 22/12/2014 (continued)

Date	Time	Tide	Meadow Pipet	Wren	Blue Tit	Turnstone	Knot	Great Northern Diver	Dunlin	Jackdaw	Starling
22/12/2014	10.30-12.00	low									
22/12/2014	12.00-13.30	mid									
22/12/2014	13.30-15.00	high									

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Winter Survey Results - 21/01/2015

Date	Time	Tide	Harbour seal	Oystercatcher	Blackheaded gull	herring gull	Black guillemot	Lesser Blackbacked gull	Cormorant	Common gull	Red shank	Curlew
21/01/2015	11.00-12.30	low		24	27			1	3	8	3	1
21/01/2015	12.30-14.00	low		28	22					3	1	1
21/01/2015	14.00-15.30	mid	1	14					3			

Winter Survey Results - 21/01/2015 (continued)

Date	Time	Tide	Mallard	Glaucous gull	Heron	Hooded Crow	Wood pigeon	Rook	Blackbird	Robin	Tree sparrow	Thrush
21/01/2015	11.00-12.30	low		3	2	12		3	4			
21/01/2015	12.30-14.00	low			1	3			3	2		
21/01/2015	14.00-15.30	mid				1	1					

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Winter Survey Results - 21/01/2015 (continued)

Date	Time	Tide	Little Egret	Greater Blackbacked Gull	Greenshank	Mediterranean Gull	Teal	Great Crested Grebe	Brent Goose	Sanderling	Goldfinch	Grey Wagtail
21/01/2015	11.00-12.30	low			1			1	26		2	4
21/01/2015	12.30-14.00	low			1				19			3
21/01/2015	14.00-15.30	mid			1				11			2

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Winter Survey Results - 21/01/2015 (continued)

Date	Time	Tide	Meadow Pipit	Wren	Blue Tit	Turnstone	Knot	Great Northern Diver	Dunlin	Jackdaw	Starling
21/01/2015	11.00-12.30	low	2	1	3						
21/01/2015	12.30-14.00	low				1	4				
21/01/2015	14.00-15.30	mid									

Winter Survey Results - 19/02/2015 (continued)

Date	Time	Tide	Harbour seal	Oystercatcher	Blackheaded gull	herring gull	Black guillemot	Lesser Blackbacked gull	Cormorant	Common gull	Red shank	Curlew
19/02/2015	13.00-14.30	low		11	4	1				4		
19/02/2015	14.30-16.00	mid		7					1	4		
19/02/2015	16.00-17.30	high	1					2	3	3		

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Winter Survey Results - 19/02/2015 (continued)

Date	Time	Tide	Mallard	Glaucous gull	Heron	Hooded Crow	Wood pigeon	Rook	Blackbird	Robin	Tree sparrow	Thrush
19/02/2015	13.00-14.30	low			1	2						
19/02/2015	14.30-16.00	mid			1			1				
19/02/2015	16.00-17.30	high				1		3	2			

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Winter Survey Results - 19/02/2015 (continued)

Date	Time	Tide	Little Egret	Greater Blackbacked	Greenshank	Mediterranean Gull	Teal	Great Crested Grebe	Brent Goose	Sanderling	Goldfinch	Grey Wagtail
19/02/2015	13.00-14.30	low	1		2				8			
19/02/2015	14.30-16.00	mid	1					1	4			
19/02/2015	16.00-17.30	high									1	1

Winter Survey Results - 19/02/2015 (continued)

Date	Time	Tide	Meadow Pipit	Wren	Blue Tit	Turnstone	Knot	Great Northern Diver	Dunlin	Jackdaw	Starling
19/02/2015	13.00-14.30	low						1			
19/02/2015	14.30-16.00	mid	1		1			1	225		
19/02/2015	16.00-17.30	high						1		7	

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Winter Survey Results - 20/03/2015

Date	Time	Tide	Harbour seal	Oystercatcher	Blackheaded gull	Herring gull	Black guillemot	Lesser Blackbacked gull	Cormorant	Common gull	Red shank	Curlew
20/03/2015	11.30-13.00	low		13		3				12	3	1
20/03/2015	13.00-14.30	mid		6					1	4	3	
20/03/2015	14.30-16.00	high						1	1	2	1	

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Winter Survey Results - 20/03/2015 (continued)

Date	Time	Tide	Mallard	Glaucous gull	Heron	Hooded Crow	Wood pigeon	Rook	Blackbird	Robin	Tree sparrow	Thrush
20/03/2015	11.30-13.00	low		2	2	6		2				
20/03/2015	13.00-14.30	mid				2						
20/03/2015	14.30-16.00	high			1	3	2	6				

Winter Survey Results - 20/03/2015 (continued)

Date	Time	Tide	Little Egret	Greater Blackbacked Gull	Greenshank	Mediterranean Gull	Teal	Great Crested Grebe	Brent Goose	Sanderling	Goldfinch	Grey Wagtail
20/03/2015	11.30-13.00	low	4		1				20			
20/03/2015	13.00-14.30	mid	1		3				21			
20/03/2015	14.30-16.00	high										

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Winter Survey Results - 20/03/2015 (continued)

Date	Time	Tide	Meadow Pipit	Wren	Blue Tit	Turnstone	Knot	Great Northern Diver	Dunlin	Jackdaw	Starling
20/03/2015	11.30-13.00	low				3					
20/03/2015	13.00-14.30	mid									30
20/03/2015	14.30-16.00	high						1			

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Appendix 12.3

Mammal Surveys

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A1 Introduction

Dixon.Brosnan Environmental Consultants assessed the impact of the proposed development of the Ringaskiddy Resource Recovery Centre at Ringaskiddy, County Cork on mammals utilising the Indaver site and the coastal habitats in proximity to it. The information in this report was used to determine the impacts on mammals in **Chapter 12**(*Biodiversity*) of the EIS.

A2 Methodology

A desktop review was carried out to identify designated Natura 2000 sites in the surrounding landscape and to assess information from other surveys in this general area. DixonBrosnan previously prepared the Flora and Fauna chapter for a similar EIS submitted in 2008 and an addendum to the EIS prepared in 2010. The closest cSAC is the Great Island Channel cSAC, which is 5.6km from the proposed development site. The closed proposed Natural Heritage Area is the Lough Beg pNHA (Site code 001066) which is located 0.3km south of the study area. No mammal species are listed as qualifying interests for either of these sites. Based on the characteristics of the Indaver site and the results of previous surveys, it was considered necessary to carry out more detailed surveys for otter, badger and bats.

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A3 General site characteristics

The Indaver site runs east-west parallel to the L2545 Ringaskiddy Road, an extension of the N28, which leads to Haulbowline Island and runs along the northern boundary of the site. To the south, the study area is bordered by agricultural land dominated by intensive pasture. A Martello Tower is located on the crest of a small hill (43m approx.) in agricultural land to the south of the study area.

To the east, the site reaches to the edge of the Cork Harbour West Channel that separates the mainland from Spike Island. The shoreline here is characterised by shingle beach with steep earthen cliffs. To the west, the site adjoins agricultural land (tillage and pasture) and a small group of residential dwellings.

The majority of the proposed development area is located in the eastern section of the study area. . A rectangle of land, used as a public car park, to the northeast of the site is not included in the development area, but is included in the study area.

Due to an absence of agricultural management, a high proportion of the study area, including the proposed development site, is covered in scrub which has become more dominant over time. The remainder of the site consists of pasture and tillage fields that remain under conventional agricultural management. The following habitats were recorded within the Indaver site; Hedgerow WL1/Treelines WL2, Dry meadow and grassy verge GS2/Wet grassland GS4, Scrub WS1, Immature woodland WS2, Broadleaved woodland WD1, Improved agricultural grassland GA1, Conifer woodland WD3, Dense bracken HD1and Arable crops BC1.

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A4 Otter surveys

The proposed development site is located in proximity to the coast and coastal protection works are proposed above the foreshore of Gobby Beach along the eastern boundary of the Indaver site. Thus potential impacts on otter, which is relatively common in Cork Harbour, could occur.

1976, as amended by the Wildlife (Amendment) Act, 2000. Otters have additional protection because of their inclusion in Annex II and Annex IV of the Habitats Directive. Otters are also listed as requiring strict protection in Appendix II of the Berne Convention on the *Conservation of European Wildlife and Natural Habitats* and are included in the Convention on International Trade of Endangered species (CITES). Although rare in parts of Europe, they are widely distributed in the Irish countryside in both marine and freshwater habitats.

Otters are solitary and nocturnal and as such are rarely seen. Thus surveys for otters rely on detecting signs of their presence. These include spraints (faeces), anal gland secretions, paths, slides, footprints and remains of prey items. Spraints are of particular value as they are used as territorial markers and are often found on prominent locations such as grass tussocks, stream junctions and under bridges. In addition they are relatively straightforward to identify and these signs of Otter presence are considered an acceptable basis for Otter surveys.

Otters occasionally dig out their own burrows but generally they make use of existing cavities as resting placing or for breeding sites. Suitable locations include eroded riverbanks, under trees along rivers, under fallen trees, within rock piles or in dry drainage pipes or culverts, etc. If ground conditions are suitable, the holt may consist of a complex tunnel and chamber system. Otters often lie out above ground especially within reedbeds where depressions in the vegetation called “couches” are formed. Generally holts or resting areas can be located by detecting signs such as spraints or tracks. In contrast natal holts which are used by breeding females can be extremely difficult to locate. They are often located a considerable distance from any aquatic habitats. In addition, natal holts are usually carefully hidden and without obvious sprainting sites. Otters do not have a well defined breeding season.

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Signs of otter activity were recorded during surveys for the Ringaskiddy Port Redevelopment EIS (Port of Cork/RPS 2014). These included the following:

- *Signs of otter were noted along the ADM Training Wall, including old spraints and an active trail*
- *Otter activity was widespread at the base of the ADM Jetty.*
- *A single sighting of an otter leaving the eastern side of the ADM Training Wall*
- *A large amount of fresh spraint and three well-used sprainting sites were identified at the point where the existing ADM Jetty leaves the land.*
- *The spaces between boulders to the north of the existing ADM Jetty are extremely large and well-connected right down to low water level. An otter couch is likely present within these boulders.*
- *The most likely holt location was identified off-site, further to the west of Paddy’s Point, where boulders were larger. This off-site area was surveyed in 2014 and a potential temporary holt/lying-up site was identified here within rocks at sea level.*

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- *It was noted in 2012 that, despite human disturbance at Ringaskiddy East (the area being regularly used for boating, swimming and dog walking), evidence of otter presence was widespread along the shoreline; however, a holt was not identified.*

It is noted that these areas are a considerable distance from the proposed development site. Paddy's Point and the ADM jetty are located approximately 550m and 1500m respectively from the Indaver site boundary.

Surveys by DixonBrosnan in 2014 and 2015 did not record the presence of otter within a radius of 150m from the study area, although some sprainting activity was recorded 300m north of the site (See **Figure 1**). It is noted that the upper shore of the beach, which adjoins the site, is extensively used by the general public, and that usage is highest in proximity to the car park that is located immediately adjacent to the proposed development site. These circumstances, particularly where dogs are also present, may reduce usage of the area by otter. Whilst otters may use the shore areas in proximity to the site on occasions, no holts were noted in this area, nor are they likely to occur in the area affected by beach nourishment works in the future.

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Figure 1 showing closest signs of otter activity (sprainting site).

A5 Bat surveys

All bat species in Ireland are protected under the Wildlife Act 1976, as amended, and the Habitats Directive and Irish implementing legislation. Ireland is also a signatory to the Bonn convention (Convention on the conservation of migratory species of wild animals, Bonn 1979) and the Bern convention, 1982 (The Convention on the Conservation of European Wildlife and Natural Habitats), and it has a commitment to the “Eurobats” agreement (Agreement on the Conservation of Bats in Europe, 1991).

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Bat surveys were undertaken in 2012 for the Ringaskiddy Port Redevelopment EIS (Port of Cork/RPS, 2015). Three bat species were recorded; Common Pipistrelle, Soprano Pipistrelle and Leisler's Bat. Both Pipistrelle species were recorded foraging within woodland areas at the base of the ADM training wall and jetty and along hedgerows, treelines and scrub habitats in Ringaskiddy East, 1500m from the Indaver site.

Bat activity was assessed at the DePuy site in 2011, in relation to the provision of a wind turbine. This site is located approximately 240m south of the Indaver site. Three species of bat were recorded within the DePuy site, namely Common Pipistrelle, Soprano Pipistrelle and Leisler's Bat. However activity within the site was relatively low (DePuy Ireland, 2011)

Dixon.Brosnan carried out night-time bat activity surveys using standard heterodyne bat monitors (Batbox III and Batbox Duet) at different areas within the site in May 2008. The survey recorded foraging Common Pipistrelle and commuting activity at different areas within the site, including the hedgerows/treelines along northern, western and southern site boundaries. As expected, most activity occurred close to better quality hedgerows. No other species were detected.

DixonBrosnan resurveyed the site in September 2014 and August 2015. A transect was walked along the perimeter of the site and bat activity monitored using a Bat Box Duet heterodyne/frequency division detector. The following were recorded (See **Figure 2**):

- Common Pipistrelle were recorded feeding along the hedgerow which runs along the southern boundary (2014 and 2015).
- Common Pipistrelle feeding along the southern boundary in the southwest corner of the site and along the woodland boundary. (2015).
- Soprano Pipistrelle fly-over along the shoreline boundary (2015)
- Common Pipistrelle flyover/feeding over the proposed development site close to the boundary with Hammond Lane (2015).

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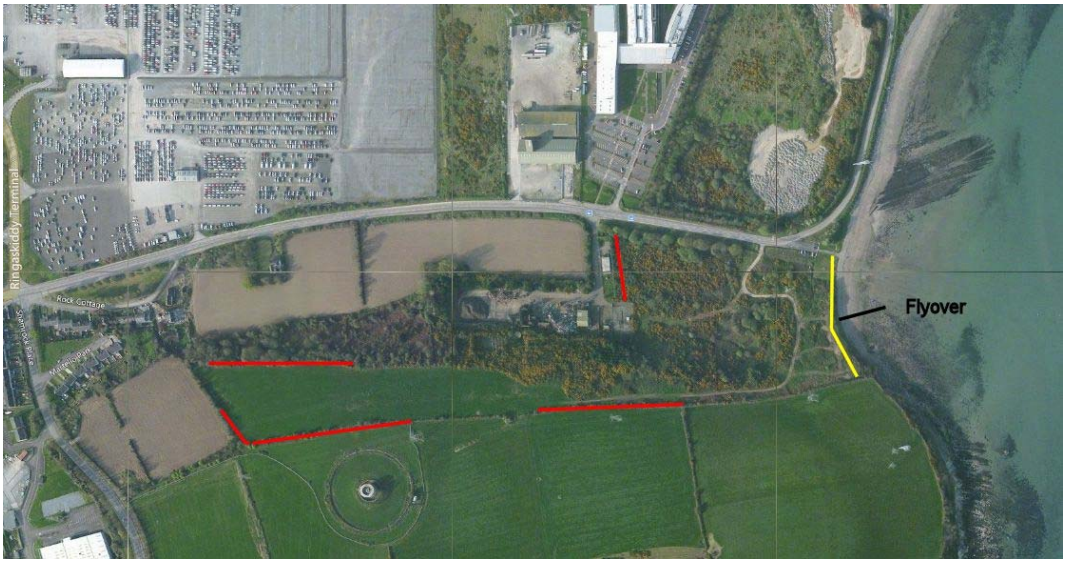

Figure 2 showing general bat activity patterns. Red indicates Common Pipistrelle, Yellow indicates Soprano Pipistrelle.

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The highest level of activity was along the external hedgerow along the southern boundary and the scrub/woodland in the western section of the site. These results are broadly similar to those obtained in 2008. The surveys found that bat activity was low, with only limited Common and Soprano Pipistrelle activity recorded. Only small numbers of individuals were recorded.

Surveys by DixonBrosnan in 2014 indicated that there are were no suitable roosting sites for bats within the Indaver site boundary. There are no structures which could potentially support roosts, and the trees are all relatively young and lack the structural complexity (i.e. rotten wood, holes etc), that would provide suitable roosting sites for bats. Inspections of the Martello tower suggest that, although it does not appear to provide suitable conditions for bats, the presence of roosting habitat cannot be excluded. The EIS prepared for the Hammond Lane development (Doherty Environmental, 2012) likewise did not record any high value roosting habitat. In conclusion, the hedgerows and treelines on external boundaries are of some local value for feeding bats, but do not provide roosting habitat.

A6 Badger surveys

Badgers and their setts are protected under the provisions of the Wildlife Act 1976, as amended and it is an offence to intentionally, knowingly or unknowingly kill or injure a protected species, or to wilfully interfere with or destroy the breeding site or resting place of a protected wild animal. Badger setts are formed by a complex group of interlinked tunnels, and therefore works in proximity to setts can potentially cause damage. The presence of badgers is indicated by readily identifiable signs including prints, trails, latrines, feeding signs and trapped hairs.

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A survey of the study area in 2001 recorded an active badger sett to the west of the Hammond Lane facility (**See Figure 3**). A survey by DixonBrosnan in 2008 found that this sett remained in active use although the adjoining field had been changed from pasture to arable land. Evidence of activity was recorded at this sett, with one large latrine located in close proximity to an active burrow entrance. A short distance to the west of the active sett, there were further entrances. A disused sett entrance was also located to the south of the active sett, and signs of badger activity including tracks, feeding signs and a latrine were recorded in pasture in the southern section of the site.

A survey in 2012, during the preparation of the EIS for the Hammond lane facility (Doherty Environmental, 2012), did not record any signs that this sett was active although badger activity was noted in dense bracken further west within the Indaver site. Surveys in 2014 and 2015 by DixonBrosnan did not record any signs of badger activity, and the previously identified sett is no longer in active use (See **Figure 3**). The reasons for this change are uncertain. However it is possible that over time the site has become less valuable for badgers due to the incremental change from large areas of grassland to a predominance of tillage and scrub, which is of less value as feeding habitat. As the originally recorded sett was small it may have been a subsidiary sett which was used sporadically as an adjunct to a main sett. Any impacts on badger from the proposed development are predicted to be negligible.

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Figure 3. Location of badger sett recorded in 2001 and 2008 denoted by red circle.

A7 Other mammals

A7.1 Seals

Harbour Seal and Grey Seal are listed on Annex II of the Habitats Directive, and both are known to occur within Cork Harbour. There are no known haul-out sites for Grey Seal in Cork Harbour. Generally this species uses more exposed sites although Grey Seals are known to feed within the overall Cork Harbour.

Haul-out sites for harbour seals may occur inshore, for example on estuaries, coves, islands etc. and this species tends to forage within a relatively short distance of such haul-out sites. Over half of foraging trips may be within 5km of the haul-out sites. Although there is no evidence for significant haul-out sites or breeding sites in Cork Harbour, there are several small haul-out sites in this general area, as noted below. The beach adjoining the proposed development site is not of value as a haul-out site due to high levels of disturbance by walkers and dogs.

A small haul-out site near Haulbowline Island (RPS, Port of Cork, 2014)

An adult Harbour Seal occasionally uses a partially submerged tyre to haul-out on at mid-high tide approx. 10m from the shoreline adjacent to the National Maritime College in Ringaskiddy

Approximately six Harbour Seals were recorded using the slipway at the National Maritime College (DixonBrosnan, 2014, RPS/Port of Cork, 2014)

During winter bird counts by DixonBrosnan in 2014/2015, four Harbour Seals were recorded in the channel between the mainland and Spike Island

Although there is nothing to indicate that the area in the immediate vicinity of the Indaver site is of particular value for seals, it is within the feeding range for local Harbour Seal populations that forage within this general area.

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A7.2 Cetaceans

Species that have been recorded by the Irish Whale and Dolphin Group within the overall harbour include Bottlenose Dolphin (*Tursiops truncatus*), Harbour Porpoise (*Phocoena phocoena*), Common Dolphin (*Delphinus delphis*), Risso's dolphin (*Grampus griseus),* Killer Whale (*Orcinus orca*) and Minke Whales (*Balaenoptera acutorostrata*). Of these, it is the smaller species such as Harbour Porpoise which are most likely to occur in the channel offshore from the site.

A7.3 Other mammals

Pygmy Shrew, Hedgehog and Stoat were not recorded, but may be present but were not recorded during surveys. Rabbits are numerous and signs of fox were noted on site. Small mammal surveys in the study area in 2001 and 2008 recorded the presence of Field Mouse, Bank Vole and Brown Rat. Such species are common in the Irish countryside.

A8 Conclusions

No otter activity was recorded in proximity to the Indaver site. The badger sett, which was previously active within the Indaver site, is no longer in use. Some limited usage of the Indaver site by Common Pipistrelle and Soprano Pipistrelle bat was recorded. Although there is nothing to indicate that the area in the immediate vicinity of the Indaver site is of particular value for seals, it is within the feeding range for local Harbour Seal populations that forage within this general area

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A9 References

Ringaskiddy Port Redevelopment EIS (Port of Cork/RPS, 2014)

DePuy (Ireland) Wind Energy Project Environmental Impact Statement April 2011

Hammond Lane Metal Co, Ringaskiddy EIS Flora and Fauna Chapter (Doherty Environmental 2012).

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Appendix 12.5

Site Synopses - Natura 2000 sites

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12.5 Site Synopses

12.5.1 Cork Harbour Special Protection Area (Site Code 004030)

Cork Harbour is a large, sheltered bay system, with several river estuaries - principally those of the Rivers Lee, Douglas, Owenboy and Owennacurra. The SPA site comprises most of the main intertidal areas of Cork Harbour, including all of the North Channel, the Douglas River Estuary, inner Lough Mahon, Monkstown Creek, Lough Beg, the Owenboy River Estuary, Whitegate Bay and the Rostellan and Poulnabibe inlets.

Owing to the sheltered conditions, the intertidal flats are often muddy in character. These muds support a range of macro-invertebrates, notably Macoma balthica, Scrobicularia plana, Hydrobia ulvae, Nepthys hombergi, Nereis diversicolor and Corophium volutator. Green algae species occur on the flats, especially Ulva lactua and Enteromorpha spp. Cordgrass (Spartina spp.) has colonised the intertidal flats in places, especially where good shelter exists, such as at Rossleague and Belvelly in the North Channel. Salt marshes are scattered through the site and these provide high tide roosts for the birds. Salt marsh species present include Sea Purslane (Halimione portulacoides), Sea Aster (Aster tripolium), Thrift (Armeria maritima), Common Saltmarsh-grass (Puccinellia maritima), Sea Plantain (Plantago maritima), Laxflowered Sea-lavender (Limonium humile) and Sea Arrowgrass (Triglochin maritima). Some shallow bay water is included in the site. Cork Harbour is adjacent to a major urban centre and a major industrial centre. Rostellan Lake is a small brackish lake that is used by swans throughout the winter. The site also includes some marginal wet grassland areas used by feeding and roosting birds.

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The site is a Special Protection Area (SPA) under the E.U. Birds Directive, of special conservation interest for the following species: Little Grebe, Great Crested Grebe, Cormorant, Grey Heron, Shelduck, Wigeon, Teal, Pintail, Shoveler, Red-breasted Merganser, Oystercatcher, Golden Plover, Grey Plover, Lapwing, Dunlin, Blacktailed Godwit, Bar-tailed Godwit, Curlew, Redshank, Black-headed Gull, Common Gull, Lesser Black-backed Gull and Common Tern. The site is also of special conservation interest for holding an assemblage of over 20,000 wintering waterbirds. The E.U. Birds Directive pays particular attention to wetlands and, as these form part of this SPA, the site and its associated waterbirds are of special conservation interest for Wetland & Waterbirds.

Cork Harbour is an internationally important wetland site, regularly supporting in excess of 20,000 wintering waterfowl, for which it is amongst the top five sites in the country. The two-year mean of summed annual peaks for the entire harbour complex was 55,401 for the period 1995/96 and 1996/97. Of particular note is that the site supports internationally important populations of Black-tailed Godwit (905) and Redshank (1,782) - all figures given are average winter means for the two winters 1995/96 and 1996/97. At least 18 other species have populations of national importance, as follows: Little Grebe (51), Great Crested Grebe (204), Cormorant (705), Grey Heron (63), Shelduck (2,093), Wigeon (1,852), Teal (922), Pintail (66), Shoveler (57), Red-breasted Merganser (88), Oystercatcher (1,404), Golden Plover (3,653), Grey Plover (84), Lapwing (7,688), Dunlin (10,373),

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Bartailed Godwit (417), Curlew (1,325) and Greenshank (26). The Shelduck population is the largest in the country (over 10% of national total). The site has regionally or locally important populations of a range of other species, including Whooper Swan (10), Pochard (145) and Turnstone (79). Other species using the site include Gadwall (13), Mallard (456), Tufted Duck (113), Goldeneye (31), Coot (53), Mute Swan (38), Ringed Plover (34) and Knot (38). Cork Harbour is a nationally important site for gulls in winter and autumn, especially Black-headed Gull (4,704), Common Gull (3,180) and Lesser Black-backed Gull (1,440).

A range of passage waders occurs regularly in autumn, including such species as Ruff (5-10), Spotted Redshank (1-5) and Green Sandpiper (1-5). Numbers vary between years and usually a few of each of these species over-winter.

The wintering birds in Cork Harbour have been monitored since the 1970s and are counted annually as part of the I-WeBS scheme.

Cork Harbour has a nationally important breeding colony of Common Tern (3-year mean of 69 pairs for the period 1998-2000, with a maximum of 102 pairs in 1995). The birds have nested in Cork Harbour since about 1970, and since 1983 on various artificial structures, notably derelict steel barges and the roof of a Martello Tower. The birds are monitored annually and the chicks are ringed.

Extensive areas of estuarine habitat have been reclaimed since about the 1950s for industrial, port-related and road projects, and further reclamation remains a threat. As Cork Harbour is adjacent to a major urban centre and a major industrial centre, water quality is variable, with the estuary of the River Lee and parts of the Inner Harbour being somewhat eutrophic. However, the polluted conditions may not be having significant impacts on the bird populations. Oil pollution from shipping in Cork Harbour is a general threat. Recreational activities are high in some areas of the harbour, including jet skiing which causes disturbance to roosting birds.

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Cork Harbour is of major ornithological significance, being of international importance both for the total numbers of wintering birds (i.e. > 20,000) and also for its populations of Black-tailed Godwit and Redshank. In addition, there are at least 18 wintering species that have populations of national importance, as well as a nationally important breeding colony of Common Tern. Several of the species which occur regularly are listed on Annex I of the E.U. Birds Directive, i.e. Whooper Swan, Golden Plover, Bar-tailed Godwit, Ruff and Common Tern. The site provides both feeding and roosting sites for the various bird species that use it.

26.2.2008 (Accessed October 2015).

12.5.1. Great Island Channel candidate Special Area of Conservation (Site Code 001058)

The Great Island Channel stretches from Little Island to Midleton, with its southern boundary being formed by Great Island. It is an integral part of Cork Harbour which contains several other sites of conservation interest. Geologically, Cork Harbour consists of two large areas of open water in a limestone basin, separated from each other and the open sea by ridges of Old Red Sandstone. Within this system, Great Island Channel forms the eastern stretch of the river basin and, compared to the rest of Cork Harbour, is relatively undisturbed. Within

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the site is the estuary of the Owennacurra and Dungourney Rivers. These rivers, which flow through Midleton, provide the main source of freshwater to the North Channel. The site is a Special Area of Conservation (SAC) selected for the following habitats and/or species listed on Annex I / II of the E.U. Habitats Directive (* = priority; numbers in brackets are Natura 2000 codes):

[1140] Tidal Mudflats and Sandflats

[1330] Atlantic Salt Meadows

The main habitats of conservation interest in Great Island Channel SAC are the sheltered tidal sand and mudflats and the Atlantic salt meadows. Owing to the sheltered conditions, the intertidal flats are composed mainly of soft muds. These muds support a range of macro-invertebrates, notably Macoma balthica, Scrobicularia plana, Hydrobia ulvae, Nepthys hombergi, Nereis diversicolor and Corophium volutator. Green algal species occur on the flats, especially Ulva lactua and Enteromorpha spp. Cordgrass (Spartina spp.) has colonised the intertidal flats in places, especially at Rossleague and Belvelly.

The saltmarshes are scattered through the site and are all of the estuarine type on mud substrate. Species present include Sea Purslane (Halimione portulacoides), Sea Aster (Aster tripolium), Thrift (Armeria maritima), Common Saltmarsh-grass (Puccinellia maritima), Sea Plantain (Plantago maritima), Greater Sea-spurrey (Spergularia media), Lax-flowered Sea-lavender (Limonium humile), Sea Arrowgrass (Triglochin maritimum), Sea Mayweed (Matricaria maritima) and Red Fescue (Festuca rubra).

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The site is extremely important for wintering waterfowl and is considered to contain three of the top five areas within Cork Harbour, namely North Channel, Harper's Island and Belvelly-Marino Point. Shelduck is the most frequent duck species with 800-1,000 birds centred on the Fota/Marino Point area. There are also large flocks of Teal and Wigeon, especially at the eastern end. Waders occur in the greatest density north of Rosslare, with Dunlin, Godwit, Curlew and Golden Plover the commonest species. A population of about 80 Grey Plover is a notable feature of the area. All the mudflats support feeding birds; the main roost sites are at Weir Island and Brown Island, and to the north of Fota at Killacloyne and Harper’s Island. Ahanesk supports a roost also but is subject to disturbance. The numbers of Grey Plover and Shelduck, as given above, are of national importance.

The site is an integral part of Cork Harbour which is a wetland of international importance for the birds it supports. Overall, Cork Harbour regularly holds over 20,000 waterfowl and contains internationally important numbers of Black-tailed Godwit (1,181) and Redshank (1,896), along with nationally important numbers of nineteen other species. Furthermore, it contains large Dunlin (12,019) and Lapwing (12,528) flocks. All counts are average peaks, 1994/95 – 1996/97. Much of the site falls within Cork Harbour Special Protection Area, an important bird area designated under the E.U. Birds Directive.

While the main land use within the site is aquaculture (oyster farming), the greatest threats to its conservation significance come from road works, infilling, sewage outflows and possible marina developments.

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The site is of major importance for the two habitats listed on Annex I of the E.U. Habitats Directive, as well as for its important numbers of wintering waders and wildfowl. It also supports a good invertebrate fauna.

24.09.2013 (Accessed October 2015).

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Appendix 12.6

NRA Guidelines for Assessment of Habitat Values

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12.6 NRA Guidelines for Assessment of Habitat Values

Table 1: Examples of valuation at different geographical scales

Ecological valuation: Examples
International Importance: 'European Site' including Special Area of Conservation (SAC), Site of Community Importance (SCI), Special Protection Area (SPA) or proposed Special Area of Conservation. Proposed Special Protection Area (pSPA). Site that fulfills the criteria for designation as a 'European Site' (see Annex III of the Habitats Directive, as amended). Features essential to maintaining the coherence of the Natura 2000 Network.[4] Site containing 'best examples' of the habitat types listed in Annex I of the Habitats Directive. Resident or regularly occurring populations (assessed to be important at the national level)5 of the following: Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; and/or Species of animal and plants listed in Annex II and/or IV of the Habitats Directive. Ramsar Site (Convention on Wetlands of International Importance Especially Waterfowl Habitat 1971). World Heritage Site (Convention for the Protection of World Cultural & Natural Heritage, 1972). Biosphere Reserve (UNESCO Man & The Biosphere Programme). Site hosting significant species populations under the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals, 1979). Site hosting significant populations under the Berne Convention (Convention on the Conservation of European Wildlife and Natural Habitats, 1979). Biogenetic Reserve under the Council of Europe. European Diploma Site under the Council of Europe. Salmonid water designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988, (S.I. No. 293 of 1988).[6]
National Importance: Site designated or proposed as a Natural Heritage Area (NHA). Statutory Nature Reserve. Refuge for Fauna and Flora protected under the Wildlife Acts. National Park. Undesignated site fulfilling the criteria for designation as a Natural Heritage Area (NHA); Statutory Nature Reserve; Refuge for Fauna and Flora protected under the Wildlife Act; and/or a National Park. Resident or regularly occurring populations (assessed to be important at the national level)7 of the following: Species protected under the Wildlife Acts; and/or Species listed on the relevant Red Data list. Site containing 'viable areas'[8] of the habitat types listed in Annex I of the Habitats Directive.

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County Importance:

- Area of Special Amenity.[9]
- Area subject to a Tree Preservation Order.
- Area of High Amenity, or equivalent, designated under the County Development Plan.
- Resident or regularly occurring populations (assessed to be important at the County level)[10] of the following:
  - Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive;
  - Species of animal and plants listed in Annex II and/or IV of the Habitats Directive;
  - Species protected under the Wildlife Acts; and/or
  - Species listed on the relevant Red Data list.
- Site containing area or areas of the habitat types listed in Annex I of the Habitats Directive that do not fulfil the criteria for valuation as of International or National importance.
- County important populations of species, or viable areas of semi-natural habitats or natural heritage features identified in the National or Local BAP, 11 if this has been prepared.
- Sites containing semi-natural habitat types with high biodiversity in a county context and a high degree of naturalness, or populations of species that are uncommon within the county.
- Sites containing habitats and species that are rare or are undergoing a decline in quality or extent at a national level.

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Local Importance (higher value):

- Locally important populations of priority species or habitats or natural heritage features identified in the Local BAP, if this has been prepared;
- Resident or regularly occurring populations (assessed to be important at the Local level)12 of the following:
  - Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive;
  - Species of animal and plants listed in Annex II and/or IV of the Habitats Directive;
  - Species protected under the Wildlife Acts; and/or
  - Species listed on the relevant Red Data list.
- Sites containing semi-natural habitat types with high biodiversity in a local context and a high degree of naturalness, or populations of species that are uncommon in the locality;
- Sites or features containing common or lower value habitats, including naturalised species that are nevertheless essential in maintaining links and ecological corridors between features of higher ecological value.

Local Importance (lower value):

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- Sites containing small areas of semi-natural habitat that are of some local importance for wildlife;
- Sites or features containing non-native species that are of some importance in maintaining habitat links.

4 See Articles 3 and 10 of the Habitats Directive.

5 It is suggested that, in general, 1% of the national population of such species qualifies as an internationally important population. However, a smaller population may qualify as internationally important where the population forms a critical part of a wider population or the species is at a critical phase of its life cycle.

6 Note that such waters are designated based on these waters' capabilities of supporting salmon (Salmo salar), trout (Salmo trutta), char (Salvelinus) and whitefish (Coregonus).

7 It is suggested that, in general, 1% of the national population of such species qualifies as a nationally important population. However, a smaller population may qualify as nationally important where the population forms a critical part of a wider population or the species is at a critical phase of its life cycle.

8 A 'viable area' is defined as an area of a habitat that, given the particular characteristics of that habitat, was of a sufficient size and shape, such that its integrity (in terms of species composition, and ecological processes and function) would be maintained in the face of stochastic change (for example, as a result of climatic variation).

9 It should be noted that whilst areas such as Areas of Special Amenity, areas subject to a Tree Preservation Order and Areas of High Amenity are often designated on the basis of their ecological value, they may also be designated for other reasons, such as their amenity or recreational value. Therefore, it should not be automatically assumed that such sites are of County importance from an ecological perspective.

10 It is suggested that, in general, 1% of the County population of such species qualifies as a County important population. However, a smaller population may qualify as County important where the population forms a critical part of a wider population or the species is at a critical phase of its life cycle.

11 BAP: Biodiversity Action Plan

12 It is suggested that, in general, 1%of the local population of such species qualifies as a locally important population. However, a smaller population may qualify as locally important where the population forms a critical part of a wider population or the species is at a critical phase of its life cycle

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Appendix 11

Air Quality

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8 Air Quality

8.1 Introduction

The Ringaskiddy Resource Recovery Centre will have one furnace and flue gas cleaning line. The line will have a moving grate furnace with a state-of-the-art flue gas cleaning system.

The combustion of waste produces a number of emissions, the discharges of which are regulated by the EU Directive on Industrial Emissions (IED) (2010/75/EU). The emissions to atmosphere which have been regulated are:

- Nitrogen Dioxide (NO_2)
- Sulphur Dioxide (SO_2)
- Total Dust (although there is no regulated Total Dust standard, standards exist for PM_{10} and $PM_{2.5}$ (particulate matter less than 10 and 2.5 microns respectively))
- Carbon Monoxide (CO)
- Total Organic Carbon (TOC)
- Hydrogen Fluoride (HF) and Hydrogen Chloride (HCl)
- Dioxins/Furans (PCDD/PCDFs)
- Cadmium (Cd) & Thallium (Tl)
- Mercury (Hg)
- and the sum of Antimony (Sb), Arsenic (As), Lead (Pb), Chromium (Cr), Cobalt (Co), Copper (Cu), Manganese (Mn), Nickel (Ni) and Vanadium (V).

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The impact of the pollutants outlined above have been assessed in this chapter of the EIS in addition to any potential construction phase emissions.

In addition, Polycyclic Aromatic Hydrocarbons (PAHs) have been assessed as incineration is a potential emission source for this group of compounds.

The scope of the evaluation of the potential impacts on air quality arising from the proposed development consists of the following components:

- Review of maximum emission levels and other relevant information needed for the modelling study;
- Review of construction phase potential emissions;
- Identification of the significant substances which are released from the facility;
- Review of background ambient air quality in the vicinity of the facility including an extensive baseline survey which was carried out in the region of the proposed Ringaskiddy Resource Recovery Centre facility over the period August 2014 to July 2015. This supplements the extensive baseline surveys undertaken in November 2006 to February 2007 and from April 2008 to July 2008;
- Air dispersion modelling of significant substances released from the facility;

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- Particulate deposition modelling of Dioxins & Furans, Polycyclic Aromatic Hydrocarbons (PAHs) and heavy metals released from the facility;
- Identification of predicted ground level concentrations of released substances at the facility boundary and at sensitive receptors in the immediate environment;
- The potential cumulative impacts of the proposed development on air quality in combination with other relevant planned or permitted development in the area;
- Evaluation of the significance of these predicted concentrations, including consideration as to whether ground level concentrations are likely to exceed the applicable stringent ambient air quality standards and guidelines.

8.1.1 Modelling Under Maximum & Abnormal Operating Conditions

In order to assess the potential impact from the proposed facility under maximum and abnormal operations, a conservative approach was adopted that is designed to "over-predict" ground level concentrations. This cautious or conservative approach will ensure that an over-estimation of impacts will occur and that the resultant emission standards adopted are stringent in their protection of ambient air quality. The approach incorporated several conservative assumptions regarding operating conditions at the proposed facility. This approach incorporated the following features:

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- For the maximum operating scenario, it has been assumed that the emission point is continuously operating at its maximum operating volume flow. This will over-estimate the actual mass emissions from the facility.
- For the maximum operating scenario, it has been assumed that the emission point is operating at its maximum emission concentration for 24-hrs/day over the course of the full year.
- Abnormal operating emissions were obtained from the process engineer and are pessimistically assumed to occur as outlined below:
    - NO_X - 400 mg/m^3 for 3% of the year (11 days per annum)
    - SO_2 - 200 mg/m^3 for 3% of the year (11 days per annum)
    - Total Dust - 30 mg/m^3 for 3% of the year (11 days per annum)
    - TOC - 30 mg/m^3 for 3% of the year (11 days per annum)
    - HCl - 60 mg/m^3 for 3% of the year (11 days per annum)
    - HF - 4 mg/m^3 for 3% of the year (11 days per annum)
    - CO - 200 mg/m^3 for 5% of the year (18 days per annum)
    - Dioxins & Furans - 0.5 ng/m^3 for 3% of the year (11 days per annum)
    - Heavy Metals (other than Hg, Cd & Tl) - 30 mg/m^3 for 3% of the year (11 days per annum)
    - Cd & Tl - 0.2 mg/m^3 for 3% of the year (11 days per annum)
    - Hg - 1 mg/m^3 for 3% of the year (11 days per annum)

As a result of these conservative assumptions, there will be an over-estimation of the emissions from the facility and the impact of the proposed facility on human health and the surrounding environment.

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8.2 Methodology

8.2.1 Modelling Study Methodology

The air dispersion modelling input data consists of detailed information on the physical environment (including building dimensions and terrain features), design details from all emission points on-site and a full year of worst-case meteorological data. Using this input data, the model predicts ambient ground level concentrations beyond the site boundary for each hour of the modelled meteorological year. The model post-processes the data to identify the location of the maximum ambient ground level concentration in the applicable format for comparison with the relevant limit values. This maximum concentration is then added to the existing background concentration to give the maximum predicted ambient concentration. The maximum ambient concentration is then compared with the relevant ambient air quality standard for the protection of human health to assess the significance of the releases from the site.

In the absence of detailed guidance in Ireland, the selection of appropriate modelling methodology has followed the guidance from the USEPA which has issued detailed and comprehensive guidance on the selection and use of air quality models[1-3].

Based on guidance from the USEPA, the most appropriate regulatory model for the current application is the AERMOD model (Version 15181). The model is applicable in both simple and complex terrain, urban or rural locations and for all averaging periods[3]. The terrain data for the region of the facility was obtained from the US Jet Propulsion Laboratory Shuttle RADAR Topography Mission (SRTM) at 1 arc-second (30m) resolution and imported into the model using the AERMOD terrain pre-processor AERMAP (see Figure 8.2). An overview of the model is outlined in Appendix 8.2.

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The selection of the urban/rural classification is based on the land use procedure of Auer[4] as recommended by the USEPA[1]. An examination of the land-use type around the site indicated that the rural boundary layer was appropriate.

The AERMOD model is capable of modelling most meteorological conditions likely to be encountered in the region. However, unusual meteorological conditions may occur infrequently, which may not be modelled adequately using AERMOD. One such condition is fumigation which occurs when a plume is emitted into a stable layer of air which subsequently mixes to ground level through either convective transfer of heat from the surface or because of advection to less stable surroundings[1]. A recommended air dispersion model is CALPUFF[1] (full details are outlined in Appendix 8.1).

8.2.2 Meteorological Considerations

Meteorological data is an important input into the air dispersion model. The local airflow pattern will be influenced by the geographical location. Important features will be the location of hills and valleys or land-water-air interfaces and whether the site is located in simple or complex terrain.

The selection of the appropriate meteorological data has followed the guidance issued by the USEPA[1]. A primary requirement is that the data used should have

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a data capture of greater than 90% for all parameters. One synoptic meteorological station operated by Met Éireann was identified near the site – Cork Airport. Data collection of greater than 90% for all parameters is required for air dispersion modelling. Cork Airport fulfils this requirement.

Cork Airport meteorological station is in a region of gentle rolling terrain and is 12 km from the site. The meteorological data used in the appraisal (2010 - 2014) is the most recent data which is available for this station. The final issue relates to the exposure of the meteorological monitoring site and specifically relating to the surface characteristics of the station compared to the site of the proposed facility. Cork Airport is 12km from the coast and located in an area of mainly agricultural land with urban characteristics to the north of the airport. In contrast, Ringaskiddy is in a coastal area with a range of surface characteristics including water, agricultural and urban within a few kilometres of the site. Thus, some differences in surface characteristics are apparent between the meteorological station at Cork Airport and the site location. In order to ascertain the likely significance of the difference in surface characteristics, a sensitivity study was conducted as shown in Appendix 8.5. Secondly, a weather station was installed on-site which measured wind speed, wind direction, temperature and relative humidity over the period starting in October 2006 and finished at the end of December 2007. This station allowed the similarities and differences between Cork Airport and the proposed site to be identified. The on-site meteorological data was used in the AERMOD modelling study and in the CALPUFF modelling study as detailed in Section 8.12 of Appendix 8.1.

The windrose from Cork Airport for the years 2010 - 2014 is shown in Figure 8.3 with detailed data outlined in Appendix 8.2. The windrose indicates the prevailing wind speed and direction over the five-year period. The prevailing wind direction is generally from the S-NW direction, with generally moderate wind speeds, averaging around 5 m/s.

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8.2.3 Background Concentrations

The ambient concentrations detailed in the following sections include both the emissions from the site and the ambient background concentration for that substance. Background concentrations have been derived from a conservative analysis of the existing background air quality and an analysis of cumulative sources in the region in the absence of the development. A detailed baseline air quality assessment (Section 8.3 of Appendix 8.1) was carried out to assess background levels of those pollutants, which are likely to be released from the site. Appropriate background values have been outlined in Table 8.1. In arriving at the combined annual background concentration, cognisance has been taken of the accuracy of the approach and the degree of double counting inherent in the assessment. In relation to NO_2, PM_{10}, $PM_{2.5}$ and benzene, the baseline monitoring programme took into account both the existing traffic levels and existing industrial sources. However, some increases in traffic levels will occur due to the additional development which has been incorporated into the final combined background levels. Again, in recognition of the various inaccuracies in this approach, the values have been rounded accordingly. A similar approach has been adopted for the other pollutants. In addition, modelling of cumulative sources has been undertaken with the impact of the cumulative sources added to the background concentration. The cumulative sources modelled were Janssen

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Biologics, Hovione Cork, GSK Ireland, ESB Aghada, Novartis Ringaskiddy Ltd, Pfizer Ireland Pharmaceuticals and BGE Whitegate.

In order to obtain the predicted environmental concentration (PEC), background data was added to the process emissions. In relation to the annual averages, the ambient background concentration was added directly to the process concentration. However, in relation to the short-term peak concentrations, concentrations due to emissions from elevated sources cannot be combined in the same way. Guidance from the UK DEFRA[5] advises that for NO_2, SO_2 and PM_{10} an estimate of the maximum combined pollutant concentration can be obtained as shown below:

NO_2 - The 99.8th%ile of total 1-hour NO_2 is equal to the minimum of either A or B below:

a) 99.8th%ile hourly background total oxidant (O_3 & NO_2) + 0.05 x (99.8th%ile process contribution NOx)

b) The maximum of either:

   99.8th% process contribution NOx + 2 x (annual mean background NO_2)

or

   99.8th% hourly background NO_2 + 2 x (annual mean process contribution NO_x)

PM_{10} - The 90.4th%ile of total 24-hour mean PM_{10} is equal to the maximum of either A or B below:

a) 90.4th%ile of 24-hour mean background PM_{10} + annual mean process contribution PM_{10}

b) 90.4th%ile 24-hour mean process contribution PM_{10} + annual mean background PM_{10}

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SO_2 - The 99.7th%ile of total 1-hour SO_2 is equal to the maximum of either A or B below:

a) 99.7th%ile hourly background SO_2 + (2 x annual mean process contribution SO_2)

b) 99.7th%ile hourly process contribution SO_2 + (2 x annual mean background contribution SO_2)

SO_2 - The 99.2th%ile of total 24-hour SO_2 is equal to the maximum of either A or B below:

a) 99.2th%ile of 24-hour mean background SO_2 + (2 x annual mean process contribution SO_2)

b) 99.2th%ile 24-hour mean process contribution SO_2 + (2 x annual mean background contribution SO_2).

8.2.4 Cumulative Appraisal

As the region around Ringaskiddy is partly industrialised and thus has several other potentially significant sources of pollutants, a detailed cumulative appraisal has been carried out using the methodology outlined by the USEPA. The impact

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of nearby sources (Janssen Biologics, Hovione Cork, GSK Ireland, ESB Aghada, Novartis Ringaskiddy Ltd, Pfizer Ireland Pharmaceuticals and BGE Whitegate) has been examined where interactions between the plume of the point source under consideration and those of nearby sources can occur. These include:

1) the area of maximum impact of the point source,
2) the area of maximum impact of nearby sources,
3) the area where all sources combine to cause maximum impact on air quality[1].

Background concentrations for the area, based on natural, minor and distant major sources need also to be taken into account in the modelling procedure. A major baseline monitoring programme (see Section 8.3) was undertaken over several months which, in conjunction with other available baseline data, was used to determine worst-case background concentrations in the region (see **Table 8.1**). Full detail of the cumulative impact assessment and associated results can be seen in Appendix 8.4.

Air modelling of road emissions associated with the project have also been undertaken and added to the existing worst-case background pollutant levels. Cumulative impacts due to the Port of Cork expansion project have been included in both the “do-nothing” and “do-something” scenario.

DePuy Ireland, which is located approximately 400m south of the proposed facility, has recently constructed a wind turbine onsite with a diameter of 101m. A wind turbine, when in operation, has the potential to interact with the plume as the plume passes the region of the turbine. The implications of this have been studied recently by Fletcher and Brown[6]. The study found that there was a small increase in relative concentration in the plume of the order of 5 – 20% over a distance of 1 to 2 turbine diameters downwind of the turbine. Thereafter, concentrations in the plume where seen to fall rapidly to below 30 – 60% of the pre-turbine plume concentration within 4 – 5 turbine diameters. Thus, given the plume concentrations expected at a distance of 400m from the facility, the impact of the DePuy turbine will not be significant and will not lead to an exceedance of the ambient air quality standards in the vicinity.

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8.2.5 Ambient Air Quality Standards

The relevant ambient air quality standards are outlined in Table 8.2. Ambient air quality legislation designed to protect human health and the environment is generally based on assessing ambient air quality at locations where the exposure of the population is significant relevant to the averaging time of the pollutant. However, in the current assessment, ambient air quality legislation has been applied to all locations with a 10km radius of the facility regardless of whether any sensitive receptors (such as residential locations) are present for significant periods of time. This represents a worst-case approach and an examination of the corresponding concentrations at the nearest sensitive receptors relative to the actual quoted maximum concentration indicates that these receptors generally experience ambient concentrations significantly lower than that reported for the maximum value.

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8.3 Receiving Environment

An extensive baseline survey was carried out in the region of the proposed Ringaskiddy Resource Recovery Centre facility over the period August 2014 to July 2015. This supplements the extensive baseline survey undertaken in November 2006 to February 2007 and from April 2008 to July 2008. These surveys focused on the significant pollutants likely to be emitted from the facility and which have been regulated in Council Directive 2010/75/EU. The substances monitored over these survey periods were NO_2, NO_X, PM_{10}, $PM_{2.5}$, benzene, SO_2, heavy metals, HCl, HF and PCDDs/PCDFs. The air monitoring program was used to determine long-term average concentrations for these pollutants in order to help quantify the existing ambient air quality in the region. NO_2, benzene and SO_2 were also monitored at a number of additional locations to give some spatial representation of the levels of these species.

The updated extensive baseline survey which was carried out in the region of the proposed Ringaskiddy Resource Recovery Centre facility over the period August 2014 to July 2015 focused on NO_2, PM_{10}, benzene, SO_2 and heavy metals over a year long period in order to capture any possible seasonal factors (as shown in Figure 8.1). The air monitoring programme was used to determine long-term average concentrations for these pollutants in order to help quantify the existing ambient air quality in the region. NO_2, benzene and SO_2 were also monitored at a number of additional locations to give greater spatial representation of the levels of these species.

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Full details of the monitoring methodology, assessment and results are outlined in **Section 8.3** of **Appendix 8.1.**

PM_{10} concentrations measured during the 2014-15 monitoring campaign averaged 20 $\mu g/m^3$, which is below the annual limit value of 40 $\mu g/m^3$. Five exceedances of the 24-hour limit value were recorded over the six-month monitoring campaign. The standard allows for compliance with the ambient air quality standard to be maintained provided no more than 35 exceedances of the 24-hour limit value occur in any one year. Since only 5 exceedances were recorded over the monitoring survey, it is extremely unlikely that 35 exceedances would occur over 365 days at the current location.

The average $PM_{2.5}$ concentration measured over the period May / June 2008 was 7 $\mu g/m^3$ which is significantly below the annual average EU limit value of 25 $\mu g/m^3$ which is applicable in 2015.

Nitrogen dioxide (NO_2) concentrations measured over the 2008 monitoring period were below both the 1-hour and annual EU limit values. The annual average NO_2 concentration average 6 $\mu g/m^3$ over the three month period. The 99.8th%ile of 1-hour concentrations peaked at 38 $\mu g/m^3$ in 2008. Long term NO_2 concentrations at a further nine locations in the region of the facility were significantly lower than the annual average limit value. The average NO_2 concentration measured over the three month period at each location ranged from 4 - 14 $\mu g/m^3$ which is between 10 - 35% of the EU annual limit value of 40 $\mu g/m^3$. The results indicate a weak NO_2 spatial concentration gradient in the region. Updated diffusion monitoring results amounting to six months of data over the period August 2014 to May 2015 indicated an average concentration of between 6 – 19 $\mu g/m^3$ which is between 15 – 48% of the EU annual limit value.

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Levels of sulphur dioxide (SO_2), benzene, hydrogen fluoride (HF) and hydrogen chloride (HCl) were all significantly below their respective limit values in 2008. Updated SO_2 diffusion monitoring results amounting to six months of data over the period August 2014 to May 2015 indicated an average concentration of between 5 – 13 $\mu g/m^3$ which is between 25 – 65% of the EU annual limit value for the protection of vegetation. Similarly, updated benzene diffusion monitoring results amounting to six months of data over the period August 2014 to July 2015 indicated an average concentration of between 1.2 – 1.3 $\mu g/m^3$ which is between 24 – 26% of the EU annual limit value.

Average concentrations of antimony (Sb), arsenic (As), cadmium (Cd), cobalt (Co), chromium (Cr), copper (Cu), mercury (Hg), manganese (Mn), nickel (Ni), lead (Pb), thallium (Tl) and vanadium (V) measured were significantly below their respective annual limit values both in 2008 and 2014-2015. Updated heavy metal monitoring results amounting to six months of data over the period August 2014 to July 2015 indicated an average concentration for each of the heavy metals which was between 0.004 – 37% of the EU annual limit value.

Background levels of PCDD / PCDFs cannot be compared to ambient air quality concentration or deposition standards. However, levels of PCDDs and PCDFs can be compared to existing levels measured sporadically in Ireland and continuously in the UK as part of the TOMPS network. The mean PCDD/PCDF concentration measured over the four one-week periods during April - May 2008 indicates that results are in line with measurements conducted elsewhere in Ireland, with an upper limit of 13.5 fg/m^3 compared to previous measurements ranging from 2.8 – 46 fg/m^3.

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8.4 Characteristics of Proposed Development

8.4.1 Construction Phase

There is the potential for a number of emissions to the atmosphere during the construction phase of the proposed development. In particular, the construction activities may generate quantities of dust in the immediate region of the construction activities and along the route of the haulage trucks.

8.4.2 Operational Phase

Council Directive 2010/75/EU on Industrial Emissions Directive (IED) has established air emission limit values as set out in Table 8.3. The Directive has also outlined stringent operating conditions in order to ensure sufficient combustion of waste thus ensuring that dioxin formation is minimised. Specifically, combustion gases must be maintained at a temperature of 850°C for at least two seconds under normal operating conditions for non-hazardous waste whilst for hazardous waste containing more than 1% halogenated organic substances, the temperature should be raised to 1100°C for at least two seconds. These measures will ensure that dioxins/furans, polychlorinated biphenyls (PCBs) and PAHs are minimised through complete combustion of waste.

Emissions from the proposed facility have been modelled using the AERMOD dispersion model which is the USEPA's regulatory model used to assess

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pollutant concentrations associated with industrial sources(1). Emissions have been assessed, firstly under maximum emissions limits of the EU Directive 2010/75/EU and secondly under abnormal operating conditions.

The Ringaskiddy Resource Recovery Centre facility has one main process emission point (flue). The operating details of this major emission point is outlined in Table 8.4. Full details of emission concentrations and mass emissions are given in Appendix 8.6.

In order to assess the potential impact from the proposed facility under maximum and abnormal operations, a conservative approach was adopted that is designed to over-predict ground level concentrations. This cautious approach will ensure that an over-estimation of impacts will occur and that the resultant emission standards adopted are protective of ambient air quality. The approach incorporated several conservative assumptions regarding operating conditions at the proposed facility. This approach incorporated the following features:

- Emissions from all emission points in the assessment were assumed to be operating at their maximum emission level, 24 hours/day over the course of a full year. This represents a very conservative approach as typical emissions from the proposed facility will be well within the emission limit values set out in the Industrial Emissions Directive.
- Maximum predicted ambient concentrations for all pollutants within a 10 km radius of the site were reported in this study even though, in many cases, no residential receptors were near the location of this maximum ambient concentration. Concentrations at the nearest residential receptors are generally significantly lower than the maximum ambient concentrations reported.
- Conservative background concentrations were used to assess the baseline levels of substances released from the site.
- Meteorological conditions leading to the highest ambient ground level concentrations, over the period 2010 - 2014 from Cork Airport and the on-site meteorological data from 2007, have been used in all assessments. For all averaging periods the year giving the highest ambient ground level concentration from 2007, 2010 - 2014 was used for comparison with the ambient air quality standards.

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Table 8.1 Estimated annual background concentrations in the region of Ringaskiddy (µg/m^3).

	NO_2	NO_X	SO_2	PM_{10}	$PM_{2.5}$	CO	TOC(2)	HCl	HF	Dioxins(1)	B(*a*)P	Cd	Hg	As	V	Ni
Baseline Monitoring Program - Year 2006 – 2008 & Year 2014 - 2015	10	13	9	20	12	-	1	1.2	0.05	0.0013 pg/m^3	-	0.001	0.001	0.001	0.002	0.007
Annual Background Concentration - Year 2020	10	13	9	20	12	450	1	1.2	0.05	0.0013 pg/m^3	0.71 ng/m^3	0.001	0.001	0.001	0.002	0.007
Facility Traffic - Year 2020(3)	0.63	1.21	-	0.1	0.1	0.005	0.005	-	-	-	-	-	-	-	-	-
Cumulative Assessment	2	3	1	-(4)	-(4)	-(4)	-(4)	-(4)	-(4)	0.001 pg/m^3	-(4)	-(4)	-(4)	-(4)	-(4)	-(4)
Annual Background & Facility Traffic Concentration (Year 2020)	**12**	**17**	**10**	**20**	**12**	**500**	**1.0**	**1.2**	**0.05**	**0.0014 pg/m^3**	**0.71 ng/m^3**	**0.001**	**0.001**	**0.001**	**0.002**	**0.007**

(1) Dioxins reported as non-detects as equal to the limit of detection.

(2) Assumed to consist solely of benzene as a worst-case.

(3) Derived using the DMRB screening model (see Appendix 8.3).

(4) No other significant source in the region.

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Table 8.2 Ambient Air Quality Standards

Emission	Limit/Guideline	SI No. 180 of 2011 (µg/m³)	UK EAL (µg/m³)	WHO 2000 & 1999 (µg/m³)	Council Directive 2004/107/ EC (µg/m³)
NO_2	99.8th percentile of 1- Hourly Averages	200			
NO_2	Annual Average	40			
NO_x	Annual Average(1)	30			
SO_2	99.7th percentile of 1- Hourly Averages	350			
SO_2	99.2th percentile of 24- Hourly Averages	125			
SO_2	Annual Average(1)	20			
PM_{10}	90th percentile of 24- Hourly Averages	50			
PM_{10}	Annual Average	40			
$PM_{2.5}$	Annual Average	25			
TOC	Annual Average	5(2)			
HCl	Maximum 1- Hour Average		800		
HCl	Annual Average		20		
HF	Maximum 1- Hour Average		160		
HF	Annual Average		16		
PCDD/PCDF(3)	Annual Average				
Benzo[a]pyrene	Annual Average				0.001
Hg	Annual Average			1.0	
Cd & Tl	Annual Average (Cd)				0.005
Sum of 9 Heavy Metals	Annual Average (Pb)	0.50			
	Hourly Average (Sb)		150		
	Annual Average (As)				0.006
	Hourly Average (As)		15		
	Hourly Average (Cr) (Total)		3.0		
	Annual Average (Cr(VI))		0.0002		
	Hourly Average (Co)		6.0		
	Hourly Average (Cu)		60		
	Annual Average (Mn)			1.0	
	Annual Average (Ni)				0.020
	Hourly Average (Ni)		30		

(1) Critical level for the protection of vegetation.
(2) Limit value is for Benzene as a worst-case.
(3) There are no air quality standard limit values for dioxins and furans. The WHO currently proposes a maximum TDI of between 1-4 pgTEQ/kg of body weight per day. A TDI of 4 pgTEQ/kg of body weight per day should be considered a maximal tolerable intake on a provisional basis and that the ultimate goal is to reduce human intake levels of below 1 pgTEQ/kg of body weight per day.

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Table 8.3 Council Directive 2010/75/EU, Annex V Air Emission Limit Values

Daily Average Values	**Concentration (Normalised (dry, 11%O_2, 273K, 1013kPa))**	
Total Dust	10 mg/m^3	
Gaseous & vaporous organic substances expressed as total organic carbon (TOC)	10 mg/m^3	
Hydrogen Chloride (HCl)	10 mg/m^3	
Hydrogen Fluoride (HF)	1 mg/m^3	
Sulphur Dioxide (SO_2)	50 mg/m^3	
Nitrogen Oxides (as NO_2)	200 mg/m^3	
Half-hourly Average Values	Concentration	
	(100%)	(97%)
Total Dust(1)	30 mg/m^3	10 mg/m^3
Gaseous & vaporous organic substances expressed as total organic carbon (TOC)	20 mg/m^3	10 mg/m^3
Hydrogen Chloride (HCl)	60 mg/m^3	10 mg/m^3
Hydrogen Fluoride (HF)	4 mg/m^3	2 mg/m^3
Sulphur Dioxide (SO_2)	200 mg/m^3	50 mg/m^3
Nitrogen Oxides (as NO_2)	400 mg/m^3	200 mg/m^3
Average Value Over 30 mins to 8 Hours	Concentration(2)	
Cadmium and its compounds, expressed as Cd	Total 0.05 mg/m^3	
Thallium and its compounds, expressed as Tl		
Mercury and its compounds, expressed as Hg	0.05 mg/m^3	
Antimony and its compounds, expressed as Sb	Total 0.5 mg/m^3	
Arsenic and its compounds, expressed as		
Lead and its compounds, expressed as Pb		
Chromium and its compounds, expressed as Cr		
Cobalt and its compounds, expressed as Co		
Copper and its compounds, expressed as Cu		
Manganese and its compounds, expressed as Mn		
Nickel and its compounds, expressed as Ni		
Vanadium and its compounds, expressed as V		
Average Values Over 6 – 8 Hours	Concentration	
Dioxins and furans	0.1 ng/m^3	
Average Value	Concentration(3)	
	Daily Average Value	30 Min Average Value
Carbon Monoxide	50 mg/m^3	100 mg/m^3

(1) Total dust emission may not exceed 150 mg/m^3 as a half-hourly average under any circumstances

(2) These values cover also the gaseous and vapour forms of the relevant heavy metals as well as their compounds

(3) Exemptions may be authorised for incineration plants using fluidised bed technology, provided that emission limit values do not exceed 100 mg/m^3 as an hourly average value.

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Table 8.4 Process Emission Design Detail

Stack Reference	Stack Height (m)	Exit Diameter (m)	Cross-Sectional Area (m^2)	Temp (K)	Volume Flow (Nm^3/hr)(1)	Exit Velocity (m/sec actual)(2)
Grate	70	2.30	4.15	418	142,000 – Maximum 106,900 – Nominal	14.0 10.5

(1) Normalised to 11% O_2, dry, 273K.

(2) Actual, 418K

8.5 Evaluation of Impacts

The results from the detailed air dispersion modelling of the facility are summarised below and in Figure 8.4. The modelling, undertaken using the USEPA regulatory model AERMOD, is discussed in detail in Appendix 8.2.

8.5.1 Do Nothing Impacts

For the Do Nothing scenario the existing air quality emission sources contained within the area of the proposed development will remain in place. Therefore, the existing baseline air quality environment is not expected to change in the Do Nothing scenario.

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8.5.2 Do Something or Potential Development Impacts

8.5.2.1 NO_2 & NO_X

NO_2 modelling results, using AERMOD, indicate that the ambient ground level concentrations will be below the relevant air quality standards for the protection of human health for nitrogen dioxide under both maximum and abnormal operation of the facility. Thus, no adverse impact on public health or the environment is envisaged to occur under these conditions at or beyond the facility boundary. Emissions at maximum operations lead to ambient NO_2 concentrations (including background concentrations) which are 63% of the maximum ambient 1-hour limit value (measured as a 99.8th%ile) and 33% of the annual average limit value at the respective worst-case receptors.

The annual average NO_X concentration (including background concentration) will also be below the critical level for the protection of vegetation accounting for 61% of the annual limit value at the worst-case receptor in the region of the Lough Beg Proposed NHA and the Cork Harbour SPA.

8.5.2.2 SO_2, CO, PM_{10} & $PM_{2.5}$

AERMOD modelling results indicate that ambient ground level concentrations will be below the relevant air quality standards for the protection of human health for sulphur dioxide, carbon monoxide and PM_{10} under maximum and abnormal operation of the facility. Results will also be below the air quality standard for $PM_{2.5}$ and the SO_2 critical level for the protection of vegetation under maximum and abnormal operation of the facility. Thus, no adverse impact on public health or the environment is envisaged to occur under these conditions at or beyond the facility boundary. Emissions at maximum operations equate to ambient

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concentrations (including background concentrations) ranging from 10% - 56% of the respective limit values at the worst-case receptors.

8.5.2.3 TOC, HCl & HF

AERMOD modelling results indicate that the ambient ground level concentrations will be below the relevant air quality guidelines for the protection of human health for TOC (assumed pessimistically to consist solely of benzene), HCl and HF under maximum and abnormal operation of the facility. Thus, no adverse impact on public health or the environment is envisaged to occur under these conditions at or beyond the facility boundary. Emissions at maximum operations equate to ambient concentrations (including background concentrations) for HCl and TOC of only 6% and 22% respectively of the ambient limit values.

HF modelling results indicate that emissions at maximum operations equate to ambient HF concentrations (including background concentrations) which will be 0.7% of the maximum ambient 1-hour limit value and 0.4% of the annual limit value.

8.5.2.4 PCDD / PCDFs (Dioxins/Furans)

Currently, no internationally recognised ambient air quality concentration or deposition standards exist for PCDD/PCDFs (Dioxins/Furans). Both the USEPA and WHO recommended approach to assessing the risk to human health from Dioxins/Furans entails a detailed risk assessment analysis involving the determination of the impact of Dioxins/Furans in terms of the TDI (Tolerable Daily Intake) approach. The WHO currently proposes a maximum TDI of between 1-4 pgTEQ/kg of body weight per day.

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Background levels of Dioxins/Furans occur everywhere and existing levels in the surrounding area have been extensively monitored as part of this study. Monitoring results indicate that the existing levels are similar to rural areas in the UK and Ireland. The additional contribution from the proposed development to levels of Dioxins/Furans is minor, with levels at the maximum off-site receptor to the south of the facility, under maximum and abnormal operation, accounting for only a small fraction of existing levels. Levels at the nearest residential receptor will also be minor, with the annual contribution from the proposed facility accounting for less than 1% of the existing background concentration under maximum operating conditions.

8.5.2.5 PAHs

PAHs modelling results, based on AERMOD, indicate that the ambient ground level concentrations will be below the relevant air quality target value for the protection of human health under maximum and abnormal operation of the facility. Thus, no adverse impact on public health or the environment is envisaged to occur under these conditions at or beyond the facility boundary. Emissions at maximum operations equate to ambient benzo[a]pyrene concentrations (excluding background concentrations) which are 0.8% of the EU annual average target value at the worst-case receptor.

8.5.2.6 Hg

Hg modelling results, based on AERMOD, indicate that the ambient ground level concentrations will be below the relevant air quality standards for the protection of human health under maximum and abnormal operation of the facility. Thus, no

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adverse impact on public health or the environment is envisaged to occur under these conditions at or beyond the facility boundary. Emissions at maximum operations equate to ambient mercury concentrations (including background concentrations) which are only 0.2% of the annual average limit value at the worst-case receptor.

8.5.2.7 Cd and Tl

AERMOD modelling results indicate that the ambient ground level concentrations will be below the relevant air quality standard for the protection of human health for cadmium under maximum and abnormal operation from the facility. Emissions at maximum levels equate to ambient Cd and Tl concentrations (including background concentrations) which are 28% of the EU annual target value for Cd close to the facility boundary (the comparison is made with the Cd limit value as this is more stringent than that for Tl).

8.5.2.8 Sum of As, Sb, Pb, Cr, Co, Cu, Ni, Mn and V

AERMOD modelling results indicate that the ambient ground level concentrations will be below the relevant air quality standards for the protection of human health for arsenic (As), nickel (Ni) and vanadium (V) (the metals with the most stringent limit values) under maximum and abnormal operation emissions from the facility (based on the ratio of metals measured at a Waste to Energy facility in Carranstown, County Meath). Thus, no adverse impact on public health or the environment is envisaged to occur under these conditions at or beyond the facility boundary. Ambient concentrations have been compared to the annual target value for As and Ni and the maximum 1-hour limit value for V as these represent the most stringent limit values for the suite of metals. Emissions at maximum operations equate to ambient As and Ni concentrations (including background concentrations) which are 17% and 38% of the EU annual target value respectively at the worst-case receptor whilst emissions at maximum operations equate to ambient V concentrations (including background concentrations) which are only 0.1% of the maximum 1-hour limit value at the worst-case receptor. Emissions under abnormal operations equate to ambient As and Ni concentrations (including background concentrations) which are 18% and 44% of the annual limit value respectively at the worst-case receptor whilst emissions at maximum operations equate to ambient V concentrations (including background concentrations) which are 0.2% of the maximum 1-hour limit value at the worst-case receptor.

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National Emissions Ceiling

A comparison of the proposed Facility's operations with the obligations under the National Emissions Ceiling Directive indicates the impact of the development is to increase SO_2 levels by 0.25% of the ceiling levels to be complied with in 2020, NO_X levels by 0.38% of the ceiling levels, VOC levels will be increased by 0.03% of the ceiling limits whilst $PM_{2.5}$ levels will be increased by 0.14% of the ceiling limits.

8.5.2.9 AERMOD Modelling Summary

AERMOD modelling results indicate that the ambient ground level concentrations will be below the relevant air quality standards or guidelines for the protection of human health for all parameters under both the maximum and abnormal operation scenarios. The modelling results indicate that the maximum long-term ground level concentration occurs to the south of the facility's boundary. Maximum operations are based on the emission concentrations outlined in EU

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Directive 2010/75/EU. Abnormal operations are based on the emission concentrations outlined in Section 8.1.1.

An appropriate stack height has been selected to ensure that ambient air quality standards for the protection of human health will not be approached even under abnormal operating scenarios. Air dispersion modelling was undertaken in an iterative fashion in order to determine the stack height for the facility. The air dispersion modelling study found that a stack height of 70 metres was appropriate.

The spatial impact of the facility is limited with concentrations falling off rapidly away from the location of the maximum ambient ground level concentration. For example, the short-term concentrations due to process emissions at the nearest residential receptor will be less than 17% of the short-term ambient air quality limit values. The annual average concentration results in an even more dramatic decrease in maximum concentration away from the facility with concentrations from emissions at the proposed facility accounting for less than 2% of the limit value (not including background concentrations) at worst case sensitive receptors near the facility.

8.5.2.10 CALPUFF Modelling

The CALPUFF modelling system has been recommended by the USEPA as a Guideline Model for source-receptor distances of greater than 50km and for use on a case-by-case basis in complex flow situations within 50km(1). CALPUFF has some important advantages over steady-state Gaussian models such as AERMOD in areas of complex meteorology. Firstly, AERMOD, being a steady state straight line plume model cannot respond to the terrain-induced spatial variability in wind fields. Secondly, as AERMOD is based on a single-station wind observation, the wind fields do not vary spatially within the modelling domain. Thirdly, AERMOD cannot treat calm conditions and does not calculate concentrations during these hours. Because of these limitations, CALPUFF would be expected to more accurately reflect the meteorological and dispersion characteristics of the modelling domain and thus lead to more accurate ambient air concentrations. As shoreline fumigation was also raised as a possible concern in the previous application and AERMOD does not have the capability to model this phenomenon, CALPUFF (version 6.42) was selected as the most appropriate model which could assess all possible meteorological conditions within the one air dispersion model.

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8.5.2.11 MM5 / CALMET Set-Up

Meteorological data is an important input into the air dispersion model. The local airflow pattern will be greatly influenced by the geographical location. Important features will be the location of hills and valleys or land-water-air interfaces and whether the existing and proposed facilities are located in simple or complex terrain.

Meteorological data for the assessment was based on various sources of information. Firstly, the Fifth Generation Penn State/NCAR (National Centre for Atmospheric Research) Mesoscale Model (known as MM5) was used for the years 2006 and 2007. The model output consists of hourly values of wind speed, wind direction, temperature and pressure on a grid size of 100 km x 100 km centred in Ringaskiddy. The data had 18 vertical levels with a base level of 15 m and a horizontal resolution of 12 km.

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CALMET (version 6.5.0) meteorological pre-processor used the three-dimensional MM5 data along with all available surface observations within the 100km x 100km grid. As no upper air observations station were located within or near to the modelling domain, upper air data was obtained from MM5 and extrapolation of surface observations. One synoptic meteorological station operated by Met Eireann was identified near the site – Cork Airport. Data collection of greater than 90% for all parameters is required for air dispersion modelling. Cork Airport fulfils this requirement. A second surface station operated by Indaver as part of the current application was available for the year 2007 and thus was also used in the assessment. Buoy data for the stations M3 and M5 for 2006 and 2007 was obtained from the Marine Institute.

The CALMET modelling domain covered an area of 100 km x 100 km centred in Ringaskiddy. The CALMET wind field data had 11 vertical levels with a base level of 10 m and a horizontal resolution of 1 km. The eleven vertical levels are at 20, 40, 80, 160, 320, 650, 1000, 1500, 2200, 3000 and 4000 metres.

8.5.2.12 CALPUFF Set-Up

Emissions from the proposed site have been modelled using the CALPUFF dispersion model (Version 7.2.1) which has been developed by Earth Tech (now part of TRC Companies, Inc) and has been approved by the U.S. Environmental Protection Agency (USEPA)[(1)] for long-range transport and on a case-by-case basis for near-field (less than 50 km) applications involving complex meteorological conditions. The model is a non-steady-state Lagrangian puff model used to assess pollutant concentrations associated with a wide range of sources including industrial sources.

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A receptor grid measuring 100 km by 100 km with the site at the centre was mapped out with terrain information at each receptor, derived from Shuttle Radar Topography Mission (SRTM) with 30 m resolution as input into the model. The model receptor grid entailed a total of 49,980 receptor points at which ambient ground levels concentrations were determined for each pollutant (inner grid at 25 m resolution, middle at 100 m resolution and outer grid at 500 m grid resolution as shown in Figure 8.5).

8.5.2.13 CALPUFF Modelling Results

The main study conclusions are presented below for each substance in turn with a graphical summary of results in comparison to the previously obtained AERMOD results presented in Figures 8.6 and 8.7. CALPUFF modelling was undertaken for both 2006 and 2007 with the worst-case result for either year reported for each averaging period.

8.5.2.14 NO_2 & NO_X

NO_2 modelling results, using CALPUFF, indicate that the ambient ground level concentrations will be below the relevant air quality standards with emissions at maximum operations leading to ambient NO_2 concentrations (including background concentrations) which are 69% of the maximum ambient 1-hour limit value (measured as a 99.8th%ile) and 32% of the annual average limit value at the respective worst-case receptors.

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8.5.2.15 SO_2, CO, PM_{10} & $PM_{2.5}$

CALPUFF modelling results indicate that ambient ground level concentrations will be below the relevant air quality standards for the protection of human health for sulphur dioxide, carbon monoxide and PM_{10} / $PM_{2.5}$ under maximum and abnormal operation of the facility. Emissions at maximum operations equate to ambient concentrations (including background concentrations) ranging from 10% - 50% of the respective limit values at the worst-case receptors.

8.5.2.16 TOC, HCl & HF

CALPUFF modelling results indicate that the ambient ground level concentrations will be below the relevant air quality guidelines for the protection of human health for TOC (assumed pessimistically to consist solely of benzene), HCl and HF under maximum and abnormal operation of the facility. Emissions at maximum operations equate to ambient concentrations (including background concentrations) for HCl and TOC of only 14% and 22% respectively of the ambient limit values.

HF modelling results indicate that emissions at maximum operations equate to ambient HF concentrations (including background concentrations) which will be 5% of the maximum ambient 1-hour limit value and 0.3% of the annual limit value.

8.5.2.17 PCDD / PCDFs (Dioxins/Furans)

Based on CALPUFF modelling results, the contribution from the facility is minor, with levels at the worst-case receptor to the south of the Facility, under maximum and abnormal operation, accounting for only a small fraction of existing levels. Levels at the nearest residential receptor will be minor, with the annual contribution from the proposed facility accounting for less than 1% of the existing background concentration under maximum operating conditions.

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8.5.2.18 PAHs

PAHs modelling results, using CALPUFF, indicate that the ambient ground level concentrations will be below the relevant air quality target value for the protection of human health under maximum and abnormal operation of the Facility. Emissions at maximum operations equate to ambient benzo[*a*]pyrene concentrations (excluding background concentrations) which are only 0.5% of the EU annual average target value at the worst-case receptor.

8.5.2.19 Hg

CALPUFF modelling results indicate that the ambient ground level concentrations of Hg will be below the relevant air quality standards for the protection of human health under maximum and abnormal operation of the facility. Emissions at maximum operations equate to ambient mercury concentrations (including background concentrations) which are only 0.1% of the annual average limit value at the worst-case receptor.

8.5.2.20 Cd and Tl

CALPUFF modelling results indicate that the ambient ground level concentrations will be below the relevant air quality standard for the protection of human health for cadmium under maximum and abnormal operation from the facility.

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Emissions at maximum levels equate to ambient Cd and Tl concentrations (including background concentrations) which are 25% of the EU annual target value for Cd close to the facility boundary (the comparison is made with the Cd limit value as this is more stringent than that for Tl).

8.5.2.21 Sum of As, Sb, Pb, Cr, Co, Cu, Ni, Mn and V

CALPUFF modelling results indicate that the ambient ground level concentrations will be below the relevant air quality standards for the protection of human health for arsenic (As), nickel (Ni) and vanadium (V) (the metals with the most stringent limit values) under maximum and abnormal operation emissions from the facility (based on the ratio of metals measured at a Waste-to-Energy facility in Carranstown, County Meath). Ambient concentrations have been compared to the annual target value for As and Ni and the maximum 1-hour limit value for V as these represent the most stringent limit values for the suite of metals. Emissions at maximum operations equate to ambient As and Ni concentrations (including background concentrations) which are 17% and 37% of the EU annual target value respectively at the worst-case receptor whilst emissions at maximum operations equate to ambient V concentrations (including background concentrations) which are only 0.5% of the maximum 1-hour limit value at the worst-case receptor.

8.5.2.22 Modelling Conclusions

Based on the emission guidelines outlined in Council Directive 2010/75/EU, detailed air dispersion modelling has shown that the most stringent ambient air quality standards for the protection of human health are not exceeded either as a result of operating under maximum or abnormal operating conditions.

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The modelling results, using both the USEPA regulatory model AERMOD and the more advanced CALPUFF model, indicate that the location of the maximum ambient ground level concentration occurs at or near the facility's southern boundary. The spatial impact of the facility is limited with concentrations falling off rapidly away from the maximum peak. For example, the short-term limit values at the nearest residential receptor will be less than 17% of the short-term ambient air quality limit values. The annual average concentration has an even more dramatic decrease in maximum concentration away from the facility with concentrations from emissions at the proposed facility accounting for less than 2% of the limit value (not including background concentrations) at worst case sensitive receptors near the facility.

In the surrounding areas of Cobh, Carrigaline and Monkstown, levels are significantly lower than most background sources with the concentrations from emissions at the proposed facility accounting for less than 1% of the annual limit values for the protection of human health for all pollutants under maximum operations of the facility.

In terms of Ireland's obligations under the Gothenburg Protocol and the POPs Convention, the impact of the facility will not be significant.

8.6 Mitigation Measures

In order to sufficiently ameliorate any potential negative impacts on the air environment, a schedule of measures has been formulated for both construction and operational phases associated with the proposed facility.

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8.6.1 Construction Phase

The potential for dust to be emitted depends on the type of construction activity being carried out in conjunction with environmental factors including levels of rainfall, wind speeds and wind direction. The potential for impact from dust depends on the distance to potentially sensitive locations and whether the wind can carry the dust to these locations. The majority of dust produced will be deposited close to the generated source. A dust minimisation plan will be formulated for the construction phase of the project, as construction activities are likely to generate some dust emissions.

In order to ensure that no dust nuisance occurs, a series of measures will be implemented.

- Hard surface roads will be swept to remove mud and aggregate materials from their surface while any un-surfaced roads will be restricted to essential site traffic only apart from the contractor's car park which will be hardcore only.
- Furthermore, any road that has the potential to give rise to fugitive dust must be regularly watered, as appropriate, during dry and/or windy conditions.
- Vehicles using site roads will have their speed restricted, and this speed restriction must be enforced rigidly. On any un-surfaced site road, this will be 20 kph, and on hard surfaced roads as site management dictates.
- Vehicles delivering material with dust potential (soil, aggregates) will be enclosed or covered with tarpaulin at all times to restrict the escape of dust.
- Wheel washing facilities will be provided for vehicle exiting site in order to ensure that mud and other wastes are not tracked onto public roads.
- Public roads outside the site will be regularly inspected for cleanliness, and cleaned as necessary.
- Material handling systems and site stockpiling of materials will be designed and laid out to minimise exposure to wind. Water misting or sprays will be used as required if particularly dusty activities are necessary during dry or windy periods.
- During movement of materials both on and off-site, trucks will be stringently covered with tarpaulin at all times. Before entrance onto public roads, trucks will be adequately inspected to ensure no potential for dust emissions.

At all times, these procedures will be strictly monitored and assessed. In the event of significant dust deposition occurring outside the site boundary, movements of materials likely to raise dust would be curtailed and satisfactory procedures implemented to rectify the problem before the resumption of construction operations.

8.6.2 Operational Phase

A number of measures have been incorporated into the design of the resource recovery centre to ensure that emissions from the plant do not exceed regulatory emission limit values as outlined in Industrial Emissions Directive 2010/75/EU. In addition, the stack height has been designed in an iterative fashion in order to ensure that ambient ground level concentrations are minimised.

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Air modelling predictions indicate that ambient air quality levels from the proposed facility will be within the ambient air quality standards at all locations beyond the site boundary, based on maximum and abnormal operating conditions. Thus no specific additional mitigation measures are required during the operational phase of the facility.

8.7 Residual Impacts

This section summarises the likely air quality impact associated with the proposed development, taking into account the mitigation measures.

8.7.1 Construction Phase

During the construction phase of the project there may be some impact on nearby properties due to dust emissions from the construction site and other activities. However, due to the formulation of an effective dust minimisation plan, it is considered that the residual impact will be slight.

8.7.2 Operational Phase

Based on the results of air dispersion modelling of process emissions, the air quality impact of the proposed facility will not be significant.

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8.8 References

[1] USEPA (2005) *Guidelines on Air Quality Models, Appendix W to Part 51, 40 CFR Ch.1*

[2] USEPA (2004) *Minimum Meteorological Data Requirements For AERMOD – Study & Recommendations", 1998,* USEPA

[3] USEPA (2004) AERMOD Description of Model Formulation

[4] Auer Jr, (1978) *Correlation of Land Use and Cover with Meteorological Anomalies,* Journal of Applied Meteorology 17(5):636-643

[5] UK DEFRA (2009) *Part IV of the Environment Act 1995: Local Air Quality Management,* LAQM. TG(09)

[6] Fletcher & Brown (2010) *Interaction of an Eulerian Flue Gas Plume with Wind Turbines,* American Institute Of Aeronautics and Astronautics

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N — NO_2

B — Benzene

S — SO_2

PM — $PM_{10}/PM_{2.5}$

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Reference

14_7880AR01

Figure 8.1a

Diffusion Tube and $PM_{10}/PM_{2.5}$ Monitoring Locations (Ringaskiddy)

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Diffusion Tube and $PM_{10}/PM_{2.5}$ Monitoring Locations (Ringaskiddy)

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Figure 8.1b
Diffusion Tube Monitoring Locations (Monkstown and Cobh)

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Diffusion Tube Monitoring Locations (Monkstown and Cobh)

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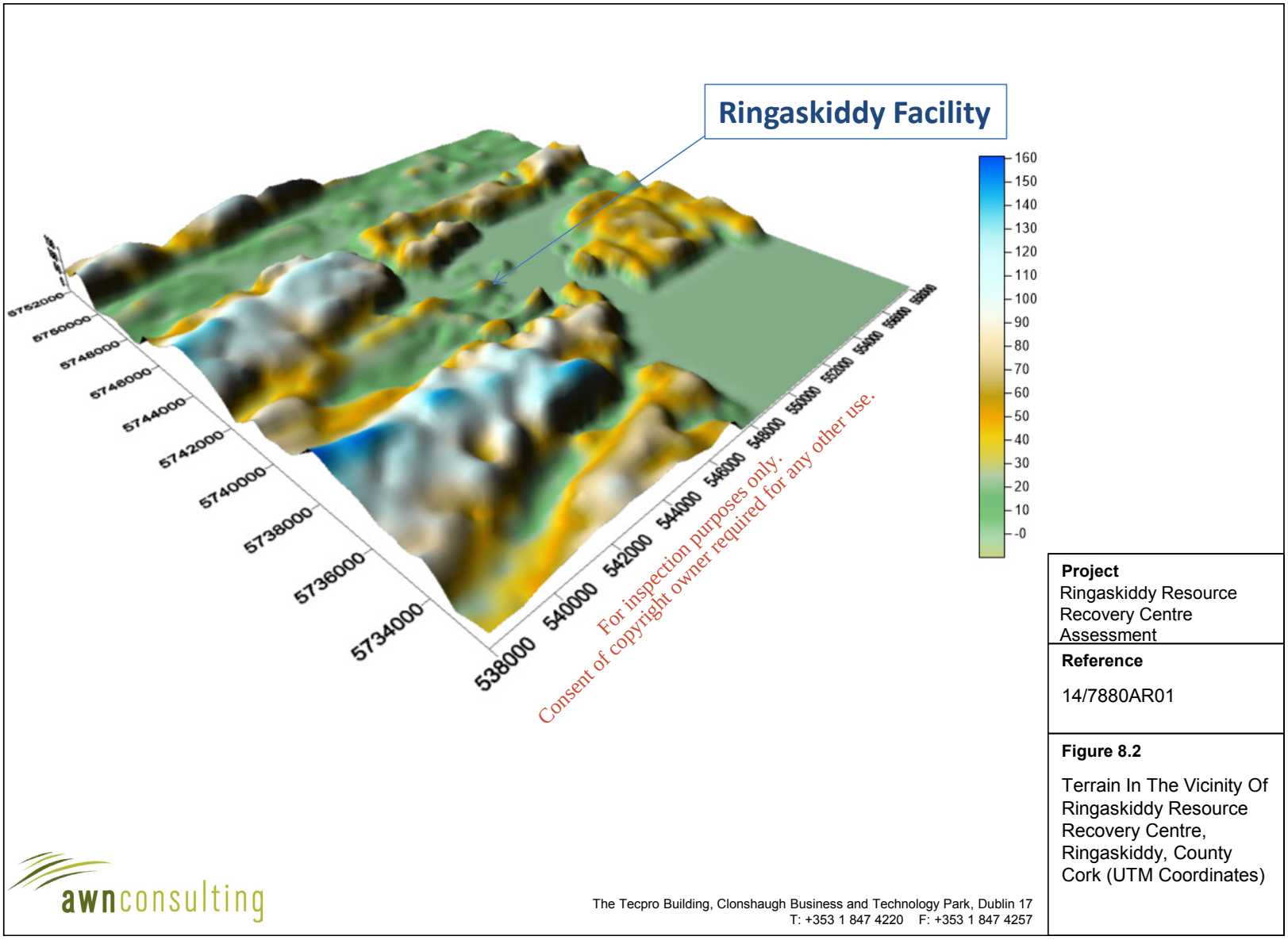

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Figure 8.2
Terrain In The Vicinity Of Ringaskiddy Resource Recovery Centre, Ringaskiddy, County Cork (UTM Coordinates)

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SRTM Terrain for AERMAP Model

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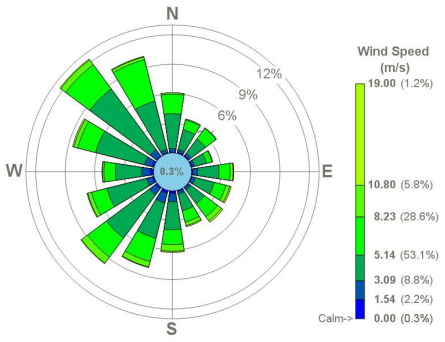
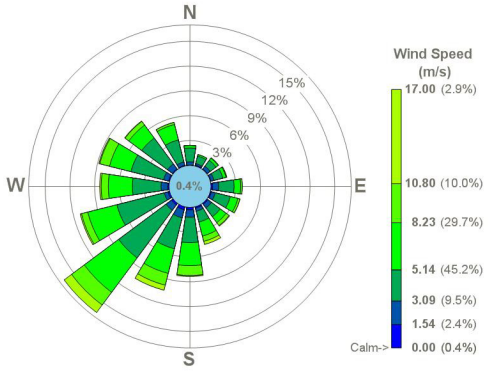
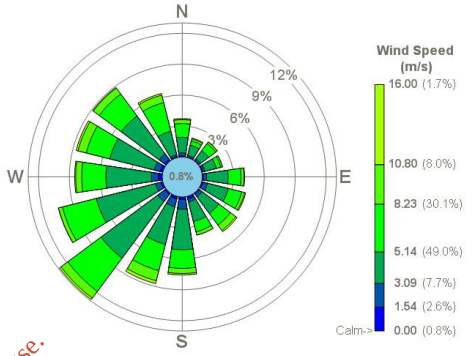
Cork Airport 2010



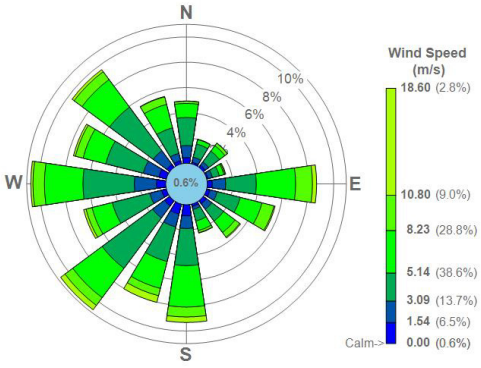
Cork Airport 2011



Cork Airport 2012



Cork Airport 2013



Cork Airport 2014

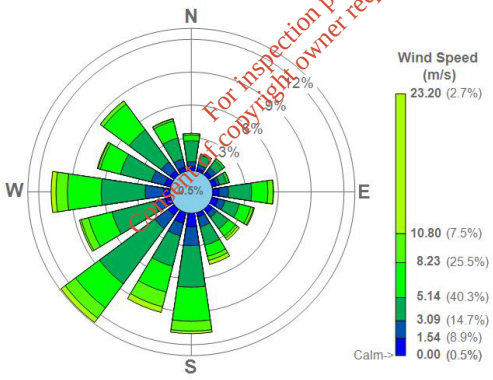


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Figure 8.3
Cork Airport
Windrose
2010 - 2014

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Cork Airport Windrose 2008-2012

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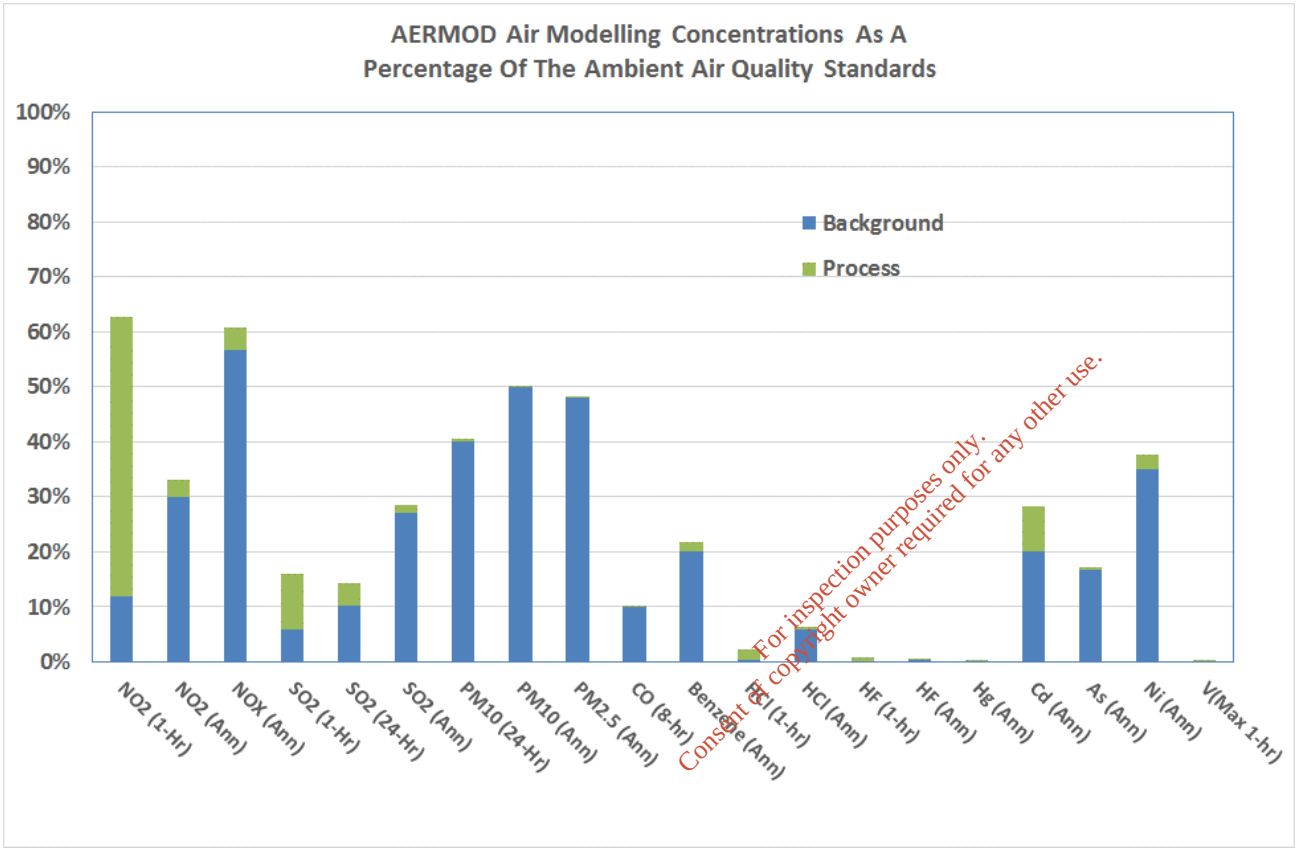

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Figure 8.4
AERMOD Modelling Results (as a % of Ambient Limit Values) For The Ringaskiddy Resource Recovery Centre, County Cork

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AERMOD Modelling Results (as a % of Ambient Limit Values)

Ringaskiddy Resource Recovery Centre

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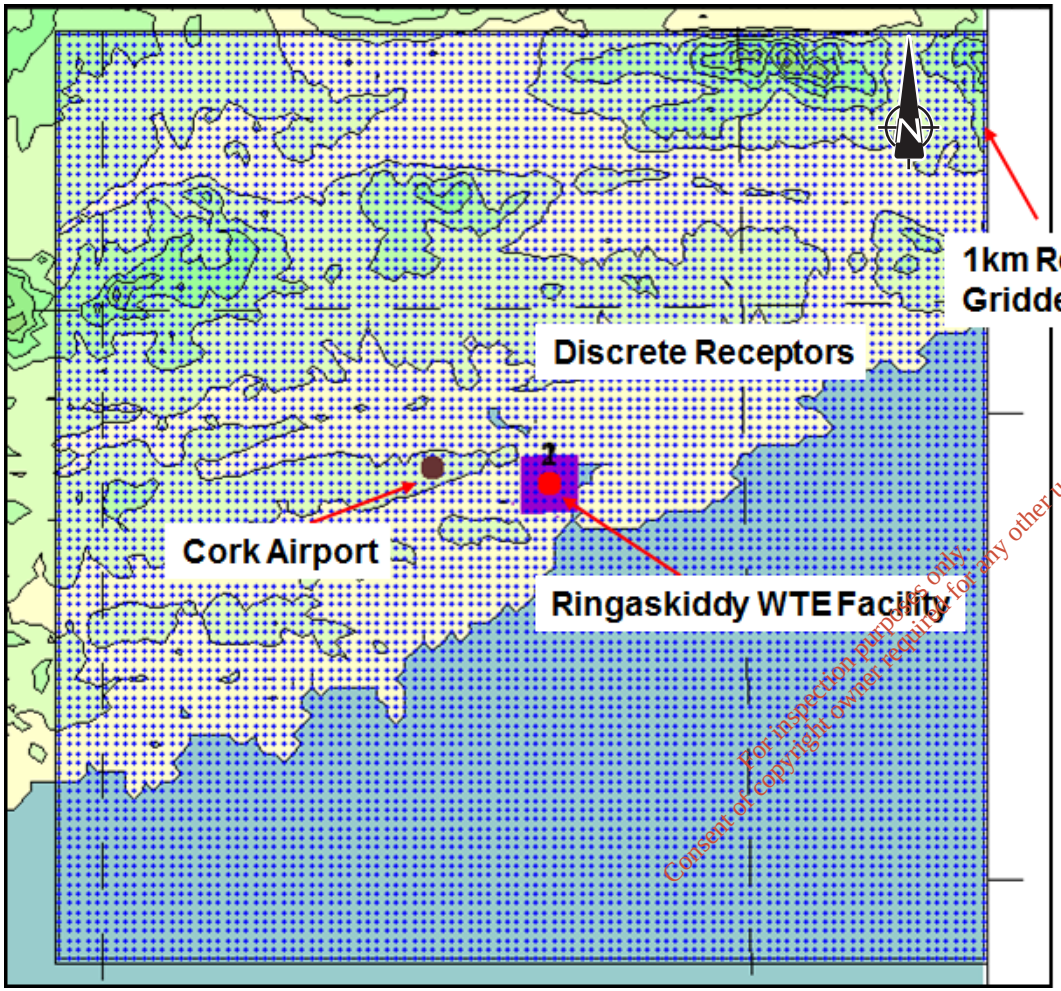

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Figure 8.5
CALPUFF Modelling Grid For The Ringaskiddy Resource Recovery Centre, Ringaskiddy, County Cork

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CALPUFF Modelling Grid

Ringaskiddy Resource Recovery Centre

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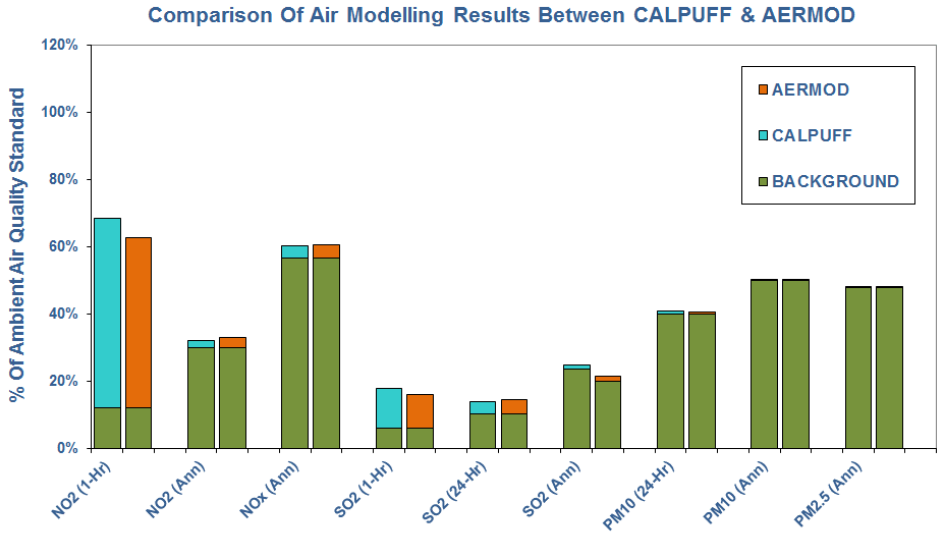

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Figure 8.6
Comparison Between AERMOD & CALPUFF Modelling Results (as a % of Ambient Limit Values) For The Ringaskiddy Resource Recovery Centre, County Cork

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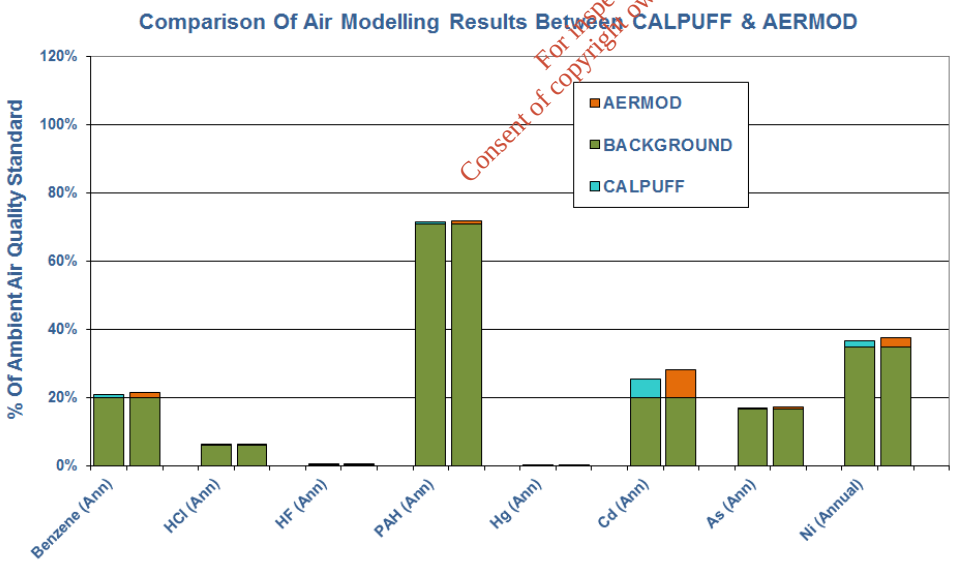

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Figure 8.7
Comparison Between AERMOD & CALPUFF Modelling Results (as a % of Ambient Limit Values) For The Ringaskiddy Resource Recovery Centre, County Cork

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Comparison Between AERMOD & CALPUFF Modelling Results

Ringaskiddy Resource Recovery Centre

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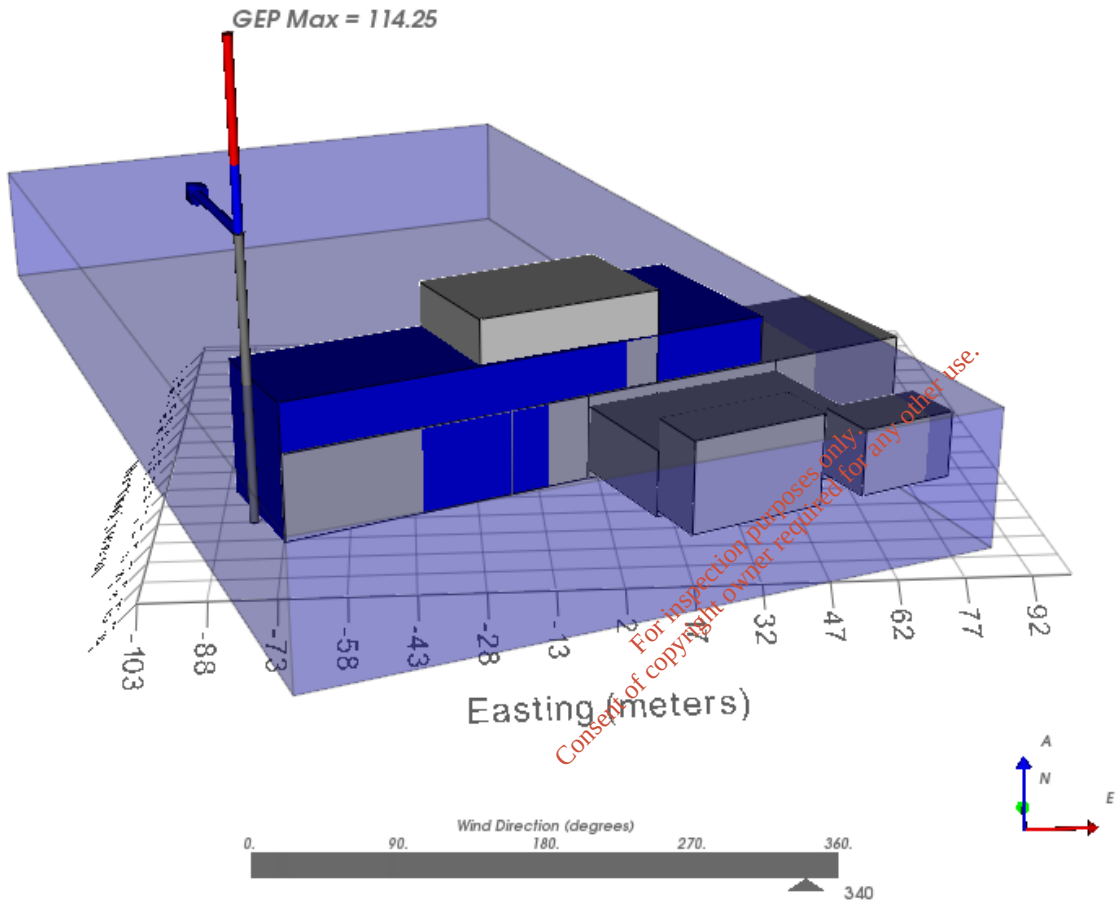

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Figure 8.8
Example Of Building Downwash At The Ringaskiddy Resource Recovery Centre, Ringaskiddy, County Cork

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Example Of Building Downwash

Ringaskiddy Resource Recovery Centre

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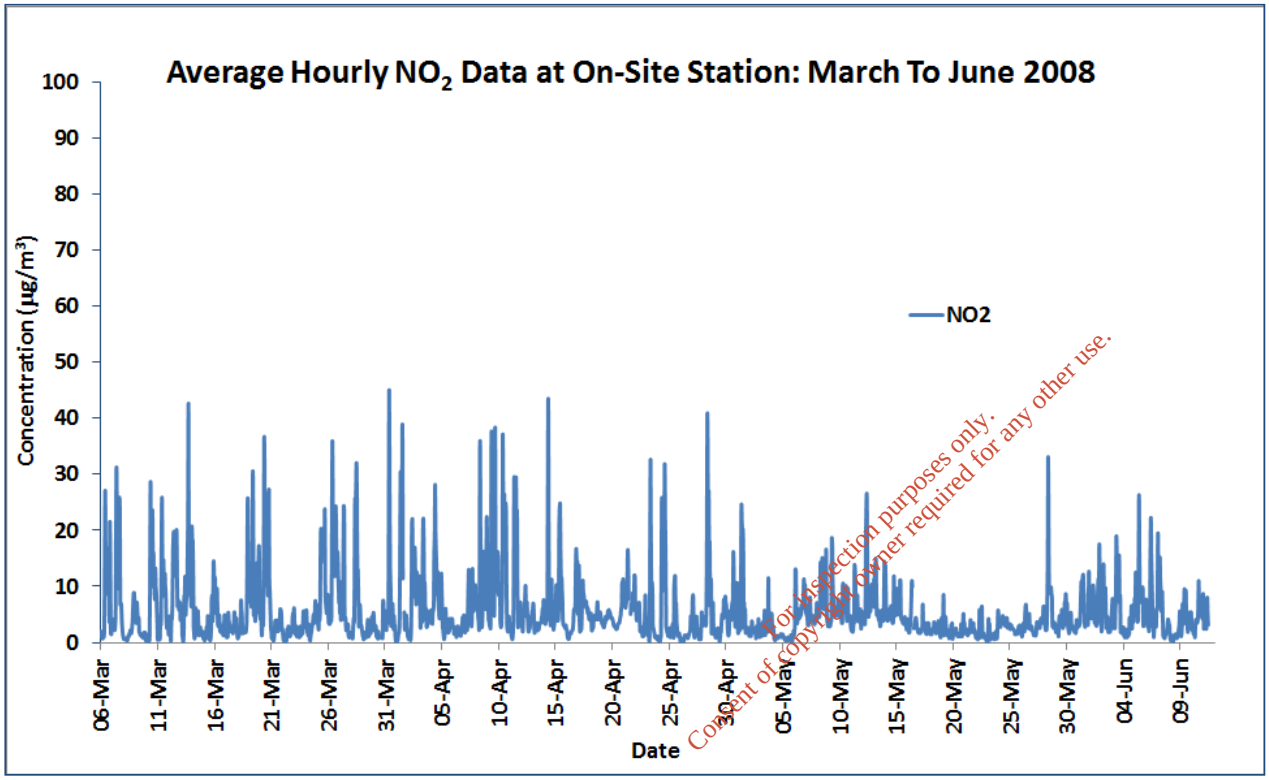

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Figure 8.9
Average Hourly NO_2 Concentration ($\mu g/m^3$) March – June 2008 At The Ringaskiddy Resource Recovery Centre, Ringaskiddy, County Cork

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Average Hourly NO_2 Concentration (mg/m^3) March – June 2008

Ringaskiddy Resource Recovery Centre

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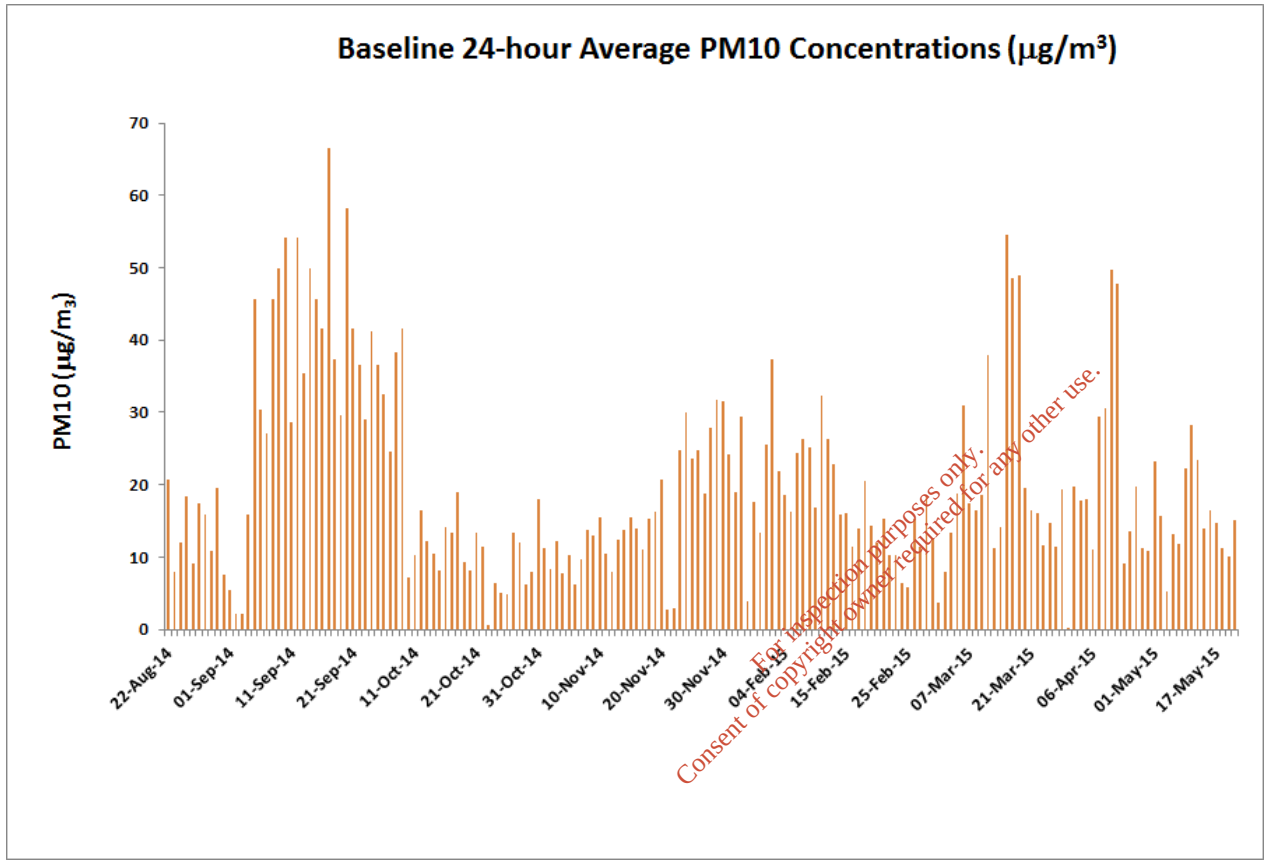

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Figure 8.10

Average 24-Hourly PM_{10} Concentration ($\mu g/m^3$) August 2014 – May 2015 At The Ringaskiddy Resource Recovery Centre, Ringaskiddy, County Cork

This graphic is for diagrammatic purposes only. No measurement to be taken.

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Average 24-Hourly PM10 Concentration (mg/m^3) August 2014 – May 2015

Ringaskiddy Resource Recovery Centre

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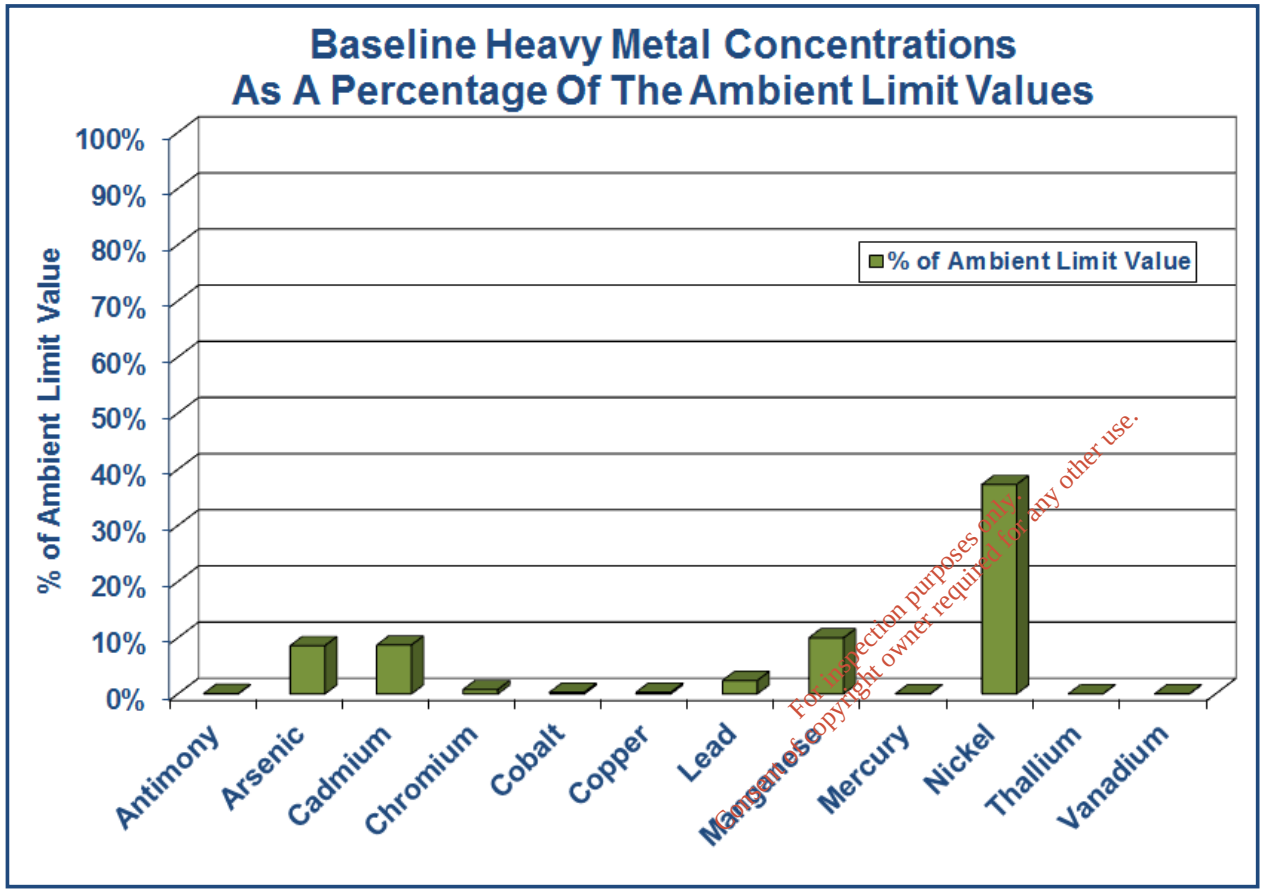

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Figure 8.11
Baseline Ambient Heavy Metal Results (as a % of Ambient Limit Values) August 2014 – May 2015 At The Ringaskiddy Resource Recovery Centre, County Cork

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Baseline Ambient Heavy Metal Results (as a % of Ambient Limit Values) August 2014 – May 2015

Ringaskiddy Resource Recovery Centre

238129-00 | January 2016 | Figure 8.11

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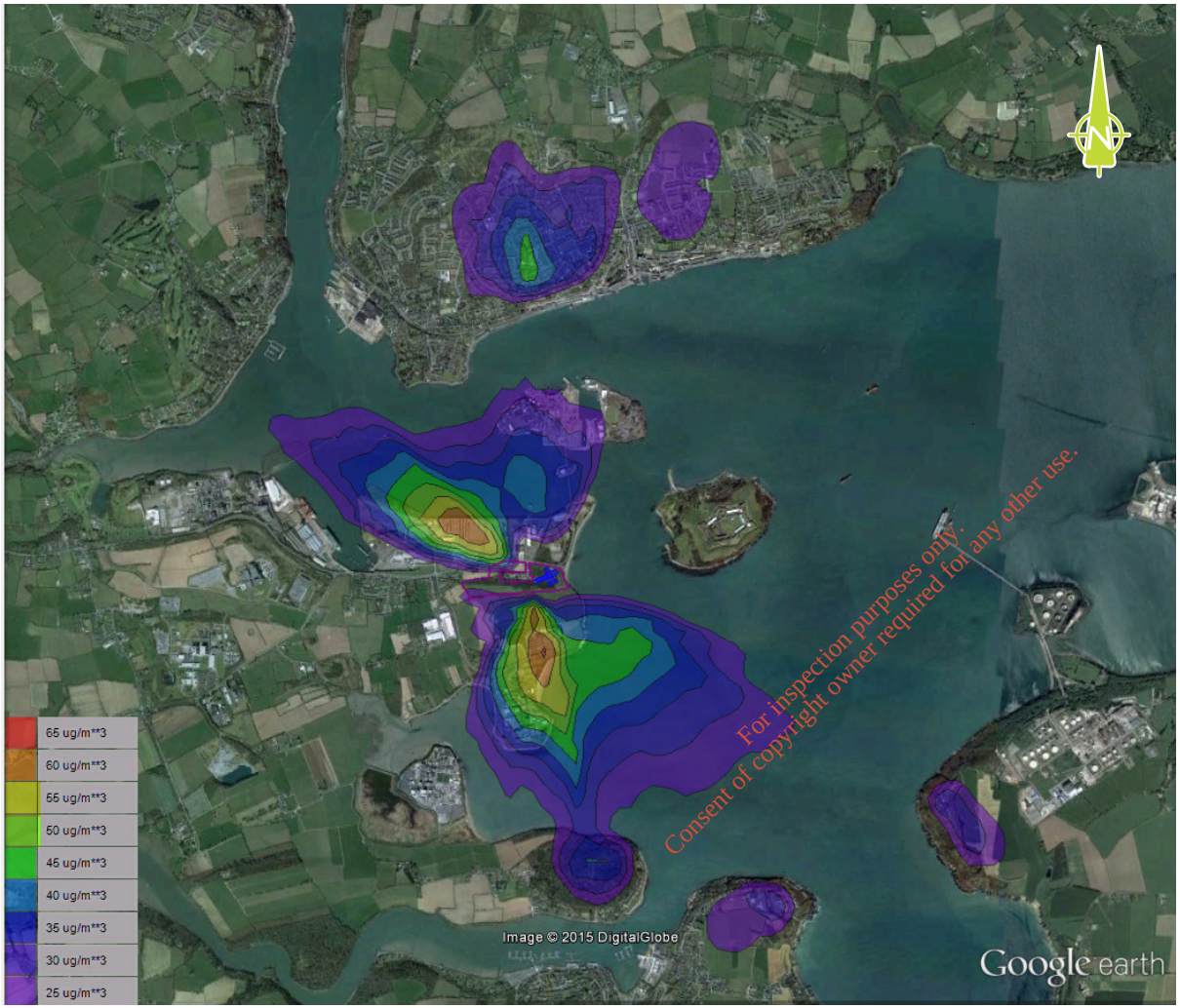

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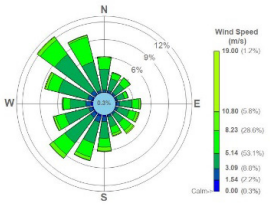

Background Mapping from Google Earth

99.8th%ile of 1-Hour Mean NO_X Concentrations (excluding background) Maximum Concentration = 72.1 µg/m³

Boundary Of Facility

Scale
1:45,000

N

Project
Ringaskiddy Resource Recovery Centre Assessment

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Figure 8.12
99.8th%ile of 1-Hour NO_X Concentrations (µg/m³) (Year 2010)

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99.8th%ile of 1-Hour NO_X Concentrations (µg/m³) (Year 2010)

Ringaskiddy Resource Recovery Centre

238129-00 | January 2016 | Figure 8.12

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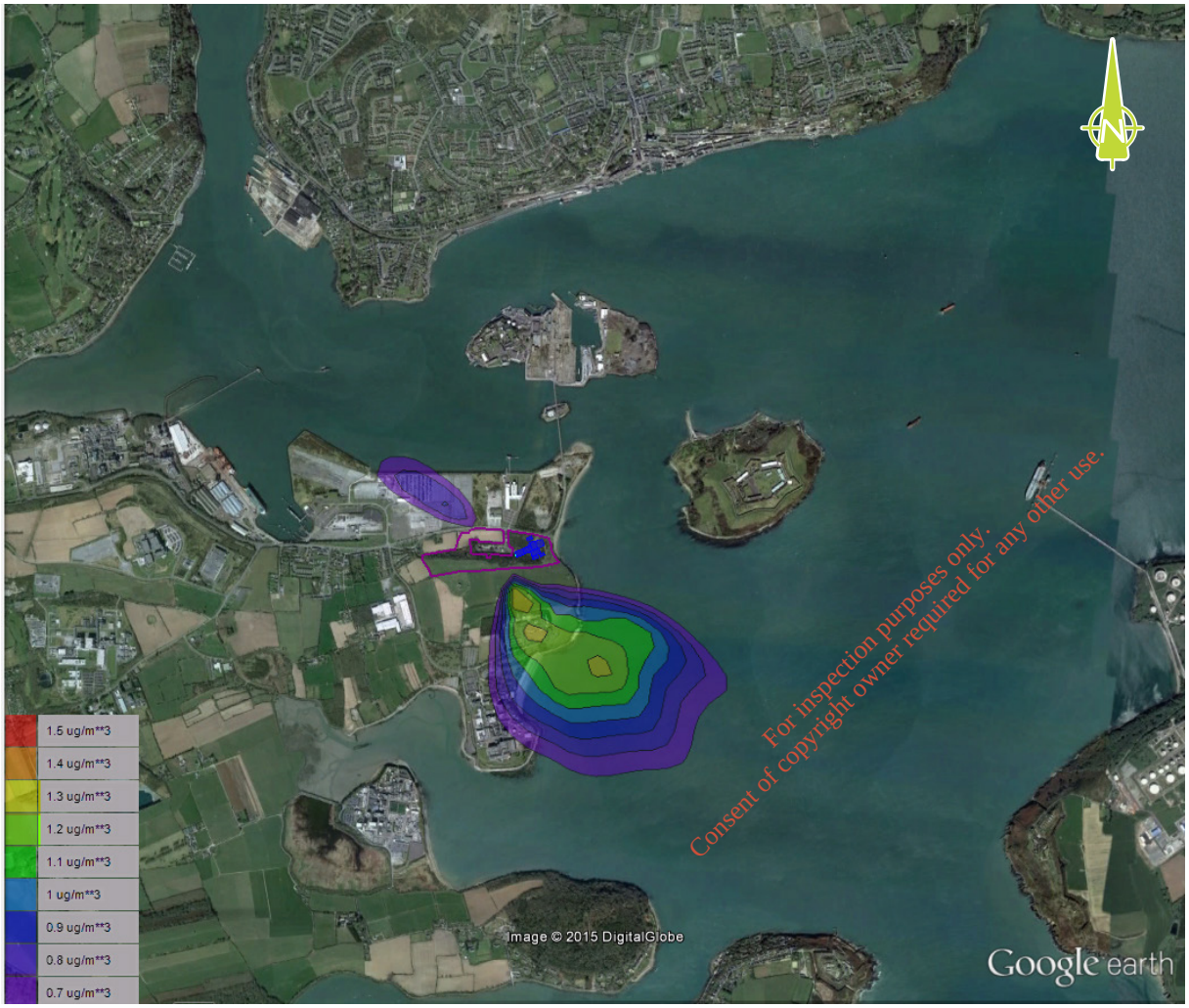

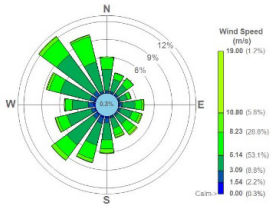

Background Mapping from Google Earth

Annual Mean NO_X Concentrations (excluding background)
Maximum Concentration = 1.7 μg/m^3

Boundary Of Facility

Scale
1:35,000

N

Project
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Figure 8.13
Annual Mean NO_X Concentrations (μg/m^3) (Year 2010)

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Annual Mean NO_X Concentrations (μg/m^3) (Year 2010)

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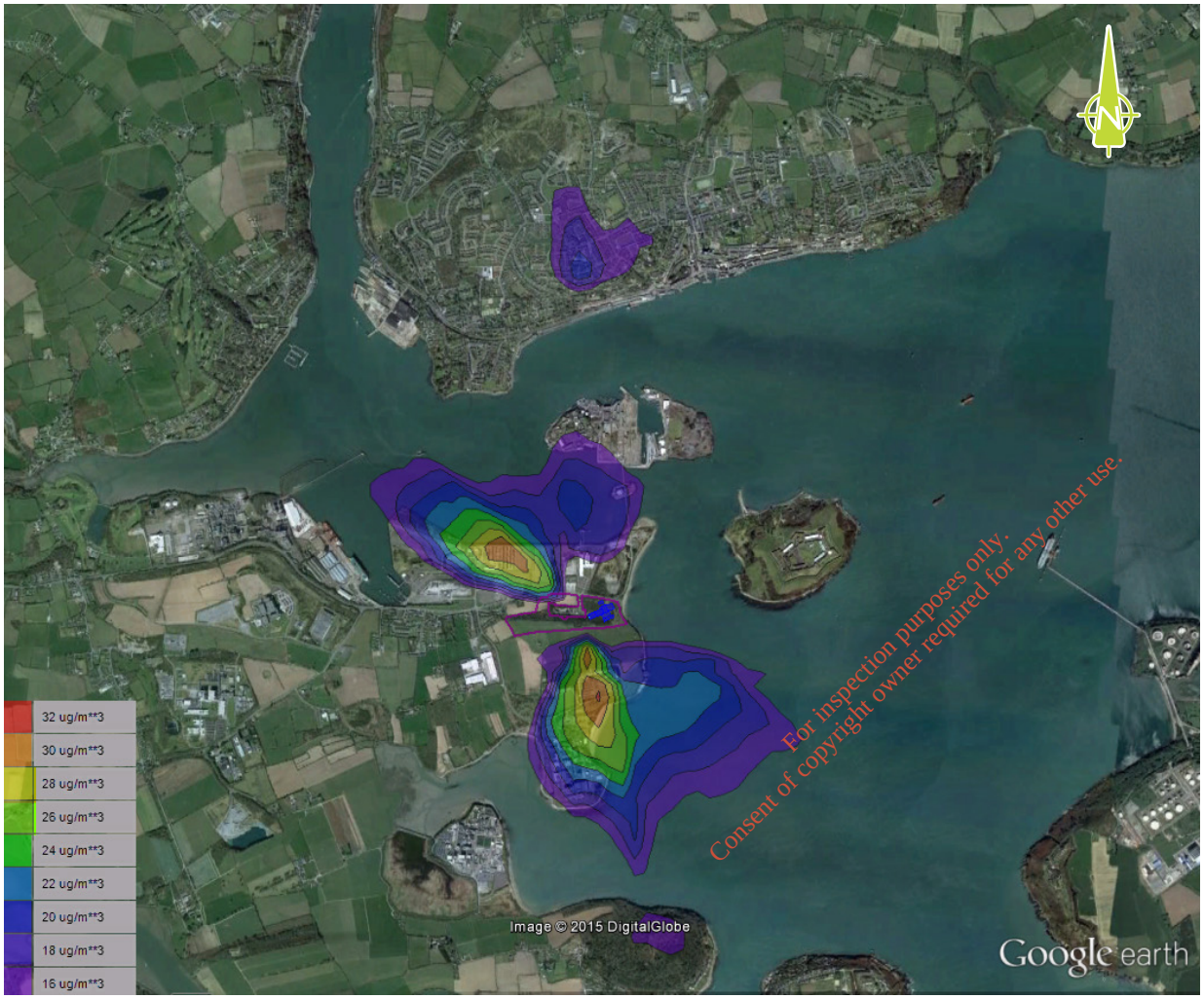

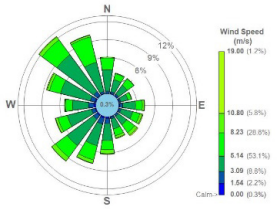

Background Mapping from Google Earth

99.7th%ile of 1-Hour Mean SO_2 Concentrations (excluding background) Maximum Concentration = 35.7 µg/m³

Boundary Of Facility

Scale
1:40,000

N

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Figure 8.14
99.7th%ile of 1-Hour SO_2 Concentrations (µg/m³) (Year 2010)

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99.7th%ile of 1-Hour SO_2 Concentrations (µg/m³) (Year 2010)

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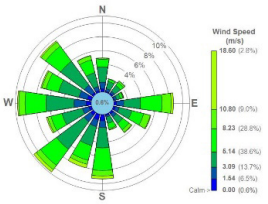

Background Mapping from Google Earth

99.2th%ile of 24-Hour Mean SO_2 Concentrations (excluding background) Maximum Concentration = 5.2 µg/m³

Boundary Of Facility

Scale
1:30,000

N

Project
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Figure 8.15
99.2th%ile of 24-Hour SO_2 Concentrations (µg/m³) (Year 2013)

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99.2th%ile of 24-Hour SO_2 Concentrations (µg/m³) (Year 2013)

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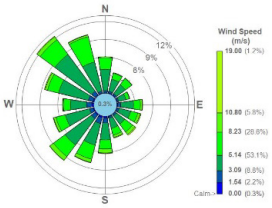

Background Mapping from Google Earth

90th%ile of 24-Hour Mean PM_{10} Concentrations (excluding background) Maximum Concentration = 0.30 µg/m³

Boundary Of Facility

Scale
1:35,000

N

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Figure 8.16
90th%ile of 24-Hour PM_{10} Concentrations (µg/m³) (Year 2010)

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90th%ile of 24-Hour PM_{10} Concentrations (µg/m³) (Year 2010)

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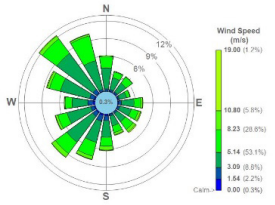

Background Mapping from Google Earth

Annual Mean PM_{10} Concentrations (excluding background)
Maximum Concentration = 0.083 µg/m^3

Boundary Of Facility

Scale
1:50,000

N

Project
Ringaskiddy Resource Recovery Centre Assessment

Reference
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Figure 8.17
Annual Mean PM_{10} Concentrations (µg/m^3) (Year 2010)

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Annual Mean PM_{10} Concentrations (µg/m^3) (Year 2010)

Ringaskiddy Resource Recovery Centre

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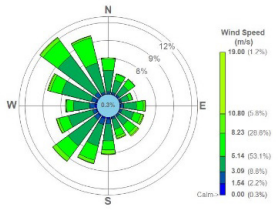

Background Mapping from Google Earth

Annual Mean TOC (as benzene) Concentrations (excluding background) Maximum Concentration = 0.083 µg/m^3

Boundary Of Facility

Scale
1:50,000

N

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Ringaskiddy Resource Recovery Centre Assessment

Reference
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Figure 8.18

Annual Mean TOC (as benzene) Concentrations (µg/m^3) (Year 2010)

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Annual Mean TOC (as benzene) Concentrations (µg/m^3) (Year 2010)

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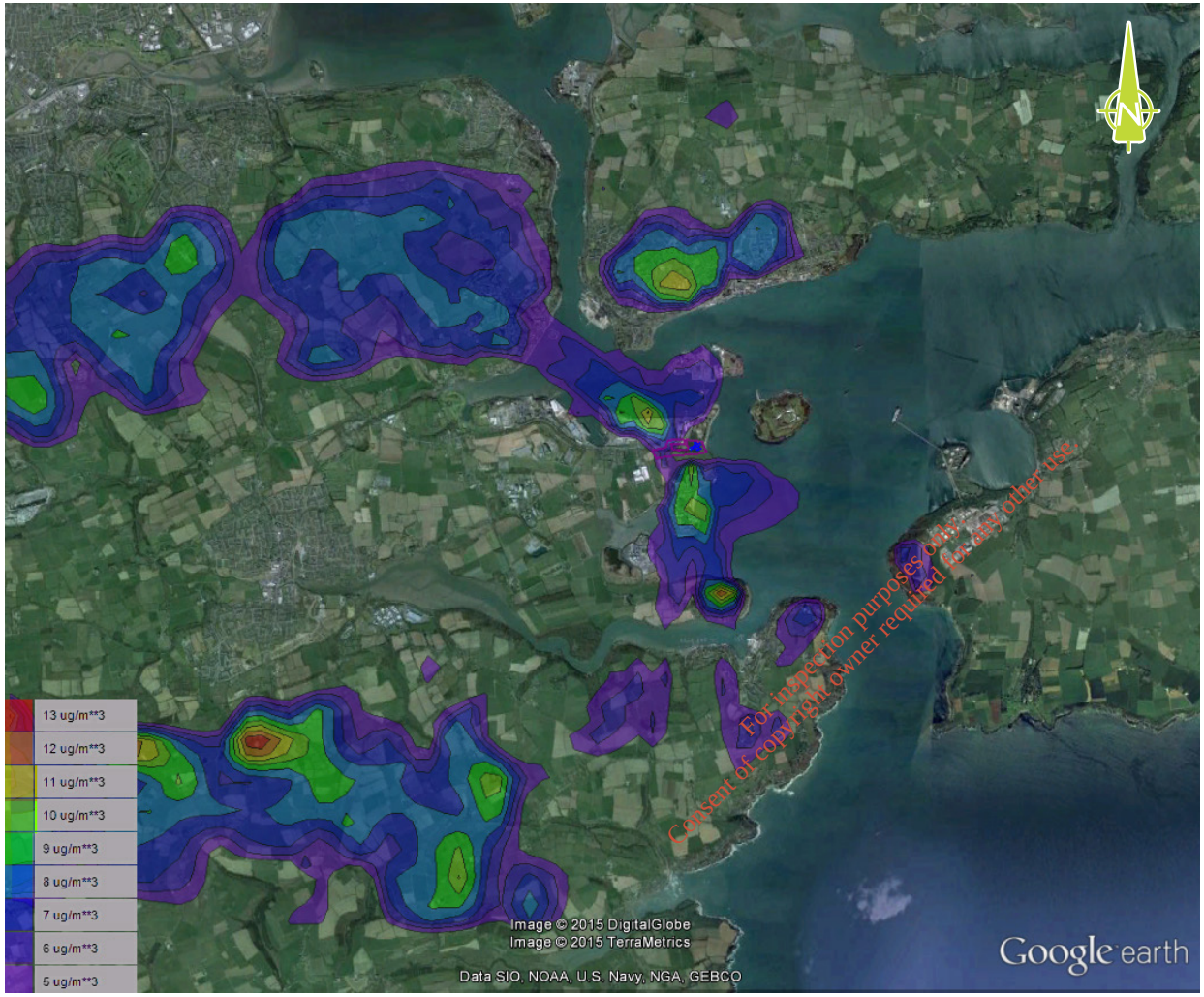

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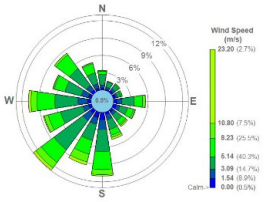

Background Mapping from Google Earth

Maximum 1-Hour Mean HCl Concentrations (excluding background) Maximum Concentration = 15.7 µg/m^3

Boundary Of Facility

Scale
1:80,000

N

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Figure 8.19
Maximum 1-Hour HCl Concentrations (µg/m^3) (Year 2014)

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Maximum 1-Hour HCl Concentrations (µg/m^3) (Year 2014)

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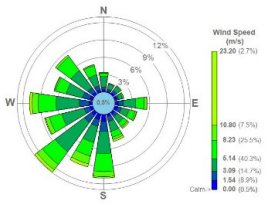

Background Mapping from Google Earth

Maximum 1-Hour Mean HF Concentrations (excluding background) Maximum Concentration = 1.04 μg/m³

Boundary Of Facility

Scale
1:80,000

N

Project
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Reference
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Figure 8.20

Maximum 1-Hour HF Concentrations (μg/m³) (Year 2014)

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Maximum 1-Hour HF Concentrations (μg/m³) (Year 2014)

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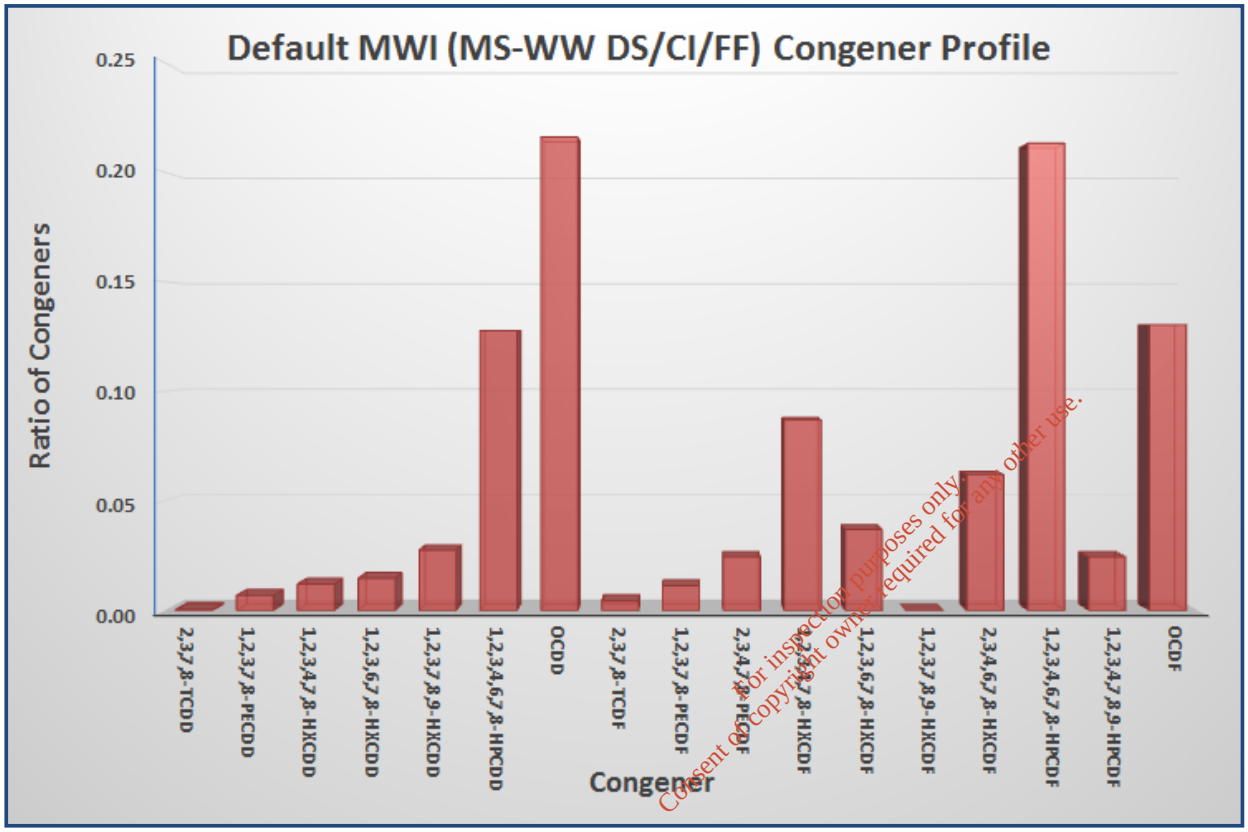

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Figure 8.21
Default Municipal Waste Incinerator Congener Profile

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Default Municipal Waste Incinerator Congener Profile

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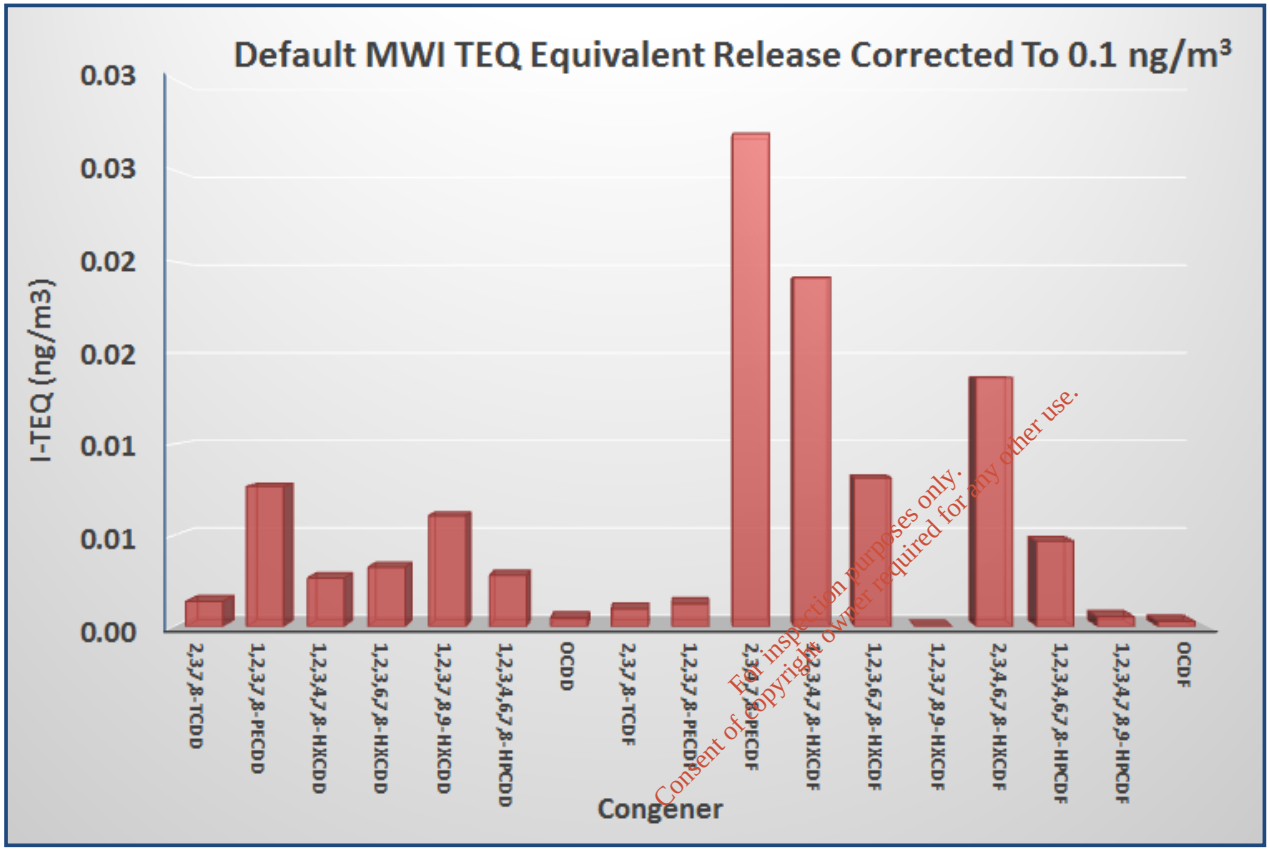

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Figure 8.22
Default Municipal Waste Incinerator Congener Profile Corrected To 0.1 ng/m³ TEQ

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Default Municipal Waste Incinerator Congener Profile Corrected To 0.1 ng/m³ TEQ

Ringaskiddy Resource Recovery Centre

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EPA Export 20-07-2019:03:56:34

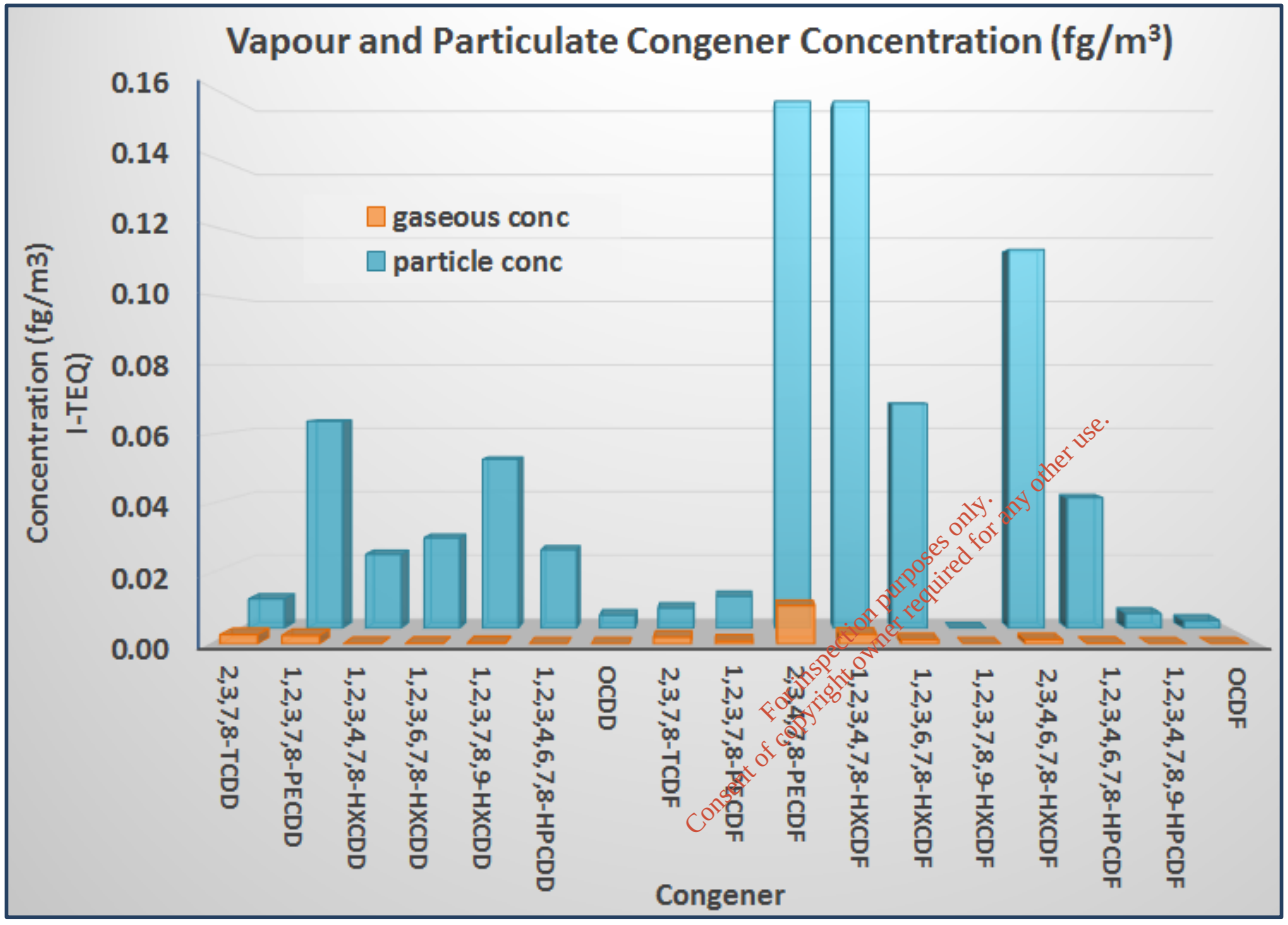

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Figure 8.23
Vapour & Particulate Dioxin Congener Concentration (fg/m³) – Maximum Operations

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Vapour & Particulate Dioxin Congener Concentration (fg/m³) – Max. Operations

Ringaskiddy Resource Recovery Centre

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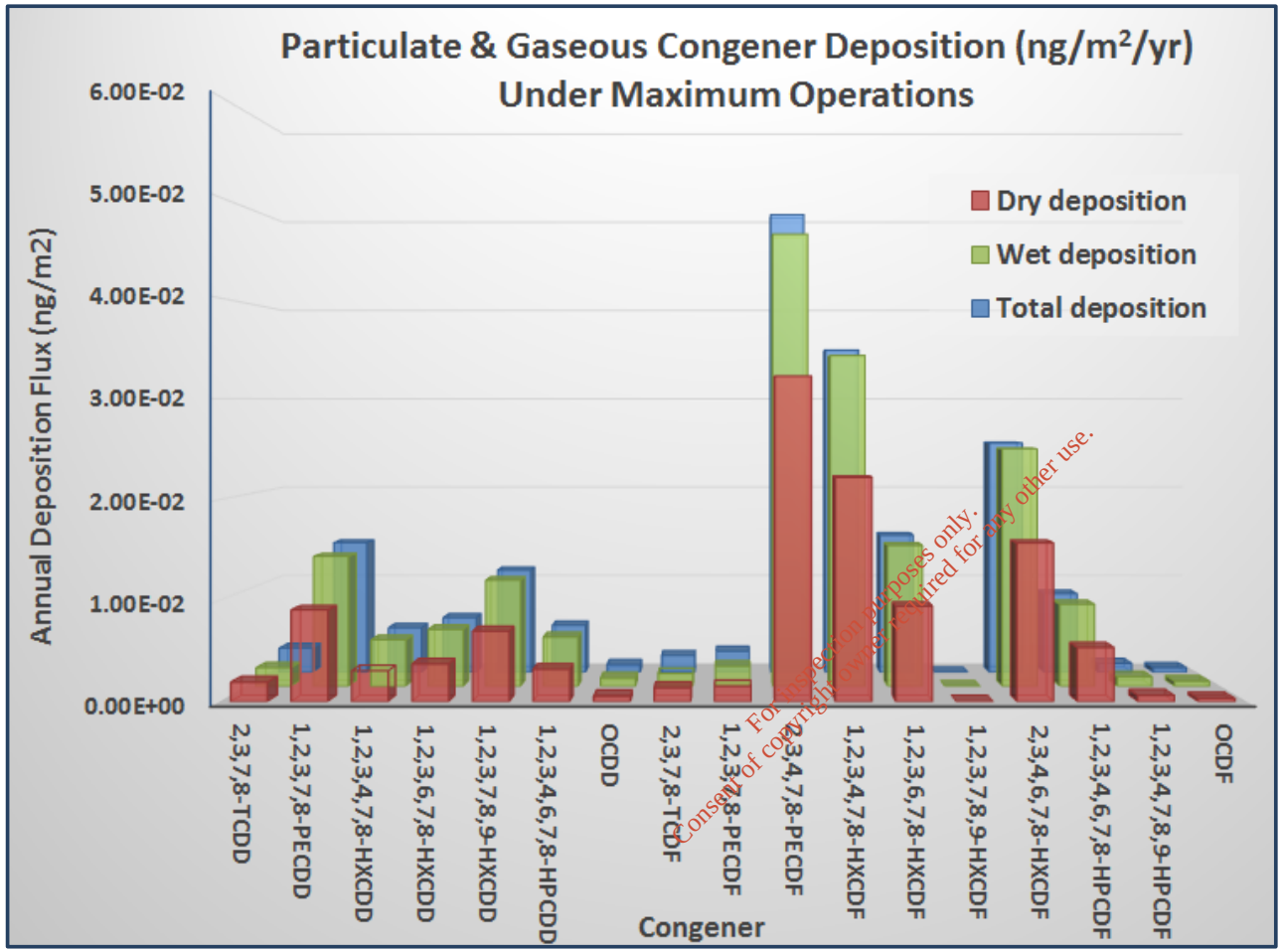

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Figure 8.24
Vapour & Particulate Dioxin Congener Deposition Rate (ng/m²/year) – Maximum Operations

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Vapour & Particulate Dioxin Congener Deposition Rate (ng/m²/year) – Max. Operations

Ringaskiddy Resource Recovery Centre

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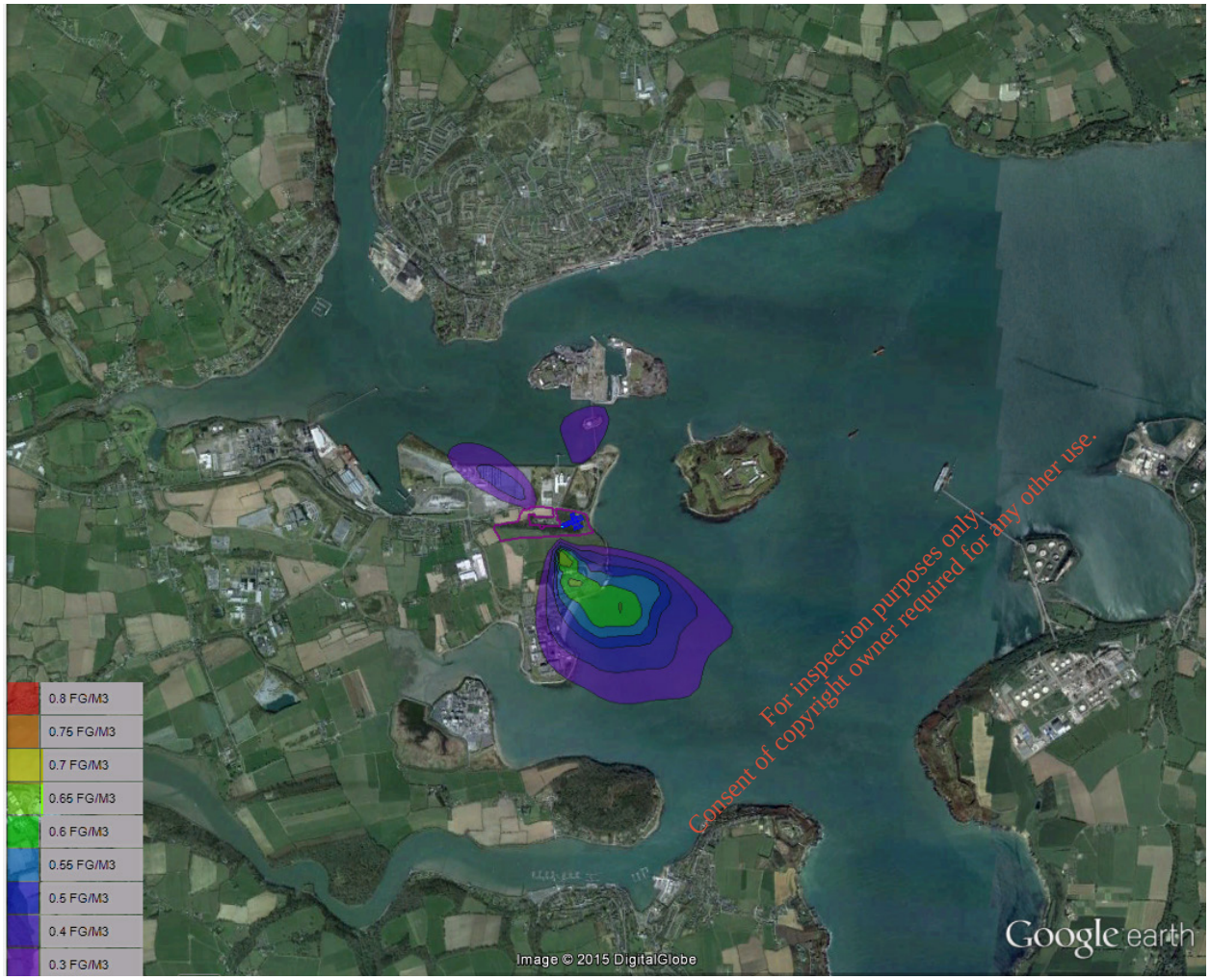

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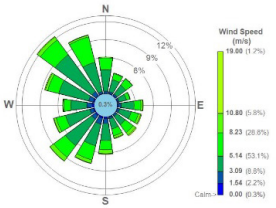

Background Mapping from Google Earth

Annual Mean Dioxin Concentrations (excluding background)
Maximum Concentration = 0.85 fg/m^3

Boundary Of Facility

Scale
1:40,000

N

Project
Ringaskiddy Resource Recovery Centre Assessment

Reference
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Figure 8.25
Annual Mean Dioxin Concentrations (fg/m^3) (Year 2010)

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Annual Mean Particulate Dioxin Concentrations (fg/m^3) (Year 2010)

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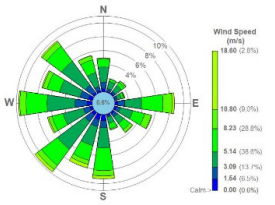

Background Mapping from Google Earth

Annual Mean Dioxin Particulate Deposition (excluding background) Maximum Concentration = 0.18 ng/m^2/yr

Boundary Of Facility

Scale
1:20,000

N

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Figure 8.26

Annual Mean Particulate Dioxin Deposition (ng/m^2/yr) (Year 2013)

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Annual Mean Particulate Dioxin Deposition (ng/m^2/yr) (Year 2013)

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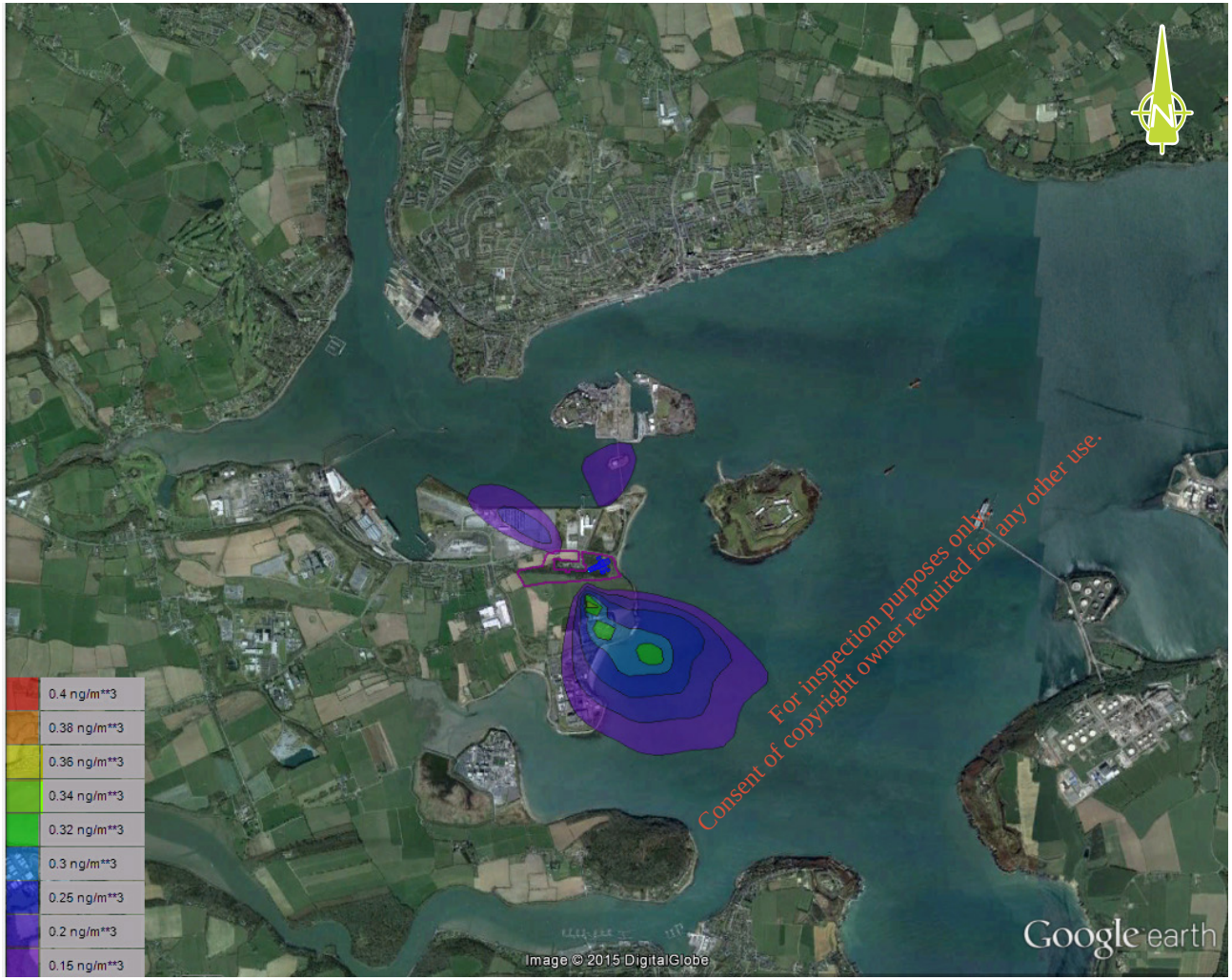

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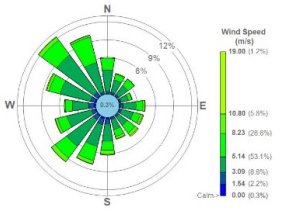

Background Mapping from Google Earth

Annual Mean Hg Concentrations (excluding background)
Maximum Concentration = 0.42 ng/m^3

Boundary Of Facility

Scale
1:40,000

N

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Figure 8.27

Annual Mean Hg Concentrations (ng/m^3) (Year 2010)

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Annual Mean Hg^{2+} (Mercury) Concentrations (ng/m^3) (Year 2010)

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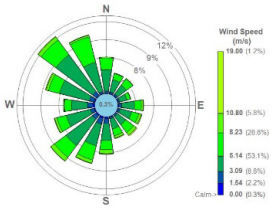

Background Mapping from Google Earth

Annual Mean Cadmium Concentrations (excluding background)
Maximum Concentration = 0.42 ng/m^3

Boundary Of Facility

Scale
1:40,000

N

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Figure 8.28
Annual Mean Cadmium Concentrations (ng/m^3) (Year 2010)

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Annual Mean Cadmium Concentrations (ng/m^3) (Year 2010)

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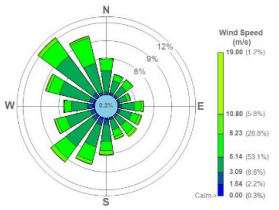

Background Mapping from Google Earth

Annual Mean Nickel Concentrations (excluding background)
Maximum Concentration = 0.53 ng/m^3

Boundary Of Facility

Scale
1:30,000

N

Project
Ringaskiddy Resource Recovery Centre Assessment

Reference
14/7880AR01

Figure 8.29

Annual Mean Nickel Concentrations (ng/m^3) (Year 2010)

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Annual Mean Nickle Concentrations (ng/m3) (Year 2010)

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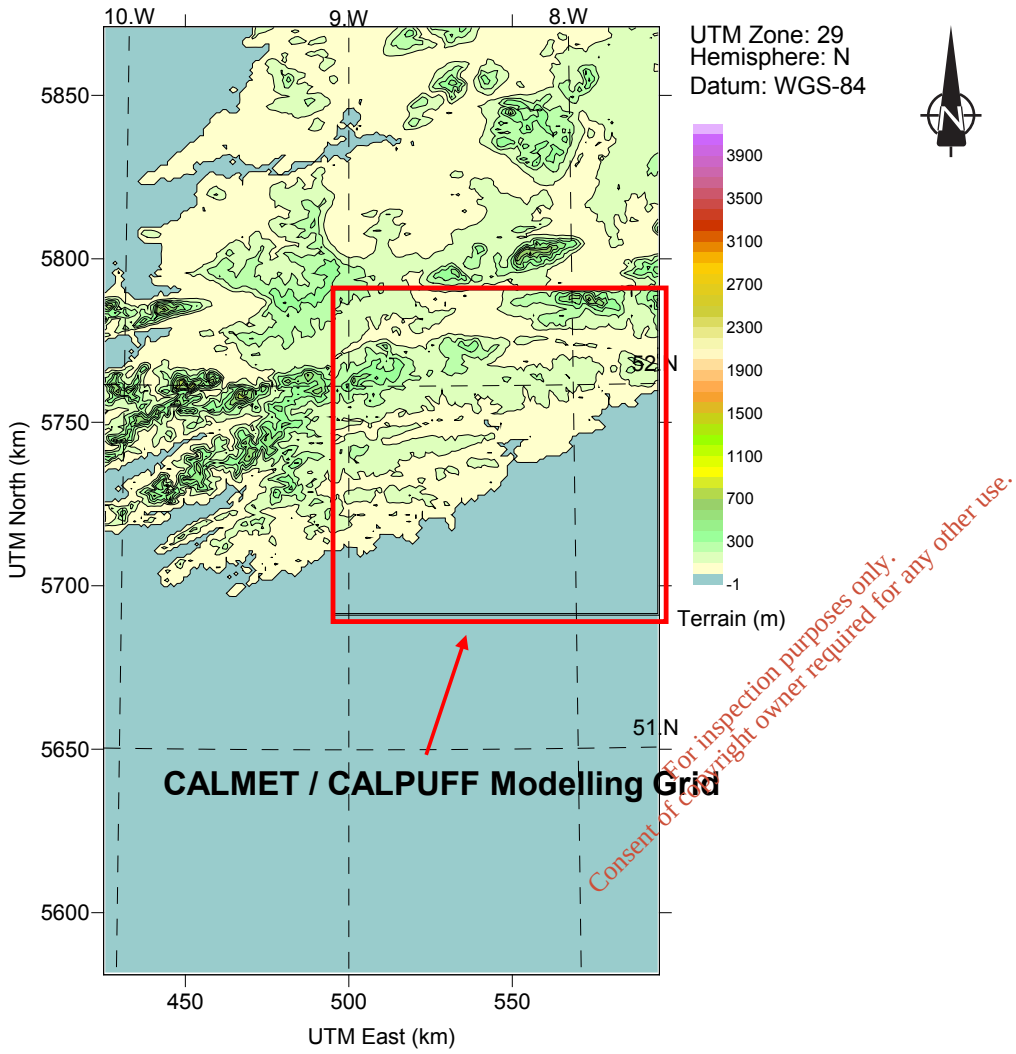

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Figure 8.30
SRTM Terrain Data In Region of Ringaskiddy

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SRTM Terrain Data In Region of Ringaskiddy

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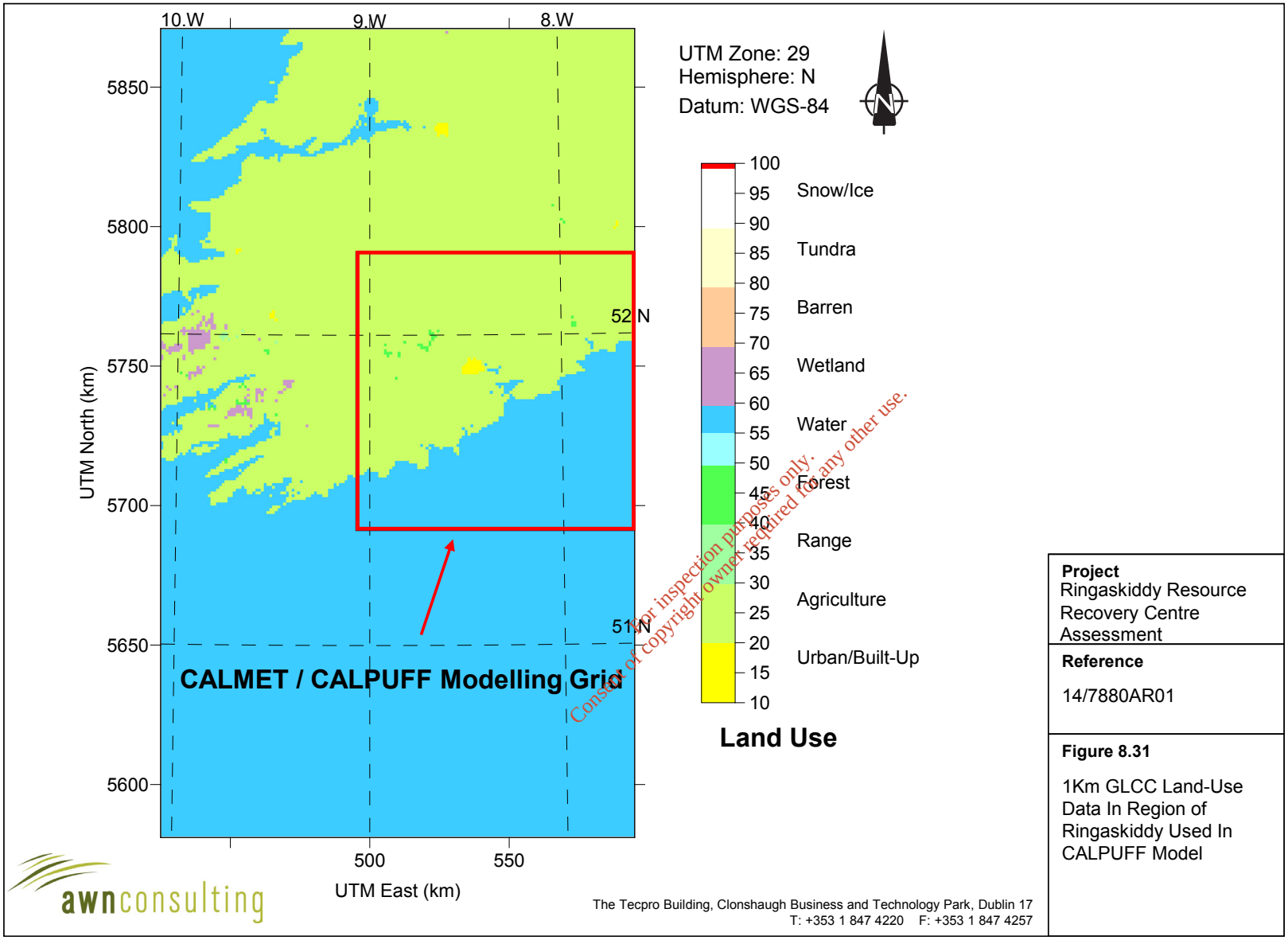

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Figure 8.31
1Km GLCC Land-Use Data In Region of Ringaskiddy Used In CALPUFF Model

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1km GLCC Land-Use Data In Region of Ringaskiddy Used In CALPUFF Model

Ringaskiddy Resource Recovery Centre

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Appendix 8.1
Air Quality Study

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APPENDIX 8.1 - AIR QUALITY STUDY

Executive Summary

The Ringaskiddy Resource Recovery Centre facility will consist of a grate incinerator for the treatment of residual municipal waste and other suitable wastes.

Air dispersion modelling was carried out using the United States Environmental Protection Agency's (USEPA) regulatory model AERMOD (version 15181). The aim of the study was to assess the impact in the ambient environment of emissions from the facility at the emission limits outlined in Council Directive 2010/75/EU. Modelling was also conducted under abnormal operating conditions to assess any short-term impact due to these infrequent events. The study demonstrates that all substances which will be emitted from the proposed facility will be at levels that are well below even the most stringent ambient air quality standards and guidelines. The dispersion model study consisted of the following components:

- Review of design emission levels and other relevant information needed for the modelling study;
- Identification of the significant substances which will be released from the facility;
- Review of background ambient air quality in the vicinity of the proposed facility;
- Air dispersion modelling of significant substances released from the facility;
- Particulate deposition modelling of Dioxins & Furans, Polycyclic Aromatic Hydrocarbons (PAHs) and heavy metals released from the facility;
- Identification of predicted ground level concentrations of released substances beyond the facility boundary and at sensitive receptors in the immediate environment;
- Evaluation of the significance of these predicted concentrations, including consideration of whether these ground level concentrations are likely to exceed the most stringent ambient air quality standards and guidelines which have been set for the protection of human health;
- Impact on public health and the environment in the unlikely event of "abnormal" operating conditions;
- The cumulative impact from the facility and surrounding industrial sources has also been undertaken.

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Modelling and a subsequent impact assessment were undertaken for the following substances released from the facility:

- Nitrogen dioxide (NO_2) and Nitrogen Oxides (NO_X);
- Sulphur Dioxide (SO_2);
- Total Dust (as PM_{10} (particulate matter less than 10 microns) and $PM_{2.5}$ (particulate matter less than 2.5 microns));
- Gaseous and vaporous organic substances expressed as total organic carbon (TOC);
- Hydrogen Chloride (HCl);
- Hydrogen Fluoride (HF);
- Polycyclic Aromatic Hydrocarbons (PAHs);
- PCDD/PCDFs (Dioxins/Furans);
- Mercury (Hg);
- Cadmium (Cd) and Thallium (Tl);
- And Other Heavy Metals (as the sum of Antimony (Sb), Arsenic (As), Lead (Pb), Chromium (Cr), Cobalt (Co), Copper (Cu), Manganese (Mn), Nickel (Ni) and Vanadium (V)).

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Assessment Approach

Emissions from the facility have been assessed firstly under maximum operating conditions and secondly under abnormal operating conditions. Maximum operations are based on a moving grate incinerator operating at emission levels at the limits defined in EU Directive 2010/75/EU. Abnormal operating conditions refer to short-term periods in which the limits detailed in EU Directive 2010/75/EU are exceeded.

This is a conservative approach as the proposed facility will typically operate at levels well within emission limits defined in the EU Directive.

Modelling Under Maximum & Abnormal Operating Conditions

In order to assess the potential impact from the proposed facility under maximum and abnormal operations, a conservative approach was adopted that is designed to over-predict ground level concentrations. This cautious approach will ensure that an over-estimation of impacts will occur and that the resultant emission standards adopted are protective of ambient air quality. The approach incorporated several conservative assumptions regarding operating conditions at the proposed facility. This approach incorporated the following features:

- For the maximum operating scenario, it has been assumed that the emission points are continuously operating at their maximum operating volume flow. This will over-estimate the actual mass emissions from the facility.

- For the maximum operating scenario, it has been assumed that the emission points are operating for 24-hrs/day over the course of the full year.

- Abnormal operating emissions were pessimistically assumed to occur as outlined below:

    - NO_X - 400 mg/m^3 for 3% of the year (11 days per annum);
    - SO_2 - 200 mg/m^3 for 3% of the year (11 days per annum);
    - Total Dust - 30 mg/m^3 for 3% of the year (11 days per annum);
    - TOC - 30 mg/m^3 for 3% of the year (11 days per annum);
    - HCl - 60 mg/m^3 for 3% of the year (11 days per annum);
    - HF - 4 mg/m^3 for 3% of the year (11 days per annum);
    - CO - 200 mg/m^3 for 5% of the year (18 days per annum);
    - Dioxins & Furans - 0.5 ng/m^3 for 3% of the year (11 days per annum);
    - Heavy Metals (other than Hg, Cd & Tl) - 30 mg/m^3 for 3% of the year (11 days per annum);
    - Cd & Tl - 0.2 mg/m^3 for 3% of the year (11 days per annum);
    - Hg - 1 mg/m^3 for 3% of the year (11 days per annum).

- Worst-case meteorological conditions over the period 2010 - 2014 from Cork Airport and the on-site meteorological data from 2007 have been used in all assessments. For all averaging periods the worst-case year from 2007, 2010 - 2014 was used for comparison with the ambient air quality standards.

As a result of these conservative assumptions, there will be an over-estimation of the emissions from the facility and the impact of the proposed facility on human health and the surrounding environment.

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Modelled Locations

In relation to the spatial assessment of emissions from the facility, modelling has been carried out to cover locations at the boundary and within a radius of 10 km of the facility, regardless of whether any sensitive receptors are located in the area. Ambient air quality legislation designed to protect human health (i.e. by setting ambient limit values for a range of pollutants) is generally based on assessing ambient air quality at locations where the exposure of the population is significant relevant to the averaging time of the pollutant. However, in the current assessment, ambient air quality legislation has been applied to all locations regardless of whether any sensitive receptors (such as residential locations) are present for significant periods of time. This represents a worst-case approach and an examination of the corresponding concentrations at the nearest sensitive receptors relative to the actual quoted maximum concentration indicates that these receptors generally experience ambient concentrations significantly lower than that reported for the maximum value.

Ambient air concentrations have also been predicted at the most sensitive residential receptors in Cobh, Monkstown and Ringaskiddy and the surrounding geographical area as far away as Passage West, Carrigaline and Crosshaven.

Cumulative Assessment

The region around the Ringaskiddy Resource Recovery Centre is partly industrialised and thus has several other potential sources of pollutants. As a result, an investigation of facilities with IED Licences has been undertaken in the region as outlined in Appendix 8.4.

The impact of additional traffic associated with the facility has also been incorporated into the existing baseline concentrations thus ensuring all sources of air emissions in the region have been taken into account.

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Baseline Air Quality Assessment

An extensive baseline survey was carried out in the region of the proposed facility over the period from August 2014 to July 2015. The survey focused on the significant pollutants likely to be emitted from the facility and which have been regulated under Council Directive 2010/75/EU. The survey updates previous surveys which were undertaken in 2001 and between 2006 - 2008.

PM_{10} concentrations measured during the monitoring campaigns averaged 20 $\mu g/m^3$, which is below the annual limit value of 40 $\mu g/m^3$. Five exceedances of the 24-hour limit value were recorded over the six month monitoring campaign. Since only 5 exceedances were recorded over the monitoring survey, it is extremely unlikely that 35 exceedances would occur over 365 days at the current location.

The average $PM_{2.5}$ concentration measured over the period May / June 2008 is 7 $\mu g/m^3$ which is significantly below the annual average EU limit value of 25 $\mu g/m^3$ which is applicable in 2015.

Nitrogen dioxide (NO_2) concentrations measured over the 2008 monitoring period were below both the 1-hour and annual EU limit values. The annual average NO_2 concentration averaged 6 $\mu g/m^3$ over the three month period. The 99.8th%ile of 1-hour concentrations peaked at 38 $\mu g/m^3$ in 2008. Long term NO_2 concentrations at a further nine locations in the region of the facility were significantly lower than the annual average limit value. The average NO_2 concentration measured over the three month period at each location ranged from 4 -

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14 μg/m^3 which is between 10 - 35% of the EU annual limit value of 40 μg/m^3. The results indicated a weak NO_2 spatial concentration gradient in the region. Updated diffusion monitoring results amounting to six months of data over the period August 2014 to May 2015 indicated an average concentration of between 6 – 19 μg/m^3 which is between 15 – 48% of the EU annual limit value.

Levels of sulphur dioxide (SO_2), benzene, hydrogen fluoride (HF) and hydrogen chloride (HCl) were all significantly below their respective limit values in 2008. Updated SO_2 diffusion monitoring results amounting to six months of data over the period August 2014 to May 2015 indicated an average concentration of between 5 – 13 μg/m^3 which is between 25 – 65% of the EU annual limit value for the protection of vegetation. Similarly, updated benzene diffusion monitoring results amounting to six months of data over the period August 2014 to July 2015 indicated an average concentration of between 1.2 – 1.3 μg/m^3 which is between 24 – 26% of the EU annual limit value.

Average concentrations of antimony (Sb), arsenic (As), cadmium (Cd), cobalt (Co), chromium (Cr), copper (Cu), mercury (Hg), manganese (Mn), nickel (Ni), lead (Pb), thallium (Tl) and vanadium (V) measured were significantly below their respective annual limit values both in 2008 and 2014-2015. Updated heavy metal monitoring results amounting to six months of data over the period August 2014 to July 2015 indicated an average concentration for each of the heavy metals which was between 0.004 – 37% of the EU annual limit value.

Background levels of PCDD / PCDFs cannot be compared to ambient air quality concentration or deposition standards. However, levels of PCDDs and PCDFs can be compared to existing levels measured sporadically in Ireland and continuously in the UK as part of the TOMPS network. The mean PCDD/PCDF concentration measured over the four one-week periods during April - May 2008 indicates that results are in line with measurements conducted elsewhere in Ireland, with an upper limit of 13.5 fg/m^3 compared to previous measurements ranging from 2.8 – 46 fg/m^3.

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Study Conclusions

The main study conclusions are presented below for each substance in turn:

NO_2 & NO_X

NO_2 modelling results indicate that the ambient ground level concentrations will be below the relevant air quality standards for the protection of human health for nitrogen dioxide under maximum and abnormal operation of the facility. Thus, no adverse impact on public health or the environment is envisaged to occur under these conditions at or beyond the facility boundary. Emissions at maximum operations lead to ambient NO_2 concentrations (including background concentrations) which are 63% of the maximum ambient 1-hour limit value (measured as a 99.8th%ile) and 33% of the annual average limit value at the respective worst-case receptors.

The annual average NO_X concentration (including background concentration) will also be below the limit value for the protection of vegetation accounting for 61% of the annual limit value at the worst-case receptor in the region of the Lough Beg Proposed NHA and the Cork Harbour SPA.

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SO_2, CO, PM_{10} & $PM_{2.5}$

Modelling results indicate that ambient ground level concentrations will be below the relevant air quality standards for the protection of human health for sulphur dioxide, carbon monoxide and PM_{10} under maximum and abnormal operation of the facility. Results will also be below the air quality standard for $PM_{2.5}$ under maximum and abnormal operation of the facility. Thus, no adverse impact on public health or the environment is envisaged to occur under these conditions at or beyond the facility boundary. Emissions at maximum operations equate to ambient concentrations (including background concentrations) ranging from 10% - 56% of the respective limit values at the worst-case receptors.

TOC, HCl & HF

Modelling results indicate that the ambient ground level concentrations will be below the relevant air quality guidelines for the protection of human health for TOC (assumed pessimistically to consist solely of benzene), HCl and HF under maximum and abnormal operation of the facility. Thus, no adverse impact on public health or the environment is envisaged to occur under these conditions at or beyond the facility boundary. Emissions at maximum operations equate to ambient concentrations (including background concentrations) for HCl and TOC of only 6% and 22% respectively of the ambient limit values.

HF modelling results indicate that emissions at maximum operations equate to ambient HF concentrations (including background concentrations) which will be 0.7% of the maximum ambient 1-hour limit value and 0.4% of the annual limit value.

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PCDD / PCDFs (Dioxins/Furans)

Currently, no internationally recognised ambient air quality concentration or deposition standards exist for PCDD/PCDFs (Dioxins/Furans). Both the USEPA and WHO recommended approach to assessing the risk to human health from Dioxins/Furans entails a detailed risk assessment analysis involving the determination of the impact of Dioxins/Furans in terms of the TDI (Tolerable Daily Intake) approach. The WHO currently proposes a maximum TDI of between 1-4 pgTEQ/kg of body weight per day.

Background levels of Dioxins/Furans occur everywhere and existing levels in the surrounding area have been extensively monitored as part of this study. Monitoring results indicate that the existing levels are similar to rural areas in the UK and Ireland. The contribution from the facility in this context is minor, with levels at the worst-case receptor to the south of the facility, under maximum and abnormal operation, accounting for only a small fraction of existing levels. Levels at the nearest residential receptor will be minor, with the annual contribution from the proposed facility accounting for less than 1% of the existing background concentration under maximum operating conditions.

PAHs

PAHs modelling results indicate that the ambient ground level concentrations will be below the relevant air quality target value for the protection of human health under maximum and abnormal operation of the facility. Thus, no adverse impact on public health or the environment is envisaged to occur under these conditions at or beyond the facility boundary. Emissions at maximum operations equate to ambient benzo[*a*]pyrene concentrations (excluding background concentrations) which are 0.8% of the EU annual average target value at the worst-case receptor.

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Hg

Hg modelling results indicate that the ambient ground level concentrations will be below the relevant air quality standards for the protection of human health under maximum and abnormal operation of the facility. Thus, no adverse impact on public health or the environment is envisaged to occur under these conditions at or beyond the facility boundary. Emissions at maximum operations equate to ambient mercury concentrations (including background concentrations) which are only 0.2% of the annual average limit value at the worst-case receptor.

Cd and Tl

Modelling results indicate that the ambient ground level concentrations will be below the relevant air quality standard for the protection of human health for cadmium under maximum and abnormal operation from the facility. Emissions at maximum levels equate to ambient Cd and Tl concentrations (including background concentrations) which are 28% of the EU annual target value for Cd close to the facility boundary (the comparison is made with the Cd limit value as this is more stringent than that for Tl).

Sum of As, Sb, Pb, Cr, Co, Cu, Ni, Mn and V

Modelling results indicate that the ambient ground level concentrations will be below the relevant air quality standards for the protection of human health for arsenic (As), nickel (Ni) and vanadium (V) (the metals with the most stringent limit values) under maximum and abnormal operation emissions from the facility (based on the ratio of metals measured at a Waste to Energy facility in Carranstown, County Meath). Thus, no adverse impact on public health or the environment is envisaged to occur under these conditions at or beyond the facility boundary. Ambient concentrations have been compared to the annual target value for As and Ni and the maximum 1-hour limit value for V as these represent the most stringent limit values for the suite of metals. Emissions at maximum operations equate to ambient As and Ni concentrations (including background concentrations) which are 17% and 38% of the EU annual target value respectively at the worst-case receptor whilst emissions at maximum operations equate to ambient V concentrations (including background concentrations) which are only 0.1% of the maximum 1-hour limit value at the worst-case receptor. Emissions under abnormal operations equate to ambient As and Ni concentrations (including background concentrations) which are 18% and 44% of the annual limit value respectively at the worst-case receptor whilst emissions at maximum operations equate to ambient V concentrations (including background concentrations) which are 0.2% of the maximum 1-hour limit value at the worst-case receptor.

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National Emissions Ceiling

A comparison of the proposed Facility's operations with the obligations under the National Emissions Ceiling Directive indicates the impact of the development is to increase SO_2 levels by 0.25% of the ceiling levels to be complied with in 2020, NO_X levels by 0.38% of the ceiling levels, VOC levels will be increased by 0.03% of the ceiling limits whilst $PM_{2.5}$ levels will be increased by 0.14% of the ceiling limits.

Summary

Modelling results indicate that the ambient ground level concentrations will be below the relevant air quality standards or guidelines for the protection of human health for all parameters under maximum and abnormal operation of the facility. The modelling results indicate that the long-term maximum concentrations occur near the southern and south-

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eastern boundaries of the facility. Maximum operations are based on the emission concentrations outlined in EU Directive 2010/75/EU.

An appropriate stack height has been selected to ensure that ambient air quality standards for the protection of human health will not be approached even under abnormal operating scenarios. The stack height determined by air dispersion modelling which will lead to adequate dispersion was 70 metres.

The spatial impact of the facility is limited with concentrations falling off rapidly away from the maximum peak. For example, the short-term concentrations due to process emissions at the nearest residential receptor will be less than 17% of the short-term ambient air quality limit values. The annual average concentration has an even more dramatic decrease in maximum concentration away from the facility with concentrations from emissions at the proposed facility accounting for less than 1% of the limit value (not including background concentrations) at worst case sensitive receptors near the facility.

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8.1 Introduction

The Ringaskiddy Resource Recovery Centre will have one furnace and flue gas cleaning line. The line will have an 80MW moving grate furnace with a state-of-the-art flue gas cleaning system.

The combustion of waste produces a number of emissions, the discharges of which are regulated by the EU Directive on Industrial Emissions (IED) (2010/75/EU). The emissions to atmosphere which have been regulated are:

- Nitrogen Dioxide (NO_2)
- Sulphur Dioxide (SO_2)
- Total Dust (as PM_{10} and $PM_{2.5}$)
- Carbon Monoxide (CO)
- Total Organic Carbon (TOC)
- Hydrogen Fluoride (HF) and Hydrogen Chloride (HCl)
- Dioxins/Furans (PCDD/PCDFs)
- Cadmium (Cd) & Thallium (Tl)
- Mercury (Hg)
- and the sum of Antimony (Sb), Arsenic (As), Lead (Pb), Chromium (Cr), Cobalt (Co), Copper (Cu), Manganese (Mn), Nickel (Ni) and Vanadium (V).

In addition, Polycyclic Aromatic Hydrocarbons (PAHs) have been assessed as incineration is a potential emission source for this group of compounds.

The scope of the study consists of the following components:

- Review of maximum emission levels and other relevant information needed for the modelling study;
- Identification of the significant substances which are released from the facility;
- Review of background ambient air quality in the vicinity of the facility;
- Air dispersion modelling of significant substances released from the facility;
- Particulate deposition modelling of Dioxins & Furans, Polycyclic Aromatic Hydrocarbons (PAHs) and heavy metals released from the facility;
- Identification of predicted ground level concentrations of released substances at the facility boundary and at sensitive receptors in the immediate environment;
- Evaluation of the significance of these predicted concentrations, including consideration of whether these ground level concentrations are likely to exceed the most stringent ambient air quality standards and guidelines.

8.1.1 Modelling Under Maximum & Abnormal Operating Conditions

In order to assess the potential impact from the proposed facility under maximum and abnormal operations, a conservative approach was adopted that is designed to over-predict ground level concentrations. This cautious approach will ensure that an over-estimation of impacts will occur and that the resultant emission standards adopted are protective of ambient air quality. The approach incorporated several conservative assumptions regarding operating conditions at the proposed facility. This approach incorporated the following features:

- For the maximum operating scenario, it has been assumed that the emission point is continuously operating at its maximum operating volume flow. This will over-estimate the actual mass emissions from the facility.

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- For the maximum operating scenario, it has been assumed that the emission point is operating at maximum capacity for 24-hrs/day over the course of the full year.

- Abnormal operating emissions were obtained from the process engineer and are pessimistically assumed to occur as outlined below:

    - NO_X - 400 mg/m^3 for 3% of the year (11 days per annum)
    - SO_2 - 200 mg/m^3 for 3% of the year (11 days per annum)
    - Total Dust - 30 mg/m^3 for 3% of the year (11 days per annum)
    - TOC - 30 mg/m^3 for 3% of the year (11 days per annum)
    - HCl - 60 mg/m^3 for 3% of the year (11 days per annum)
    - HF - 4 mg/m^3 for 3% of the year (11 days per annum)
    - CO - 200 mg/m^3 for 5% of the year (18 days per annum)
    - Dioxins & Furans - 0.5 ng/m^3 for 3% of the year (11 days per annum)
    - Heavy Metals (other than Hg, Cd & Tl) - 30 mg/m^3 for 3% of the year (11 days per annum)
    - Cd & Tl - 0.2 mg/m^3 for 3% of the year (11 days per annum)
    - Hg - 1 mg/m^3 for 3% of the year (11 days per annum)

As a result of these conservative assumptions, there will be an over-estimation of the emissions from the facility and the impact of the proposed facility on human health and the surrounding environment.

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8.2 Study Methodology

8.2.1 Introduction

The air dispersion modelling input data consists of detailed information on the physical environment (including building dimensions and terrain features), design details from all emission points on-site and a full year of worst-case meteorological data. Using this input data, the model predicts ambient ground level concentrations beyond the facility boundary for each hour of the modelled meteorological year. The model post-processes the data to identify the location and maximum value of the worst-case ground level concentration in the applicable format for comparison with the relevant limit values. This worst-case concentration is then added to the existing background concentration to give the worst-case predicted ambient concentration. The worst-case ambient concentration is then compared with the relevant ambient air quality standard for the protection of human health to assess the significance of the emissions from the facility.

Throughout this study a worst-case approach was taken. This will most likely lead to an over-estimation of the levels that will arise in practice. The worst-case assumptions are outlined below:

- Emissions from all emission points in the assessment were assumed to be operating at their maximum emission level, 24 hours/day over the course of a full year. This represents a very conservative approach as typical emissions from the proposed facility will be well within the emission limit values set out in the Industrial Emissions Directive.

- Maximum predicted ambient concentrations for all pollutants within a 10 km radius of the facility were reported in this study even though, in many cases, no residential receptors were near the location of this maximum ambient concentration. Concentrations at the nearest residential receptors are generally significantly lower than the maximum ambient concentrations reported.

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- Worst-case background concentrations were used to assess the baseline levels of substances released from the facility.

- Worst-case meteorological conditions over the period 2010 - 2014 from Cork Airport and the on-site meteorological data from 2007 have been used in all assessments. For all averaging periods the worst-case year from 2007, 2010 - 2014 was used for comparison with the ambient air quality standards.

8.2.2 Meteorological Considerations

Meteorological data is an important input into the air dispersion model. The local airflow pattern will be influenced by the geographical location. Important features will be the location of hills and valleys or land-water-air interfaces and whether the facility is located in simple or complex terrain.

The selection of the appropriate meteorological data has followed the guidance issued by the USEPA[1]. A primary requirement is that the data used should have a data capture of greater than 90% for all parameters based on an analysis of the data on a quarterly basis. One synoptic meteorological station operated by Met Eireann was identified near the Facility – Cork Airport. Data collection of greater than 90% for all parameters in each quarter is required for air dispersion modelling. Cork Airport fulfils this requirement.

The additional requirements of the selection process depend on the degree to which the data is considered to be representative of the modelled domain. This criterion can be defined as "the extent to which a set of measurements taken in a space-time domain reflects the actual conditions in the same or different space-time domain taken on a scale appropriate for a specific application"[2]. The meteorological data should be representative of conditions affecting the transport and dispersion of pollutants in the area of interest as determined by the location of the sources and receptors being modelled.

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The representativeness of the data is dependent on[1]:

1) the proximity of the meteorological monitoring site to the area under consideration,

2) the complexity of the terrain,

3) the exposure of the meteorological monitoring site (surface characteristics around the meteorological site should be similar to the surface characteristics within the modelling domain),

4) the period of time during which data is collected.

In the region of the facility, Cork Airport meteorological station is in a region of gentle rolling terrain and is 12km of the site. The meteorological data used in the assessment (2010 - 2014) is the most recent data set available. The final issue relates to the exposure of the meteorological monitoring site and specifically relating to the surface characteristics of the station compared to the site of the proposed facility. Cork Airport is 12km from the coast and in a region of mainly agricultural land with urban characteristics to the north of the airport. In contrast, Ringaskiddy is in a coastal setting with a range of surface characteristics including water, agricultural and urban within a few kilometres of the site. Thus, some differences in surface characteristics are apparent between the meteorological station and the site. In order to ascertain the likely significance of the difference in surface characteristics, a sensitivity study was conducted as shown in Appendix 8.5. Secondly, a weather station was installed on-site which measured wind speed, wind direction, temperature and relative

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humidity starting in October 2006 and finished at the end of December 2007. The on-site meteorological data for 2007 was used in AERMOD modelling study and in the CALPUFF modelling study as detailed in Section 8.12.

The windrose from Cork Airport for the years 2010 - 2014 is shown in Figure 8.3 with detailed data outlined in Appendix 8.2. The windrose indicates the prevailing wind speed and direction over the five-year period. The prevailing wind direction is generally from the south to north-westerly in direction over the period 2010 - 2014. The mean wind speed is approximately 5.4 m/s over the period 1981-2010. Calm conditions account for only a small fraction of the time in any one year peaking at 66 hours in 2012 (0.8% of the time). The number of missing hours are also very low with an average of 2 missing hours / year over the period 2010 – 2014 (0.1% of the time).

8.2.3 Modelling Methodology

Emissions from the proposed facility have been modelled using the AERMOD dispersion model (Version 15181) which has been developed by the U.S. Environmental Protection Agency (USEPA)[3]. The model is a steady-state Gaussian plume model used to assess pollutant concentrations associated with industrial sources. The model has been designated the regulatory model by the USEPA for modelling emissions from industrial sources in both flat and complex terrain[1]. An overview of the model is outlined in Appendix 8.2.

The AERMOD model is capable of modelling most meteorological conditions likely to be encountered in the region. However, unusual meteorological conditions may occur infrequently, which may not be modelled adequately using AERMOD. One such condition is fumigation which occurs when a plume is emitted into a stable layer of air which subsequently mixes to ground level through either convective transfer of heat from the surface or because of advection to less stable surroundings[4]. A recommended air dispersion model is CALPUFF[1] (full details are outlined in Section 8.12).

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8.2.4 Sensitive Receptors

In relation to the spatial assessment of emissions from the facility, modelling has been carried out to cover locations at the boundary and within a radius of 10 km of the facility, regardless of whether any sensitive receptors are located in the area. Ambient air quality legislation designed to protect human health (i.e. by setting ambient limit values for a range of pollutants) is generally based on assessing ambient air quality at locations where the exposure of the population is significant relevant to the averaging time of the pollutant. However, in the current assessment, ambient air quality legislation has been applied to all locations regardless of whether any sensitive receptors (such as residential locations) are present for significant periods of time. This represents a worst-case approach and an examination of the corresponding concentrations at the nearest sensitive receptors relative to the actual quoted maximum concentration indicates that these receptors generally experience ambient concentrations significantly lower than that reported for the maximum value.

The closest sensitive receptors to the facility are the residential properties at the eastern edge of Ringaskiddy village which are located 200 m west of the facility boundary. The Lough Beg proposed NHA is approximately 2 km from the northern boundary. The Cork Harbour SPA is approximately 500 m south of the facility boundary.

8.2.5 Terrain

The AERMOD air dispersion model has a terrain pre-processor AERMAP[4] which was used to map the physical environment in detail over the receptor grid. The digital terrain input data

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used in the AERMAP pre-processor was obtained from the US Jet Propulsion Laboratory Shuttle RADAR Topography Mission (SRTM) at 1 arc-second (30m) resolution. This data was run to obtain for each receptor point the terrain height and the terrain height scale. The terrain height scale is used in AERMOD to calculate the critical dividing streamline height, H_{crit}, for each receptor. The terrain height scale is derived from the Digitial Elevation Model (DEM) files in AERMAP by computing the relief height of the DEM point relative to the height of the receptor and determining the slope. If the slope is less than 10%, the program goes to the next DEM point. If the slope is 10% or greater, the controlling hill height is updated if it is higher than the stored hill height.

In areas of complex terrain, AERMOD models the impact of terrain using the concept of the dividing streamline (H_c). As outlined in the AERMOD model formulation[1] a plume embedded in the flow below H_c tends to remain horizontal; it might go around the hill or impact on it. A plume above H_c will ride over the hill. Associated with this is a tendency for the plume to be depressed toward the terrain surface, for the flow to speed up, and for vertical turbulent intensities to increase.

AERMOD model formulation captures the effect of flow above and below the dividing streamline by weighting the plume concentration associated with two possible extreme states of the boundary layer (horizontal plume and terrain-following). The relative weighting of the two states depends on: 1) the degree of atmospheric stability; 2) the wind speed; and 3) the plume height relative to terrain. In stable conditions, the horizontal plume "dominates" and is given greater weight while in neutral and unstable conditions, the plume traveling over the terrain is more heavily weighted[2].

The terrain in the region of the facility is complex in the sense that the maximum terrain in the modelling domain peaks at 162m which is above the stack top of all emission points onsite. However, in general, as shown in Figure 8.2, the region of the site has gentle or moderately sloping terrain.

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8.2.6 Geophysical Considerations

AERMOD simulates the dispersion process using planetary boundary layer (PBL) scaling theory[3]. PBL depth and the dispersion of pollutants within this layer are influenced by specific surface characteristics such as surface roughness, albedo and the availability of surface moisture. Surface roughness is a measure of the aerodynamic roughness of the surface and is related to the height of the roughness element. Albedo is a measure of the reflectivity of the surface whilst the Bowen ratio is a measure of the availability of surface moisture.

AERMOD incorporates a meteorological pre-processor AERMET[35] to enable the calculation of the appropriate parameters. The AERMET meteorological preprocessor requires the input of surface characteristics, including surface roughness (z_0), Bowen Ratio and albedo by sector and season, as well as hourly observations of wind speed, wind direction, cloud cover, and temperature. The values of albedo, Bowen Ratio and surface roughness depend on land-use type (e.g., urban, cultivated land etc) and vary with seasons and wind direction. The assessment of appropriate land-use type was carried out to a distance of 10km from the meteorological station for Bowen Ratio and albedo and to a distance of 1km for surface roughness in line with USEPA recommendations[4,5] as outlined in Appendix 8.2.

In relation to AERMOD, detailed guidance for calculating the relevant surface parameters has been published[6]. The most pertinent features are:

- The surface characteristics should be those of the meteorological site (Cork Airport) rather than the installation;

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- Surface roughness should use a default 1km radius upwind of the meteorological tower and should be based on an inverse-distance weighted geometric mean. If land use varies around the site, the land use should be sub-divided by sectors with a minimum sector size of 30º;
- Bowen ratio and albedo should be based on a 10km grid. The Bowen ratio should be based on an un-weighted geometric mean. The albedo should be based on a simple un-weighted arithmetic mean.

AERMOD has an associated pre-processor, AERSURFACE[5], which has representative values for these parameters depending on land use type. The AERSURFACE pre-processor currently only accepts NLCD92 land use data which covers the USA. Thus, manual input of surface parameters is necessary when modelling in Ireland. Ordnance survey discovery maps (1:50,000) and digital maps such as those provided by the EPA, National Parks and Wildlife Service (NPWS) and Google Earth® are useful in determining the relevant land use in the region of the meteorological station. The Alaska Department of Environmental Conservation has issued a guidance note for the manual calculation of geometric mean for surface roughness and Bowen ratio for use in AERMET[6]. This approach has been applied to the current site with full details provided in Appendix 8.2.

8.2.7 Building Downwash

When modelling emissions from an industrial installation, stacks which are relatively short can be subjected to additional turbulence due to the presence of nearby buildings. Buildings are considered nearby if they are within five times the lesser of the building height or maximum projected building width (but not greater than 800m).

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The USEPA has defined the "Good Engineering Practice" (GEP) stack height as the building height plus 1.5 times the lesser of the building height or maximum projected building width. It is generally considered unlikely that building downwash will occur when stacks are at or greater than GEP[1].

When stacks are less than this height, building downwash will tend to occur. As the wind approaches a building it is forced upwards and around the building leading to the formation of turbulent eddies. In the lee of the building these eddies will lead to downward mixing (reduced plume centreline and reduced plume rise) and the creation of a cavity zone (near wake) where re-circulation of the air can occur. Plumes released from short stacks may be entrained in this airflow leading to higher ground level concentrations than in the absence of the building.

The Plume Rise Model Enhancements (PRIME)[7,8] plume rise and building downwash algorithms, which calculates the impact of buildings on plume rise and dispersion, have been incorporated into AERMOD. The building input processor BPIP-PRIME produces the parameters which are required in order to run PRIME. The model takes into account the position of each stack relative to each relevant building and the projected shape of each building for 36 wind directions (at 10º intervals). The model determines the change in plume centreline location with downwind distance based on the slope of the mean streamlines and coupled to a numerical plume rise model[8].

Given that the main stack onsite is less than 2.5 times the lesser of the building height or maximum projected building width, building downwash will need to be taken into account and the PRIME algorithm run prior to modelling with AERMOD. Shown in Figure 8.8 is an example of the dominant building (in blue) which is influencing the building downwash for the main stack (A1-1). The dominant building may change as the wind direction changes for each of the 36 wind directions. The dominant building will vary as a function of wind direction and relative building heights.

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8.2.8 Assessment Methodology

Council Directive 2010/75/EU

Council Directive 2010/75/EU on Industrial Emissions (IED) has outlined air emission limit values as set out in Table A8.1. The Directive has also outlined stringent operating conditions in order to ensure sufficient combustion of waste thus ensuring that dioxin formation is minimised. Specifically, the combustion gases must be maintained at a temperature of 850°C for at least two seconds under normal operating conditions for non-hazardous waste whilst for hazardous waste containing more than 1% halogenated organic substances, the temperature should be raised to 1100°C for at least two seconds. These measures will ensure that dioxins/furans, polychlorinated biphenyls (PCBs) and PAHs are minimised through complete combustion of waste.

Specific emission measurement requirements have been outlined in the directive for each pollutant:

1) continuous measurements of the following substances; NO_x, CO, total dust, TOC, HCl, and SO_2,
2) bi-annual measurements of heavy metals, dioxins and furans.

Indaver is committed, as a minimum, to meeting all the requirements of Council Directive 2010/75/EU. Indeed, due to the advanced post-combustion flue gas cleaning technology employed, expected average emission values will be lower than the maximum values used in this study. The maximum and average emission concentrations and mass emission rates have been detailed in Table A8.2.

The advanced post-combustion flue gas cleaning technology which will be employed to control emissions of pollutants is detailed in Chapter 4.

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Guidelines On Air Quality Models

The selection of appropriate modelling methodology has followed the guidance from the EPA[9] and the USEPA[1,10,11] which have issued detailed and comprehensive guidance on the selection and use of air quality models.

Based on guidance from the USEPA, the most appropriate regulatory model for the current application is the AERMOD model (Version 15181). The model is applicable in both simple and complex terrain, urban or rural locations and for all averaging periods[1,3]. The selection of the urban/rural classification is based on the land use procedure of Auer[12] as recommended by the USEPA[1]. If 50% of the land use within a 3km circumference of the source is classified as high density residential, medium to heavy industry or commercial, urban boundary layer option should be used; otherwise the rural boundary layer should be used. An examination of the land-use type around the facility indicated that the rural boundary layer was appropriate.

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Table A8.1 Council Directive 2010/75/EU, Annex V Air Emission Limit Values

Daily Average Values	**Concentration**	
Total Dust	10 mg/m^3	
Gaseous & vaporous organic substances expressed as total organic carbon (TOC)	10 mg/m^3	
Hydrogen Chloride (HCl)	10 mg/m^3	
Hydrogen Fluoride (HF)	1 mg/m^3	
Sulphur Dioxide (SO_2)	50 mg/m^3	
Nitrogen Oxides (as NO_2)	200 mg/m^3	
Half-hourly Average Values	**Concentration**	
	(100%)	**(97%)**
Total Dust(1)	30 mg/m^3	10 mg/m^3
Gaseous & vaporous organic substances expressed as total organic carbon (TOC)	20 mg/m^3	10 mg/m^3
Hydrogen Chloride (HCl)	60 mg/m^3	10 mg/m^3
Hydrogen Fluoride (HF)	4 mg/m^3	2 mg/m^3
Sulphur Dioxide (SO_2)	200 mg/m^3	50 mg/m^3
Nitrogen Oxides (as NO_2)	400 mg/m^3	200 mg/m^3
Average Value Over 30 mins to 8 Hours	**Concentration**(2)	
Cadmium and its compounds, expressed as Cd	Total 0.05 mg/m^3	
Thallium and its compounds, expressed as Tl		
Mercury and its compounds, expressed as Hg	0.05 mg/m^3	
Antimony and its compounds, expressed as Sb	Total 0.5 mg/m^3	
Arsenic and its compounds, expressed as As		
Lead and its compounds, expressed as Pb		
Chromium and its compounds, expressed as Cr		
Cobalt and its compounds, expressed as Co		
Copper and its compounds, expressed as Cu		
Manganese and its compounds, expressed as Mn		
Nickel and its compounds, expressed as Ni		
Vanadium and its compounds, expressed as V		
Average Values Over 6 – 8 Hours	**Concentration**	
Dioxins and furans	0.1 ng/m^3	
Average Value	**Concentration**(3)	
	Daily Average Value	**30 Min Average Value**
Carbon Monoxide	50 mg/m^3	100 mg/m^3

(1) Total dust emission may not exceed 150 mg/m^3 as a half-hourly average under any circumstances
(2) These values cover also the gaseous and vapour forms of the relevant heavy metals as well as their compounds
(3) Exemptions may be authorised for incineration plants using fluidised bed technology, provided that emission limit values do not exceed 100 mg/m^3 as an hourly average value.

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Table A8.2 Air Emission Values From The Proposed Ringaskiddy Resource Recovery Centre, County Cork.

Maximum 30-Minute Values	**EU Maximum Emission Concentration**	**Annual Average Daily Emission Concentration**	**Maximum Operating Values(1)**	**Average Operating Values(2)**
			Emission Rate (g/s)	**Emission Rate (g/s)**
Total Dust	30 mg/m^3	10 mg/m^3	1.18	0.89
Gaseous & vaporous organic substances expressed as total organic carbon (TOC)	20 mg/m^3	10 mg/m^3	0.79	0.59
Hydrogen Chloride (HCl)	60 mg/m^3	10 mg/m^3	2.37	1.78
Hydrogen Fluoride (HF)	4 mg/m^3	1.0 mg/m^3	0.16	0.119
Sulphur Dioxide (SO_2)	200 mg/m^3	50 mg/m^3	7.89	5.94
Nitrogen Oxides (as NO_2)	400 mg/m^3	200 mg/m^3	15.8	11.9
Daily Average Value	**Emission Concentration**	**Emission Concentration**	**Emission Rate (g/s)**	**Emission Rate (g/s)**
Cadmium and its compounds, expressed as Cd	Total 0.05 mg/m^3	Total 0.05 mg/m^3	0.0020	0.0015
Thallium and its compounds, expressed as Tl				
Mercury and its compounds, expressed as Hg	0.05 mg/m^3	0.05 mg/m^3	0.0020	0.0015
Antimony and its compounds, expressed as Sb	Total 0.5 mg/m^3	Total 0.50 mg/m^3	0.020	0.015
Arsenic and its compounds, expressed as As				
Lead and its compounds, expressed as Pb				
Chromium and its compounds, expressed as Cr				
Cobalt and its compounds, expressed as Co				
Copper and its compounds, expressed as Cu				
Manganese and its compounds, expressed as Mn				
Nickel and its compounds, expressed as Ni				
Vanadium and its compounds, expressed as V				
Average Values Over 6 – 8 Hours	**Emission Concentration**	**Emission Concentration**	**Emission Rate (µg/s)**	**Emission Rate (µg/s)**
Dioxins and furans	0.1 ng/m^3	0.1 ng/m^3	0.0040	0.0030
Average Value	**Emission Concentration**	**Emission Concentration**	**Emission Rate (g/s)**	**Emission Rate (g/s)**
Carbon Monoxide	100 mg/m^3	50 mg/m^3	3.95	1.49

(1) Maximum operating value based on maximum emission concentration in Council Directive 2010/75/EC and maximum volume flow.
(2) Average operating value based on maximum emission concentration in Council Directive 2010/75/EC and average volume flow.

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8.3 ASSESSMENT OF BASELINE AIR QUALITY

8.3.1 Introduction

An extensive baseline survey was carried out in the region of the proposed Ringaskiddy Resource Recovery Centre facility over the period August 2014 to July 2015. This supplements the extensive baseline surveys undertaken in November 2006 to February 2007 and from April 2008 to July 2008. These surveys focused on the significant pollutants likely to be emitted from the facility and which have been regulated in Council Directive 2010/75/EU. The substances monitored over these survey periods were NO_2, NO_X, PM_{10}, $PM_{2.5}$, benzene, SO_2, heavy metals, HCl, HF and PCDDs/PCDFs. The air monitoring program was used to determine long-term average concentrations for these pollutants in order to help quantify the existing ambient air quality in the region. NO_2, benzene and SO_2 were also monitored at a number of additional locations to give some spatial representation of the levels of these species.

The updated extensive baseline survey which was carried out in the region of the proposed Ringaskiddy Resource Recovery Centre facility over the period August 2014 to July 2015 focused on NO_2, PM_{10}, benzene, SO_2 and heavy metals over a year long period in order to capture any possible seasonal factors. The air monitoring program was used to determine long-term average concentrations for these pollutants in order to help quantify the existing ambient air quality in the region. NO_2, benzene and SO_2 were also monitored at a number of additional locations to give greater spatial representation of the levels of these species.

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8.3.2 Methodology

NO_2

Monitoring of nitrogen dioxide in the vicinity of Ringaskiddy over the period August 2014 to May 2015 was carried out using passive diffusion tubes. The spatial variation in NO_2 levels away from sources is particularly important, as a complex relationship exists between NO, NO_2 and O_3 leading to a non-linear variation of NO_2 concentrations with distance from sources. In order to assess the spatial variation in NO_2 levels in the region around Ringaskiddy, passive diffusion tube monitoring over six one-month periods at ten locations in the area (see Figure 8.1) was carried out. Passive sampling of NO_2 involves the molecular diffusion of NO_2 molecules through a polycarbonate tube and their subsequent adsorption onto a stainless steel disc coated with triethanolamine. Following sampling, the tubes were analysed using UV spectrophotometry, by ESG (a UKAS accredited laboratory).

SO_2

In order to assess the spatial variation in sulphur dioxide levels in the area, SO_2 was monitored using passive diffusion tubes over six one-month periods at six locations over the period August 2014 to May 2015 (see Figure 8.1). Passive sampling of SO_2 involves the molecular diffusion of SO_2 molecules through a tube fabricated of PTFE and their subsequent adsorption onto a stainless steel gauze coated with sodium carbonate. Following sampling, the adsorbed sulphate is removed from the tubes with deionised water and analysed using ion chromatography. Analysis was carried out by ESG.

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Benzene

In order to assess the spatial variation in benzene levels in the area, benzene was monitored using passive diffusion tubes over six one-month periods at six locations over the period August 2014 to May 2015 (see Figure 8.1). Passive sampling of benzene involves the molecular diffusion of benzene molecules through a stainless steel tube and their subsequent adsorption onto a stainless steel gauze coated with Chromasorb 106. Following sampling, the tubes were analysed by Gas Chromatography, at ESG.

PCDD/PCDFs

Sampling for PCDDs and PCDFs was carried out over four 3-4 day periods extended over one month at the on-site monitoring station in 2008. Sampling was carried out in accordance with the requirements of the United States Environmental Protection Agency (US EPA) methodology. The sampling method was taken from the Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air. Method TO9 describes a method for the sampling of PCDDs and PCDFs in ambient air using high resolution gas chromatography/mass spectrometry.

Sampling of the ambient air was achieved using a high volume air sampler. Air was drawn through a fine porosity quartz filter and adsorbent cartridge containing polyurethane foam to trap the particulate and volatile fractions respectively. In order to obtain a detection limit in ambient air of approximately one femtogram (fg), a sample volume of at least 500m^3 was required.

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Analysis for PCDDs and PCDFs was by high-resolution gas chromatography/mass spectrometry (GC/MS) and was carried out by Scientific Analysis Laboratories (SAL), Manchester. SAL Ltd are UKAS accredited for the analysis of PCDDs and PCDFs. Extraction, clean-up and analysis procedures followed USEPA protocols and the full quality assurance and quality control regime set out in EPA Method 1613 was followed.

HCl & HF

Gaseous HF and HCl were monitored over four 4-7 day periods extended over one month at the on-site monitoring station in 2008. HF and HCl were sampled using sequential filtration onto pre-cleaned 47mm diameter, 0.45µm nominal pore size nylon membrane filters. Particles and aerosols, including salt which may interfere with the gaseous measurement, were removed from the airstream using a 47mm diameter, 1µm pore size teflon filter. The filters were housed in a single multi-stage open-face teflon holder designed to minimise any losses onto the sampler surfaces. The teflon cassette contained a Teflon filter upstream of a nylon filter to ensure quantitative collection of the acid gases.

Ambient air was sampled through the cassette assembly using a sampling pump set at a flowrate of approximately 5 litres per minute (l/min). The actual volume sampled was recorded on a digital dry gas meter. Following sampling, the nylon filters were extracted with eluent in a sonic bath and chloride (Cl^-) and fluoride (F^-) concentrations determined on the solution by ion chromatography (IC). An equivalent mass of HCl and HF was then determined from the molecular masses. The methodology therefore assumes that all the gaseous chloride and fluoride present in the air is in the form of HCl and HF respectively. Analysis was carried out by Scientific Analysis Laboratories, Manchester.

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$PM_{2.5}$

The $PM_{2.5}$ monitoring program, focused on assessing 24-hour average concentrations over a one-month at the on-site monitoring station (see Figure 8.1) in 2008. $PM_{2.5}$ sampling was carried out by means of an R&P Partisol®-Plus Sequential Air Sampler (Model 2025). The sampler is a manual air sampling platform which has been designed to meet US EPA Reference Designation (RFPS-1298-127). Approximately 24 m^3 of air was sampled daily through a size selective inlet, which removed particles with a diameter >2.5 µg. The remaining particles (<2.5 µg) were collected on pre-weighed 47mm diameter filters. The Partisol® sampler was programmed to automatically replace each sampled filter by a new pre-weighed filter at midnight. This ensured that each filter represented a sampling period of exactly 24 hours. Gravimetric determination was carried out pre- and post-sampling at a UKAS accredited laboratory (Bureau Veritas Laboratories, Glasgow). The gravimetric results allowed a calculation of the average $PM_{2.5}$ concentration over each 24-hour period.

PM_{10}

The PM_{10} monitoring program, using a PM_{10} continuous monitor, focused on assessing 24-hour average concentrations over the period August 2014 to July 2015 at a monitoring station located on-site in Ringaskiddy, County Cork (see Figure 8.1). PM_{10} sampling was carried out by means of an R&P Partisol®-Plus Sequential Air Sampler (Model 2025). The sampler is a manual air sampling platform which has been designed to meet US EPA Reference Designation (RFPS-1298-127). Approximately 24 m^3 of air was sampled daily through a size selective inlet, which removed particles with a diameter >10 µg. The remaining particles (<10 µg) were collected on pre-weighed 47mm diameter filters. The Partisol® sampler was programmed to automatically replace each sampled filter by a new pre-weighed filter at midnight. This ensured that each filter represented a sampling period of exactly 24 hours. Gravimetric determination was carried out pre- and post-sampling at a UKAS accredited laboratory (Bureau Veritas, UK). The gravimetric results allowed a calculation of the average PM_{10} concentration over each 24-hour period. The results, which are shown in Table A8.16, can be directly compared with the 24-hour limit value (which is set as a 90th%ile), and the long-term average can be indicatively compared with the annual limit value.

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Heavy Metals

Sampling for heavy metals over the period August 2014 to July 2015 was conducted using the same methodology as for PM_{10}. PTFE filters were utilised as they have low background heavy metal concentrations. Following sampling and re-weighing, the PTFE filters were acid digested in batches of 5 - 7 samples and the metals suite determined by inductively coupled plasma (ICP) by Bureau Veritas, UK.

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8.3.3 Results And Discussion

NO_2

Nitrogen dioxide (NO_2) results are presented in Table A8.3 and Table A8.4. The NO_2 chemiluminescent results, undertaken in 2008, indicated compliance with NO_2 limit values over the three month monitoring period. During the monitoring period no exceedence of the 1-hour limit value of 200 $\mu g/m^3$ was observed whilst the mean over this period was 5.6 $\mu g/m^3$ which is 14% of the annual NO_2 limit value (see Figure 8.9). The 2008 NO_2 diffusion tube concentrations measured over the three-month survey period are below the annual EU limit value of 40 $\mu g/m^3$ for the protection of human health. The average NO_2 concentration measured over the three month period at each location ranged from 4 - 14 $\mu g/m^3$ which is between 10 - 35% of the EU annual limit value of 40 $\mu g/m^3$. The results indicate a weak NO_2 spatial concentration gradient in the region.

Updated results at 15 locations (as opposed to 10 locations in the 2008 survey) indicated compliance with the NO_2 annual limit value over a larger geographical area. Updated NO_2 diffusion monitoring results, amounting to six months of data over the period August 2014 to May 2015, indicated an average concentration of between 6 – 19 $\mu g/m^3$ which is between 15 – 48% of the EU annual limit value as shown in Table A8.5.

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SO_2

Sulphur dioxide (SO_2) results are presented in Table A8.6 and A8.7. The 2008 SO_2 diffusion tube concentrations measured over the three-month survey period are below the annual EU limit value of 20 $\mu g/m^3$ for the protection of vegetation as shown in Table A8.6. The average SO_2 concentration measured over the three month period at each location ranged from 0.6 - 1.4 $\mu g/m^3$ which is between 3 - 7% of the EU annual limit value of 20 $\mu g/m^3$.

Updated SO_2 diffusion monitoring results amounting to six months of data over the period August 2014 to May 2015, at six locations in Ringaskiddy, Cobh and Monkstown, indicated an average concentration of between 5 – 13 $\mu g/m^3$ which is between 25 – 65% of the EU annual limit value for the protection of vegetation as shown in Table A8.7.

Benzene

Benzene results are presented in Table A8.8 and A8.9. The 2008 benzene diffusion tube concentrations measured over the three-month survey period are below the annual EU limit value of 5 $\mu g/m^3$ for the protection of human health as shown in Table A8.8. The average benzene concentration measured over the three month period at each location ranged from 0.3 - 0.4 $\mu g/m^3$ which is between 6 - 8% of the EU annual limit value of 5 $\mu g/m^3$.

Updated benzene diffusion monitoring results amounting to six months of data over the period August 2014 to May2015, at six locations in Ringaskiddy, Cobh and Monkstown, indicated an average concentration of between 1.2 – 1.3 $\mu g/m^3$ which is between 24 – 26% of the EU annual limit value as shown in Table A8.9.

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PCDDs & PCDFs

Background levels of PCDD/PCDFs occur everywhere and existing levels in the Ringaskiddy region have been monitored over four one-week periods in April - May 2008. Monitoring was carried out over four 4-5 (approx.) day periods, the results of which are detailed in Tables A8.10 and A8.11. A summary of the results for the one-month period is detailed in Table A8.12.

The mean PCDD/PCDF concentration measured over the four one-week periods during April - May 2008 indicates that results are in line with measurements conducted elsewhere in Ireland, with an upper limit of 13.5 fg/m^3 compared to previous measurements ranging from 2.8 – 46 fg/m^3.

HCl & HF

HCl and HF were measured over four sets of 3-4 day periods at the on-site monitoring station during April - June 2008. The results are detailed in Table A8.13. The average concentrations measured during the one-month period in 2008 were 1.2 μg/m^3 (HCl) and < 0.05 μg/m^3 (HF). The average HCl levels can be indicatively compared to the hourly EAL for HCl of 800 μg/m^3 and the long-term of EAL of 20 μg/m^3 whereas the average HF level can be indicatively compared to the annual UK DEFRA Limit value for HF of 16 μg/m^3. Hence, measured levels of HCl and HF were considerably lower than the relevant limit values.

$PM_{2.5}$

Daily concentrations of $PM_{2.5}$ measured in 2008 using the sequential $PM_{2.5}$ sampler are shown in Table A8.14. The average $PM_{2.5}$ concentration measured over the one-month period is 7 μg/m^3 which is significantly below the annual average EU limit value of 25 μg/m^3 which is applicable in 2015.

PM_{10}

Daily concentrations of PM_{10} measured, in 2006 – 2007, using the sequential PM_{10} sampler are shown in Table A8.15. The 24-hour PM_{10} concentrations measured over the three-month period are significantly below the 24-hour EU limit value of 50 μg/m^3 which has been applicable since 2005.

No exceedances of the 24-hour limit value were recorded over the three months of this monitoring campaign. The 90th%ile, which means the 36th highest value measured over a full year is compared to the limit value. The standard allows for compliance with the ambient air quality standard to be maintained provided no more than 35 exceedances of the 24-hour limit value occur in any one year. Since no exceedances were recorded over the three-months of this monitoring survey, it is extremely unlikely that 35 exceedances would occur over 365 days at the current location.

The average PM_{10} concentration measured over the three-month period in 2006 – 2007 is 6 μg/m^3 which is only 12% of the EU annual limit value of 40 μg/m^3, which has been applicable since 2005.

Updated monitoring results, amounting to six months of data over the period August 2014 to July 2015, indicated average PM_{10} concentrations measured during the monitoring campaigns of 20 μg/m^3, which is below the annual limit value of 40 μg/m^3 as shown in Figure 8.10 and Table A8.16. Five exceedances of the 24-hour limit value were recorded over the six month monitoring campaign. Since only 5 exceedances

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were recorded over the monitoring survey, it is extremely unlikely that 35 exceedances would occur over 365 days at the current location. Furthermore, monitoring was ongoing during a period of construction near the monitoring station which is likely to have contributed to the period of elevated values in September 2014.

Metals

Ambient concentrations of the suite of metals were measured over 12 sets of 5-7 day periods spread over three-months at the fixed monitoring station during the period November 2006 - February 2007. The results for each sample are detailed in Tables A8.17 and A8.18 and in Figure 8.11. The average concentrations of antimony (Sb), arsenic (As), cadmium (Cd), cobalt (Co), chromium (Cr), copper (Cu), mercury (Hg), manganese (Mn), nickel (Ni), lead (Pb), thallium (Tl) and vanadium (V) were significantly below their respective annual limit values, with upper range average levels reaching only 0.01 - 2% of these limits (see Tables A8.17 and A8.18).

Updated heavy metal monitoring results amounting to six months of data over the period August 2014 to July 2015 indicated an average concentration for each of the heavy metals which was between 0.004 – 37% of the EU annual limit value (see Tables A8.19 - A8.21).

Table A8.3 Summary of Continuous NO_2 Monitoring Results at On-Site Monitoring Station (Year 2008)

Monitoring Period	Details	
March 2008	Total No. Days Sampling	26
	No. Hourly Averages >200 µg/m^3	0
	Monthly Average	6.5 µg/m^3
April 2008	Total No. Days Sampling	30
	No. Hourly Averages >200 µg/m^3	0
	Monthly Average	6.6 µg/m^3
May 2008	Total No. Days Sampling	31
	No. Hourly Averages >200 µg/m^3	0
	Monthly Average	4.0 µg/m^3
June 2008	Total No. Days Sampling	11
	No. Hourly Averages >200 µg/m^3	0
	Monthly Average	5.5 µg/m^3
March - May 2008 Monitoring Period	*Total No. Days Sampling*	*98*
	No. Hourly Averages >200 µg/m^3	*0*
	99.8th%ile of 1-hour Averages	*39.3 µg/m^3*
	Monitoring Period Average	*5.6 µg/m^3*
	Limit Values	**200 µg/m^3 Note 1, 40 µg/m^3 Note 2**

Note 1 EU Council Directive 2008/50/EC - 1-hour limit of 200 µg/m^3 as a 99.8th%ile (i.e. 18 hours >200 µg/m^3 permitted per year).
Note 2 EU Council Directive 2008/50/EC - Annual average limit value.

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Table A8.4 Average NO_2 Concentrations Measured in Ringaskiddy Using Passive Diffusion Tubes (March - June 2008).

Location	**NO_2 ($\mu g/m^3$) 04/03/08 – 01/04/08**	**NO_2 ($\mu g/m^3$) 01/04/08 - 02/05/08**	**NO_2 ($\mu g/m^3$) 02/05/08 - 05/06/08**	**NO_2 Average ($\mu g/m^3$)**	***Adjusted NO_2 Average ($\mu g/m^3$)***
M1- On-Site Monitoring Station	9	8	6	8	6
M2 – Car Park East of Site	10	10	8	9	7
M3 – Nearest Residential	13	11	8	11	8
M4 – Main Residential	11	14	11	12	9
M5 – Ringaskiddy Village	15	16	14	15	11
M6 – N28/R613 Junction	19	19	18	19	14
M7 – South of Haulbowline Island	10	8	6	8	6
M8 – National School	4	7	4	5	4
M9 – Loughbeg	7	8	6	7	5
M10 – Opposite Site Entrance	13	10	3	9	6
		Limit Value			*40 $\mu g/m^3$ Note 1*

Note 1 EU Council Directive 2008/50/EC (as an annual average).

Note 2 Diffusion tube monitoring bias adjustment carried out based on UK DEFRA methodology. Chemiluminescent average for equivalent monitoring period = 5.7 $\mu g/m^3$. Thus the diffusion tube bias is 5.7/7.7 = 0.74

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Table A8.5 Average NO_2 Concentrations Measured in Ringaskiddy, Cobh & Monkstown Using Passive Diffusion Tubes (August 2014 – May 2015).

Location	NO_2 ($\mu g/m^3$) 14/08/14 – 15/09/14	NO_2 ($\mu g/m^3$) 15/09/14 - 20/10/14	NO_2 ($\mu g/m^3$) 20/10/14 – 21/11/14	NO_2 ($\mu g/m^3$) 14/01/15 – 13/02/15	NO_2 ($\mu g/m^3$) 13/02/15 – 16/03/15	NO_2 ($\mu g/m^3$) 31/03/15 – 01/05/15	NO_2 Average ($\mu g/m^3$)	*Adjusted NO_2 Average ($\mu g/m^3$)*
N1- Before Bridge to Haulbowline Island	10.2	13.4	15.8	20.3	18.7	12.6	15	12
N2 – Car Park East of Hammond Lane	7.6	Missing	16.9	14.8	12.6	8	12	10
N3 – Opposite Bus Stop on L2545	4.8	11.4	Missing	12.2	9.9	9.1	9	8
N4 – L2545 (Martello Park)	9.9	13	17.2	16.9	13.7	11.9	14	11
N5 – Entrance to NVD	8.3	9.5	14	14.1	10.3	9.5	11	9
N6 – Ringaskiddy Terminal Car Park	5.9	10.1	16.1	14	10.9	8.9	11	9
N7 – Ringaskiddy Village	8.3	9.6	13.3	15.2	8.4	8.4	11	9
N8 – Ringport Business Park	10.2	11.5	12.1	14.4	9.9	10.5	11	9
N9 – Loughbeg 1	9	11.3	9.7	14.6	7.5	11.1	11	9
N10 – Before Entrance to Johnson & Johnson	8.5	11	11.8	14.3	9.9	10.1	11	9
N11 - Loughbeg 2 (Near National School)	6.3	8.8	9	9.9	7	7	8	6
N12 - Monkstown Car Park	9.3	14.4	17.1	21.5	12.3	14.4	15	12
N13 - Scotsman's Road	9.2	10.6	11.3	10.5	8	9	10	8
N14 - Cobh Promenade	21.4	12.8	13.6	17.6	12.5	10.8	15	12
N15 - Cobh Cathedral	Missing	Missing	23.1	28.6	24.6	19.9	23	19
Limit Value								*40 $\mu g/m^3$ Note 1*

Note 1 EU Council Directive 2008/50/EC (as an annual average).

Note 2 Diffusion tube monitoring bias adjustment carried out based on UK DEFRA methodology. The diffusion tube bias is 0.81.

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Table A8.6 Average SO_2 Concentrations Measured in Ringaskiddy Using Passive Diffusion Tubes (March - June 2008).

Location	**SO_2 ($\mu g/m^3$) 04/03/08 - 01/04/08**	**SO_2 ($\mu g/m^3$) 01/04/08 - 02/05/08**	**SO_2 ($\mu g/m^3$) 02/05/08 - 05/06/08**	**SO_2 Average ($\mu g/m^3$)**
M1- On-Site Monitoring Station	1.2	0.82	<0.1	0.7
M3 - Nearest Residential	1.5	1.5	1.2	1.4
M4 - Main Residential	Note 1	0.98	0.15	0.6
M5 - Ringaskiddy Village	1.4	1.1	1.1	1.2
M8 - National School	1.3	1.3	0.75	1.1
			Limit Value	*20 $\mu g/m^3$ Note 2*

Note 1 Sample tube tampered with during monitoring.
Note 2 EU Council Directive 2008/50/EC (annual average limit for the protection of ecosystems).

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Table A8.7 Average SO_2 Concentrations Measured in Ringaskiddy, Cobh and Monkstown Using Passive Diffusion Tubes (August 2014 – May 2015).

Location	**SO_2 ($\mu g/m^3$) 14/08/14 - 15/09/14**	**SO_2 ($\mu g/m^3$) 15/09/14 - 20/10/14**	**SO_2 ($\mu g/m^3$) 20/10/14 - 21/11/14**	**SO_2 ($\mu g/m^3$) 14/01/15 - 13/02/15**	**SO_2 ($\mu g/m^3$) 13/02/15 - 16/03/15**	**SO_2 ($\mu g/m^3$) 31/03/15 - 01/05/15**	**SO_2 Average ($\mu g/m^3$)**
S1- Car Park East of Hammond Lane	9.1	7.7	3.6	4.3	20.3	3.7	8
S2 - Opposite Bus Stop on L2545	7.9	5	3.4	4.1	7.8	3.8	5
S3 - L2545 (Martello Park)	9.5	4.8	4.9	5.4	14.7	3.1	7
S4 - Ringaskiddy Village	10.9	8.6	32.9	10.9	9.3	4.7	13
S5 - Monkstown Car Park	9.7	7.1	10.4	5	7.6	7.9	8
S6 - Cobh Promenade	12	18.5	13.9	7.5	7.5	5	11
Limit Value							*20 $\mu g/m^3$ Note 1*

Note 1 EU Council Directive 2008/50/EC (annual average limit for the protection of ecosystems).

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Table A8.8 Average Benzene Concentrations Measured in Ringaskiddy Using Passive Diffusion Tubes (March - June 2008).

Location	Benzene (µg/m^3) 04/03/08 - 01/04/08	Benzene (µg/m^3) 01/04/08 - 02/05/08	Benzene (µg/m^3) 02/05/08 - 05/06/08	Benzene Average (µg/m^3)[Note 1]
M1- On-Site Monitoring Station	<0.2	0.2	0.7	0.4
M3 - Nearest Residential	0.6	0.3	<0.2	0.4
M4 - Main Residential	Note 2	0.3	<0.2	0.3
M5 - Ringaskiddy Village	0.4	<0.2	0.3	0.3
M8 - National School	0.5	<0.2	0.2	0.3
			Limit Value	*5 µg/m^3 Note 3*

Note 1 Average calculated assuming non detects are equal to the detection limit.
Note 2 Sample tube tampered with during monitoring.
Note 3 EU Council Directive 2008/50/EC (as an annual average).

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Table A8.9 Average Benzene Concentrations Measured in Ringaskiddy Using Passive Diffusion Tubes (August 2014 – May 2015).

Location	Benzene (µg/m^3) 14/08/14 - 15/09/14	Benzene (µg/m^3) 15/09/14 - 20/10/14	Benzene (µg/m^3) 20/10/14 - 21/11/14	Benzene (µg/m^3) 21/11/14 - 22/12/14	Benzene (µg/m^3) 14/01/15 - 13/02/15	Benzene (µg/m^3) 13/02/15 - 16/03/15	Benzene (µg/m^3) 31/03/15 - 01/05/15	Benzene Average (µg/m^3)
S1- Car Park East of Hammond Lane	1	Note 1	Note 1	1	1	1	3	1.3
S2 - Opposite Bus Stop on L2545	Note 1	Note 1	Note 1	1	2	1	1	1.2
S3 - L2545 (Martello Park)	1	Note 1	Note 1	2	2	1	1	1.3
S4 - Ringaskiddy Village	1	Note 1	Note 1	2	2	1	1	1.3
S5 - Monkstown Car Park	1	1	Note 1	2	2	1	1	1.2
S6 - Cobh Promenade	1	2	Note 1	2	2	1	1	1.3
Limit Value								*5 µg/m^3 Note2*

Note 1 Sample tube damaged due to heavy rainfall
Note 2 EU Council Directive 2008/50/EC (as an annual average).

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Table A8.10 Average PCDD/PCDF Concentrations Measured at the On-Site Monitoring Station (Sampling Periods 1 & 2).

PCDD Congeners	**I-TEF**[Note 1]	**Sampling Period 1: 21/04/08 - 25/04/08**			**Sampling Period 2: 02/05/08 - 06/05/08**		
		Ambient Concentration (fg/m^3) [Note 2]	**Lower Limit TEQ**[Note 3] **(fg/m^3)**	**Upper Limit TEQ**[Note 4] **(fg/m^3)**	**Ambient Concentration (fg/m^3)** [Note 2]	**Lower Limit TEQ**[Note 3] **(fg/m^3)**	**Upper Limit TEQ**[Note 4] **(fg/m^3)**
2,3,7,8-TCDD	1.0	*1.514*	1.5137	1.5137	*1.718*	-	1.7185
1,2,3,7,8-PeCDD	0.5	5.178	2.5892	2.5892	4.419	2.2095	2.2095
1,2,3,4,7,8-HxCDD	0.1	4.063	0.4063	0.4063	*1.718*	-	0.1718
1,2,3,6,7,8-HxCDD	0.1	4.382	0.4382	0.4382	3.601	0.3601	0.3601
1,2,3,7,8,9-HxCDD	0.1	3.824	0.3824	0.3824	*1.146*	-	0.1146
1,2,3,4,6,7,8-HpCDD	0.01	41.43	0.4143	0.4143	*2.046*	-	0.0205
OCDD	0.001	143.4	0.1434	0.1434	24.55	0.0245	0.0245
PCDF Congeners	**I-TEF**[Note 1]						
2,3,7,8-TCDF	0.1	7.967	0.7967	0.7967	7.283	0.7283	0.7283
1,2,3,7,8-PeCDF	0.05	5.099	0.2549	0.2549	6.137	0.3069	0.3069
2,3,4,7,8-PeCDF	0.5	11.15	5.577	5.577	9.001	4.5007	4.5007
1,2,3,4,7,8-HxCDF	0.1	19.92	1.9917	1.9917	6.301	0.6301	0.6301
1,2,3,6,7,8-HxCDF	0.1	10.36	1.0357	1.0357	3.355	0.3355	0.3355
1,2,3,7,8,9-HxCDF	0.1	15.93	0.5258	0.5258	*2.864*	-	0.2537
2,3,4,6,7,8-HxCDF	0.1	5.258	1.5934	1.5934	2.537	0.2864	0.2864
1,2,3,4,6,7,8-HpCDF	0.01	74.09	0.7409	0.7409	8.183	0.0818	0.0818
1,2,3,4,7,8,9-HpCDF	0.01	9.560	0.0956	0.0956	*2.782*	-	0.0278
OCDF	0.001	127.5	0.1275	0.1275	9.820	0.0098	0.0098
		Total TEQ	**18.6**	**18.6**	**Total TEQ**	**9.0**	**11.8**

Note 1 Annex 1, Council Directive 2010/75/EU.

Note 2 Ambient concentration of congener (values in italics indicate levels below the limit of detection).

Note 3 Lower Limit TEQ calculated assuming non-detects are equal to zero (i.e. congeners with ambient levels below the limit of detection not included in Total TEQ)

Note 4 Upper Limit TEQ calculated assuming non-detects are equal to the limit of detection (i.e. congeners with ambient levels below the limit of detection included in Total TEQ).

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Table A8.11 Average PCDD/PCDF Concentrations Measured at the On-Site Monitoring Station (Sampling Periods 3 & 4).

PCDD Congeners	**I-TEF**[Note 1]	**Sampling Period 3: 08/05/08 - 13/05/08**			**Sampling Period 4: 19/05/08 - 23/05/08**		
		Ambient Concentration (fg/m^3) [Note 2]	**Lower Limit TEQ**[Note 3] **(fg/m^3)**	**Upper Limit TEQ**[Note 4] **(fg/m^3)**	**Ambient Concentration (fg/m^3)** [Note 2]	**Lower Limit TEQ**[Note 3] **(fg/m^3)**	**Upper Limit TEQ**[Note 4] **(fg/m^3)**
2,3,7,8-TCDD	1.0	0.6530	0.6530	0.6530	*1.281*	-	1.2808
1,2,3,7,8-PeCDD	0.5	4.505	2.2527	2.2527	2.481	1.2407	1.2407
1,2,3,4,7,8-HxCDD	0.1	6.073	0.6073	0.6073	*1.521*	-	0.1521
1,2,3,6,7,8-HxCDD	0.1	6.530	0.6530	0.6530	2.001	0.2001	0.2001
1,2,3,7,8,9-HxCDD	0.1	3.591	0.3591	0.3591	*1.201*	-	0.1201
1,2,3,4,6,7,8-HpCDD	0.01	25.47	0.2547	0.2547	7.124	0.0712	0.0712
OCDD	0.001	43.75	0.0437	0.0437	21.61	0.0216	0.0216
PCDF Congeners	**I-TEF**[Note 1]						
2,3,7,8-TCDF	0.1	8.489	0.8489	0.8489	4.323	0.4323	0.4323
1,2,3,7,8-PeCDF	0.05	8.489	0.4244	0.4244	3.922	0.1961	0.1961
2,3,4,7,8-PeCDF	0.5	11.75	5.8767	5.8767	7.284	3.6422	3.6422
1,2,3,4,7,8-HxCDF	0.1	9.795	0.9795	0.9795	7.364	0.7364	0.7364
1,2,3,6,7,8-HxCDF	0.1	3.461	0.3461	0.3461	4.162	0.4162	0.4162
1,2,3,7,8,9-HxCDF	0.1	*4.636*	-	0.2285	*3.442*	-	0.2722
2,3,4,6,7,8-HxCDF	0.1	2.285	0.4636	0.4636	2.722	0.3442	0.3442
1,2,3,4,6,7,8-HpCDF	0.01	12.41	0.1241	0.1241	8.805	0.0881	0.0881
1,2,3,4,7,8,9-HpCDF	0.01	*2.351*	-	0.0235	*2.882*	-	0.0288
OCDF	0.001	16.98	0.0170	0.0170	16.01	0.0160	0.0160
		Total TEQ	**13.9**	**14.2**	**Total TEQ**	**7.4**	**9.3**

Note 1 Annex 1, Council Directive 2010/75/EU.

Note 2 Ambient concentration of congener (values in italics indicate levels below the limit of detection).

Note 3 Lower Limit TEQ calculated assuming non-detects are equal to zero (i.e. congeners with ambient levels below the limit of detection not included in Total TEQ)

Note 4 Upper Limit TEQ calculated assuming non-detects are equal to the limit of detection (i.e. congeners with ambient levels below the limit of detection included in Total TEQ).

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Table A8.12 Summary of PCDD / PCDF Concentrations Measured at On-Site Monitoring Station (April - May 2008)

Pollutant	Averaging Period	Minimum PCDDs/PCDFs (I-TEQ) (fg/m^3)	Maximum PCDDs/PCDFs (I-TEQ) (fg/m^3)
April / May 2008 Monitoring			
PCCD/PCDFs	21/04/08 - 25/04/08	18.6	18.6
PCCD/PCDFs	02/05/08 - 06/05/08	9.5	11.8
PCCD/PCDFs	08/05/08 - 13/05/08	13.9	14.2
PCCD/PCDFs	19/05/08 - 23/05/08	7.4	9.3
PCCD/PCDFs	**4-Week Average**	**12.4**	**13.5**

Table A8.13 Average HCl & HF Concentrations Measured at On-Site Monitoring Station (April - June 2008)

Sampling Period	HCl ($\mu g/m^3$)	HF ($\mu g/m^3$)
21/04/08 - 02/05/08	0.22	<0.05
19/05/08 - 23/05/08	0.52	<0.05
23/05/08 - 27/05/08	1.1	<0.05
05/06/08 - 09/06/08	2.7	<0.05
Average	**1.2**	***<0.05***

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Table A8.14 $PM_{2.5}$ Concentrations Measured at On-Site Monitoring Station (May - June 2008)

Date	$PM_{2.5}$ ($\mu g/m^3$)	Date	$PM_{2.5}$ ($\mu g/m^3$)
09/05/08	2.8	25/05/08	9.1
10/05/08	5.7	26/05/08	7.7
11/05/08	9.1	27/05/08	6.2
12/05/08	6.7	28/05/08	7.9
13/05/08	7.7	29/05/08	7.4
14/05/08	8.5	30/05/08	7.7
15/05/08	8.8	31/05/08	8.0
16/05/08	10.5	01/06/08	6.3
17/05/08	4.5	02/06/08	7.5
18/05/08	6.2	03/06/08	7.4
19/05/08	6.0	04/06/08	7.6
20/05/08	10.5	05/06/08	7.7
21/05/08	17.8	06/06/08	7.9
22/05/08	7.2	07/06/08	6.3
24/05/08	11.5	**Mean**	**7**
Limit Values	*25*[Note 1]	***Limit Values***	***25***[Note 1]

Note 1 EU Council Directive 2008/50/EC - annual limit value.

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Table A8.15 Results of PM_{10} monitoring carried out at an on-site location in Ringaskiddy, Co. Cork (2006 – 2007).

Sampling Date	PM_{10} (µg/m³)	Sampling Date	PM_{10} (µg/m³)	Sampling Date	PM_{10} (µg/m³)
08-Nov-06	5	02-Jan-07	6	31-Jan-07	7
09-Nov-06	7	03-Jan-07	4	01-Feb-07	5
10-Nov-06	7	04-Jan-07	6	02-Feb-07	5
12-Nov-06	3	05-Jan-07	< 1	03-Feb-07	8
13-Nov-06	6	06-Jan-07	< 1	04-Feb-07	8
14-Nov-06	5	07-Jan-07	8	05-Feb-07	8
15-Nov-06	3	08-Jan-07	8	06-Feb-07	3
16-Nov-06	2	09-Jan-07	10	07-Feb-07	11
17-Nov-06	3	10-Jan-07	5	08-Feb-07	7
18-Nov-06	5	11-Jan-07	12	09-Feb-07	-(2)
19-Nov-06	4	12-Jan-07	3	10-Feb-07	-(2)
13-Dec-06	-(1)	13-Jan-07	4	11-Feb-07	-(2)
15-Dec-06	-(1)	14-Jan-07	5	12-Feb-07	-(2)
16-Dec-06	-(1)	15-Jan-07	6	13-Feb-07	-(2)
17-Dec-06	-(1)	16-Jan-07	9	14-Feb-07	-(2)
18-Dec-06	-(1)	17-Jan-07	7	15-Feb-07	-(2)
19-Dec-06	-(1)	18-Jan-07	4	16-Feb-07	-(2)
20-Dec-06	6	19-Jan-07	4	17-Feb-07	-(2)
21-Dec-06	7	20-Jan-07	7	18-Feb-07	-(2)
22-Dec-06	8	21-Jan-07	< 1	19-Feb-07	-(2)
23-Dec-06	6	22-Jan-07	1	20-Feb-07	-(2)
24-Dec-06	6	23-Jan-07	3	21-Feb-07	-(2)
25-Dec-06	9	24-Jan-07	4	22-Feb-07	-(2)
26-Dec-06	10	25-Jan-07	7	23-Feb-07	-(2)
27-Dec-06	6	26-Jan-07	5	24-Feb-07	-(2)
28-Dec-06	11	27-Jan-07	3	25-Feb-07	-(2)
30-Dec-06	4	28-Jan-07	3	26-Feb-07	-(2)
31-Dec-06	11	29-Jan-07	6	27-Feb-07	-(2)
01-Jan-07	3	30-Jan-07	4		
Mean			**6**		
No. Exceedances of 24-hour Limit Value			**0**		
Limit Values			**40(3), 50(4)**		

(1) Filter misplaced in laboratory.
(2) Filter weighing error in laboratory.
(3) EU Council Directive 2008/50/EC - (as an annual average).
(4) EU Council Directive 2008/50/EC - (as a 90th percentile of 24 hour averages).

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Table A8.16a PM_{10} Concentrations Measured at On-Site Monitoring Station (August 2014 - July 2015)

Date	PM_{10} (µg/m^3)	Date	PM_{10} (µg/m^3)
22-Aug-14	21	30-Oct-14	8
23-Aug-14	8	31-Oct-14	18
24-Aug-14	12	01-Nov-14	11
25-Aug-14	18	02-Nov-14	8
26-Aug-14	9	03-Nov-14	12
27-Aug-14	17	04-Nov-14	8
28-Aug-14	16	05-Nov-14	10
29-Aug-14	11	06-Nov-14	6
30-Aug-14	20	07-Nov-14	10
31-Aug-14	7	08-Nov-14	14
01-Sep-14	5	09-Nov-14	13
02-Sep-14	2	10-Nov-14	16
03-Sep-14	2	11-Nov-14	10
04-Sep-14	16	12-Nov-14	8
05-Sep-14	46	13-Nov-14	12
06-Sep-14	30	14-Nov-14	14
07-Sep-14	27	15-Nov-14	16
08-Sep-14	46	16-Nov-14	14
09-Sep-14	50	17-Nov-14	11
10-Sep-14	54	18-Nov-14	15
11-Sep-14	29	19-Nov-14	16
12-Sep-14	54	20-Nov-14	21
13-Sep-14	35	21-Nov-14	3
14-Sep-14	50	22-Nov-14	3
15-Sep-14	46	23-Nov-14	25
16-Sep-14	42	24-Nov-14	30
17-Sep-14	67	25-Nov-14	24
18-Sep-14	37	26-Nov-14	25
19-Sep-14	30	27-Nov-14	19
20-Sep-14	58	28-Nov-14	28
21-Sep-14	42	29-Nov-14	32
22-Sep-14	37	30-Nov-14	32
23-Sep-14	29	01-Dec-14	24
24-Sep-14	41	02-Dec-14	19
25-Sep-14	37	03-Dec-14	29
26-Sep-14	32	29-Jan-15	4
27-Sep-14	25	30-Jan-15	18
28-Sep-14	38	31-Jan-15	13
29-Sep-14	42	01-Feb-15	25
10-Oct-14	7	02-Feb-15	37
11-Oct-14	10	03-Feb-15	22
12-Oct-14	16	04-Feb-15	19
13-Oct-14	12	05-Feb-15	16
14-Oct-14	11	06-Feb-15	24
15-Oct-14	8	07-Feb-15	26
16-Oct-14	14	08-Feb-15	25
17-Oct-14	13	09-Feb-15	17
18-Oct-14	19	10-Feb-15	32
19-Oct-14	9	11-Feb-15	26
20-Oct-14	8	12-Feb-15	23
21-Oct-14	13	14-Feb-15	16
22-Oct-14	11	15-Feb-15	16
23-Oct-14	1	16-Feb-15	11
24-Oct-14	6	17-Feb-15	14
25-Oct-14	5	18-Feb-15	20
26-Oct-14	5	19-Feb-15	14
27-Oct-14	13	20-Feb-15	12
28-Oct-14	12	21-Feb-15	15
29-Oct-14	6	22-Feb-15	10
Limit Values	*40*[Note 1]	*Limit Values*	*40*[Note 1]

Note 1 EU Council Directive 2008/50/EC - annual limit value.

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Table A8.16b PM_{10} Concentrations Measured at On-Site Monitoring Station (August 2014 - July 2015)

Date	PM_{10} (µg/m^3)	Date	PM_{10} (µg/m^3)
23-Feb-15	10	09-Apr-15	50
24-Feb-15	6	10-Apr-15	48
25-Feb-15	6	11-Apr-15	9
26-Feb-15	15	12-Apr-15	14
27-Feb-15	11	13-Apr-15	20
28-Feb-15	19	29-Apr-15	11
01-Mar-15	13	30-Apr-15	11
02-Mar-15	4	01-May-15	23
03-Mar-15	8	02-May-15	16
04-Mar-15	13	03-May-15	5
05-Mar-15	19	08-May-15	13
06-Mar-15	31	09-May-15	12
07-Mar-15	17	10-May-15	22
08-Mar-15	17	11-May-15	28
09-Mar-15	19	14-May-15	23
10-Mar-15	38	15-May-15	14
11-Mar-15	11	16-May-15	17
12-Mar-15	14	17-May-15	15
17-Mar-15	55	18-May-15	11
18-Mar-15	49	19-May-15	10
19-Mar-15	49	20-May-15	15
20-Mar-15	20	25-Jun-15	20
21-Mar-15	17	26-Jun-15	14
22-Mar-15	16	27-Jun-15	21
23-Mar-15	12	28-Jun-15	17
24-Mar-15	15	29-Jun-15	25
25-Mar-15	11	30-Jun-15	32
26-Mar-15	19	01-Jul-15	16
27-Mar-15	0.2	02-Jul-15	15
03-Apr-15	20	03-Jul-15	21
04-Apr-15	18	04-Jul-15	19
05-Apr-15	18	05-Jul-15	15
06-Apr-15	11	06-Jul-15	15
07-Apr-15	29	07-Jul-15	17
08-Apr-15	30	08-Jul-15	14
Mean		***20***	
No. Exceedances of 24-hour Limit Value		***5***	
Limit Values		**40(1), 50(2)**	

(1) EU Council Directive 2008/50/EC - (as an annual average).
(2) EU Council Directive 2008/50/EC - (as a 90th percentile of 24 hour averages).

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Table A8.17 Levels of heavy metals measured at an on-site location in Ringaskiddy during the period 08/11/06 – 27/02/07.

Species	Period 1 08/11/06 - 13/11/06 (ng/m^3)	Period 2 14/11/06 - 19/11/06 (ng/m^3)	Period 3 20/12/06 - 26/12/06 (ng/m^3)	Period 4 27/12/06 - 02/01/07 (ng/m^3)	Period 5 03/01/07 - 11/01/07 (ng/m^3)	Period 6 12/01/07 - 18/01/07 (ng/m^3)	Period 7 19/01/07 - 25/01/07 (ng/m^3)	Limit Values (ng/m^3)(1)
Antimony	< 0.069	< 0.069	< 0.006	< 0.006	< 0.069	< 0.060	< 0.060	5000
Arsenic	< 0.069	< 0.069	< 0.060	< 0.060	< 0.069	< 0.060	< 0.060	6(2)
Cadmium	< 0.069	< 0.069	0.23	0.054	< 0.069	0.012	0.018	5(2)
Chromium	< 0.069	< 0.069	3.4	4.9	< 0.069	< 0.060	< 0.060	5000
Cobalt	< 0.069	< 0.069	< 0.060	< 0.060	< 0.069	< 0.060	< 0.060	200
Copper	0.076	< 0.069	1.0	3.3	0.13	< 0.060	< 0.060	2000
Lead	14.4	6.5	0.94	1.8	20.6	17.6	6.5	500
Manganese	< 0.069	< 0.069	1.1	0.80	< 0.069	< 0.060	< 0.060	150
Mercury	< 0.069	< 0.069	< 0.060	< 0.060	< 0.069	< 0.060	< 0.060	1000
Nickel	0.097	< 0.069	< 0.060	< 0.060	< 0.069	0.077	< 0.060	20(2)
Thallium	< 0.014	< 0.014	< 0.012	< 0.012	< 0.014	< 0.012	< 0.012	1000
Vanadium	< 0.069	< 0.069	0.52	< 0.060	< 0.069	< 0.060	< 0.060	1000

(1) Annual average limit values set by the EU, WHO, TA Luft Guidelines or a derived as an Environmental Assessment Level.

(2) EU Directive 2004/107/EC

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Table A8.18 Levels of heavy metals measured at an on-site location in Ringaskiddy during the period 08/11/06 – 27/02/07.

Species	Period 8 26/01/07 - 01/02/07 (ng/m^3)	Period 9 02/02/07 - 08/02/07 (ng/m^3)	Period 10 09/02/07 - 15/02/07 (ng/m^3)	Period 11 16/02/07 - 22/02/07 (ng/m^3)	Period 12 23/02/07 - 27/02/07 (ng/m^3)	Lower Range Average (ng/m^3)(1)	Upper Range Average (ng/m^3)(2)	Limit Values (ng/m^3)(3)
Antimony	0.006	0.012	< 0.060	< 0.060	< 0.060	**0.001**	**0.045**	5000
Arsenic	< 0.060	< 0.060	< 0.060	< 0.060	< 0.060	**ND**	**0.062**	6(4)
Cadmium	0.006	< 0.006	0.11	0.006	< 0.006	**0.037**	**0.055**	5(4)
Chromium	< 0.060	< 0.060	< 0.060	< 0.060	< 0.060	**0.70**	**0.75**	5000
Cobalt	< 0.060	< 0.060	< 0.060	< 0.060	< 0.060	**ND**	**0.062**	200
Copper	0.10	< 0.060	0.11	< 0.060	< 0.060	**0.12**	**0.42**	2000
Lead	10.8	19.4	7.4	3.3	9.2	**9.9**	**9.9**	500
Manganese	< 0.060	< 0.060	< 0.060	< 0.060	< 0.060	**0.16**	**0.21**	150
Mercury	< 0.060	< 0.060	< 0.060	< 0.060	< 0.060	**N.D.**	**0.062**	1000
Nickel	< 0.060	< 0.060	< 0.060	0.13	0.071	**0.031**	**0.073**	20(4)
Thallium	< 0.012	< 0.012	< 0.012	< 0.012	< 0.012	**N.D.**	**0.012**	1000
Vanadium	< 0.060	< 0.060	< 0.060	< 0.060	< 0.060	**0.043**	**0.10**	1000

(1) Values at detection limit have been taken to equal to zero.
(2) Values at detection limit have been taken to equal to the detection limit
(3) Annual average limit values set by the EU, WHO, TA Luft Guidelines or a derived as an Environmental Assessment Level.
(4) EU Directive 2004/107/EC

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Table A8.19 Levels of heavy metals measured at an on-site location in Ringaskiddy during the period 04/09/14 – 13/11/14.

Species	Period 1 04/09/14 - 09/09/14 (ng/m^3)	Period 2 10/09/14 - 14/09/14 (ng/m^3)	Period 3 15/09/14 - 21/09/14 (ng/m^3)	Period 4 22/09/14 - 28/09/14 (ng/m^3)	Period 5 10/10/14 - 16/10/14 (ng/m^3)	Period 6 17/10/14 - 23/10/14 (ng/m^3)	Period 7 24/10/14 – 30/10/14 (ng/m^3)	Period 8 31/10/14 - 06/11/14 (ng/m^3)	Period 9 07/11/14 - 13/11/14 (ng/m^3)	Limit Values (ng/m^3)(1)
Antimony	0.63	0.50	0.95	0.65	5.60	5.60	5.48	5.42	5.30	5000
Arsenic	0.21	0.17	0.60	0.30	0.60	0.60	0.60	0.42	0.60	6(2)
Cadmium	0.35	0.33	0.46	0.18	0.18	0.18	0.12	0.12	0.24	5(2)
Chromium	13.89	15.00	14.29	11.90	36.31	34.52	36.31	33.93	39.88	5000
Cobalt	0.69	0.58	0.65	0.47	0.60	0.36	0.48	0.42	0.54	200
Copper	7.64	6.67	6.55	3.45	5.95	7.14	4.88	3.81	5.30	2000
Lead	9.72	10.00	15.48	4.82	8.33	7.14	5.54	5.77	5.89	500
Manganese	15.28	15.83	14.88	10.12	12.50	11.90	13.10	12.50	14.29	150
Mercury	0.56	0.67	0.42	0.42	0.36	0.36	0.12	0.12	0.12	1000
Nickel	9.72	10.83	11.31	7.14	8.33	7.14	5.48	5.42	8.33	20(2)
Thallium	0.07	0.08	0.02	0.01	0.04	0.03	0.02	0.05	0.03	1000
Vanadium	2.15	2.92	3.10	1.79	0.60	0.60	3.57	1.61	1.19	5000

(1) Annual average limit values set by the EU, WHO, TA Luft Guidelines or a derived as an Environmental Assessment Level.

(2) EU Directive 2004/107/EC

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Table A8.20 Levels of heavy metals measured at an on-site location in Ringaskiddy during the period 14/11/14 – 12/03/15.

Species	Period 10 14/11/14 - 20/11/14 (ng/m^3)	Period 11 21/11/14 - 27/11/14 (ng/m^3)	Period 12 28/11/14 - 03/12/14 (ng/m^3)	Period 13 29/01/15 - 04/02/15 (ng/m^3)	Period 14 05/02/15 - 11/02/15 (ng/m^3)	Period 15 12/02/15 and 14/02/15 - 19/02/15 (ng/m^3)	Period 16 20/02/15 – 26/02/15 (ng/m^3)	Period 17 27/02/15 - 05/03/15 (ng/m^3)	Period 18 06/03/15 - 12/03/15 (ng/m^3)	Limit Values (ng/m^3)[1]
Antimony	7.74	5.71	6.53	4.82	2.38	1.49	1.25	1.49	1.19	5000
Arsenic	2.02	1.19	0.69	0.12	0.30	0.42	0.18	1.19	0.60	6[2]
Cadmium	0.42	0.25	0.28	0.12	0.18	0.18	0.12	0.12	0.12	5[2]
Chromium	35.12	36.90	36.11	39.88	50.60	47.02	45.83	48.21	31.55	5000
Cobalt	0.60	0.53	0.46	0.50	0.55	0.57	0.77	0.60	0.36	200
Copper	9.52	7.74	8.33	5.00	5.36	3.87	3.21	8.93	8.33	2000
Lead	101.19	14.29	9.72	6.55	7.14	7.74	3.75	4.58	8.93	500
Manganese	14.88	16.67	17.36	14.29	19.05	14.29	13.10	14.29	12.50	150
Mercury	0.12	0.06	0.06	0.04	0.04	0.12	0.06	0.12	0.12	1000
Nickel	5.71	5.60	6.32	5.65	5.95	7.14	5.65	5.95	4.17	20[2]
Thallium	0.04	0.02	0.04	0.04	0.04	0.03	0.02	0.06	0.05	1000
Vanadium	1.90	1.43	2.22	0.71	0.36	1.49	0.77	1.55	0.83	5000

[1] Annual average limit values set by the EU, WHO, TA Luft Guidelines or a derived as an Environmental Assessment Level.

[2] EU Directive 2004/107/EC

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Table A8.21 Levels of heavy metals measured at an on-site location in Ringaskiddy during the period 17/03/15 – 08/07/15.

Species	Period 19 17/03/15 - 23/03/15 (ng/m^3)	Period 20 24/03/15 - 26/03/15 (ng/m^3)	Period 21 03/04/15 - 12/04/15 (ng/m^3)	Period 22 29/04/15 - 02/05/15 (ng/m^3)	Period 23 03/05/15 and 08/05/15 - 11/05/15 (ng/m^3)	Period 24 14/05/15 - 20/05/15 (ng/m^3)	Period 25 25/06/15 - 01/07/15 (ng/m^3)	Period 26 02/07/15 - 08/07/15 (ng/m^3)	Averages – Sept 14 – July 15 (ng/m^3)	Limit Values (ng/m^3)[1]
Antimony	1.96	2.08	1.92	2.19	1.67	1.85	4.76	4.76	**3.2**	**5000**
Arsenic	0.06	0.14	0.63	0.21	0.33	0.24	4.76	4.76	**0.8**	**6[2]**
Cadmium	0.30	0.14	5.42	0.31	0.17	0.18	5.95	5.95	**0.9**	**5[2]**
Chromium	51.8	50.0	62.5	54.2	52.5	50.6	45.2	44.1	**39.2**	**5000**
Cobalt	0.65	0.63	0.88	0.73	0.53	0.54	1.79	1.79	**0.7**	**200**
Copper	3.81	1.39	6.25	3.13	4.67	3.81	5.95	5.95	**5.6**	**2000**
Lead	8.33	7.50	17.92	6.04	4.83	4.70	23.81	5.95	**12.1**	**500**
Manganese	18.45	16.67	21.25	16.67	15.00	14.88	17.86	11.90	**15.0**	**150**
Mercury	0.03	0.07	0.04	0.21	0.75	0.18	5.36	5.36	**0.6**	**1000**
Nickel	7.14	6.11	8.75	6.88	14.17	10.12	5.95	5.36	**7.3**	**20[2]**
Thallium	0.02	0.04	0.03	0.02	0.08	0.06	5.95	5.95	**0.5**	**1000**
Vanadium	1.73	0.92	2.46	0.67	1.92	2.08	3.57	3.57	**1.8**	**5000**

(1) Annual average limit values set by the EU, WHO, TA Luft Guidelines or a derived as an Environmental Assessment Level.

(2) EU Directive 2004/107/EC

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8.4 Modelling Methodology

8.4.1 Introduction

Emissions from the proposed facility has been modelled using the AERMOD dispersion model which is the USEPA's regulatory model used to assess pollutant concentrations associated with industrial sources(1). Emissions have been assessed, firstly under maximum emissions limits of the EU Directive 2010/75/EU and secondly under abnormal operating conditions.

8.4.2 Process Emissions

The Ringaksiddy Resource Recovery Centre facility has one main process emission point (flue). The operating details of this major emission point is outlined in Table A8.22. Full details of emission concentrations and mass emissions are given in Appendix 8.6.

Table A8.22 Process Emission Design Details

Stack Reference	Stack Height (m)	Exit Diameter (m)	Cross-Sectional Area (m^2)	Temp (K)	Volume Flow (Nm^3/hr)(1)	Exit Velocity (m/sec actual)(2)
Grate	70	2.30	4.15	418	142,000 – Maximum 106,900 – Nominal	14.0 10.5

(1) Normalised to 11% O_2, dry, 273K.
(2) Actual, 418K

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The AERMOD model was run using a unitised emission rate of 1 g/s for the stack. The unitised concentration output has then been adjusted for each substance based on the specific emission rate of each.

8.4.3 Background Concentrations

The ambient concentrations detailed in the following sections include both the emissions from the facility and the ambient background concentration for that substance. Background concentrations have been derived from a conservative analysis of the existing background air quality and an analysis of cumulative sources in the region in the absence of the development. A detailed baseline air quality assessment (Section 8.3) was carried out to assess background levels of those pollutants, which are likely to be released from the site. Appropriate background values have been outlined in Table A8.23. In arriving at the combined annual background concentration, cognisance has been taken of the accuracy of the approach and the degree of double counting inherent in the assessment. In relation to NO_2, PM_{10}, $PM_{2.5}$ and benzene the baseline monitoring program will have taken into account the existing traffic levels and existing home heating and minor industrial sources. However, traffic levels associated with the development have been incorporated into the final combined background levels. The values have been rounded accordingly based on this conservative approach. A similar approach has been adopted for the other pollutants.

In order to obtain the predicted environmental concentration (PEC), background data was added to the process emissions. In relation to the annual averages, the ambient background concentration was added directly to the process concentration. However, in relation to the short-term peak concentrations, concentrations due to emissions from elevated sources cannot be combined in the same way. Guidance from the UK DEFRA(13) advises that for NO_2, SO_2 and PM_{10} an estimate of the maximum combined pollutant concentration can be obtained as shown below:

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NO_2 - The 99.8th%ile of total 1-hour NO_2 is equal to the minimum of either A or B below:

a) 99.8th%ile hourly background total oxidant (O_3 & NO_2) + 0.05 x (99.8th%ile process contribution NO_x)

b) The maximum of either:

99.8th% process contribution NO_x + 2 x (annual mean background NO_2)
or
99.8th% hourly background NO_2 + 2 x (annual mean process contribution NO_x)

PM_{10} - The 90.4th%ile of total 24-hour mean PM_{10} is equal to the maximum of either A or B below:

a) 90.4th%ile of 24-hour mean background PM_{10} + annual mean process contribution PM_{10}
b) 90.4th%ile 24-hour mean process contribution PM_{10} + annual mean background PM_{10}

SO_2 - The 99.7th%ile of total 1-hour SO_2 is equal to the maximum of either A or B below:

a) 99.7th%ile hourly background SO_2 + (2 x annual mean process contribution SO_2)
b) 99.7th%ile hourly process contribution SO_2 + (2 x annual mean background contribution SO_2)

SO_2 - The 99.2th%ile of total 24-hour SO_2 is equal to the maximum of either A or B below:

a) 99.2th%ile of 24-hour mean background SO_2 + (2 x annual mean process contribution SO_2)
b) 99.2th%ile 24-hour mean process contribution SO_2 + (2 x annual mean background contribution SO_2).

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Table A8.23 Estimated annual background concentrations in the region of Ringaskiddy (μg/m^3).

	NO_2	NO_X	SO_2	PM_{10}	$PM_{2.5}$	CO	TOC(2)	HCl	HF	Dioxins(1)	B(*a*)P	Cd	Hg	As	V	Ni
Baseline Monitoring Program - Year 2006 – 2008 & Year 2014 - 2015	10	13	9	20	12	-	1	1.2	0.05	0.0013 pg/m^3	0.71 ng/m^3	0.001	0.001	0.001	0.002	0.007
Annual Background Concentration - Year 2020	10	13	9	20	12	450	1	1.2	0.05	0.0013 pg/m^3	0.71 ng/m^3	0.001	0.001	0.001	0.002	0.007
Facility Traffic - Year 2020(3)	0.63	1.21	-	0.1	0.1	0.005	0.005	-	-	-	-	-	-	-	-	-
Cumulative Assessment	2	3	1	-(4)	-(4)	-(4)	-(4)	-(4)	-(4)	0.001 pg/m^3	-(4)	-(4)	-(4)	-(4)	-(4)	-(4)
Annual Background & Facility Traffic Concentration (Year 2020)	**12**	**17**	**10**	**20**	**12**	**500**	**1.0**	**1.2**	**0.05**	**0.0014 pg/m^3**	**0.71 ng/m^3**	**0.001**	**0.001**	**0.001**	**0.002**	**0.007**

(1) Dioxins reported as non-detects as equal to the limit of detection.
(2) Assumed to consist solely of benzene as a worst-case.
(3) Derived using the DMRB screening model (see Appendix 8.3).
(4) No other significant source in the region.

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8.5 Nitrogen Dioxide Emissions and Results

8.5.1 Source Information

Source information including emission release heights, volume flows, locations and stack diameters has been summarised in Appendix 8.6.

8.5.2 Modelling of Nitrogen Dioxide

Nitrogen oxides (NO_X), containing both nitrogen oxide (NO) and nitrogen dioxide (NO_2) are emitted from the combustion process on-site, although it is the latter which is considered the more harmful to human health. These combustion processes lead to emissions which are mainly in the form of nitrogen oxide (NO) (typically 95%) with small amounts of the more harmful nitrogen dioxide.

Ambient Ground Level Concentrations (GLCs) of Nitrogen Dioxide have been predicted for the following scenarios in Table A8.24.

Table A8.24 Emission Scenario for Nitrogen Dioxide

Pollutant	Scenario	Concentration	Emission Rate (g/s)
NO_2	Maximum 1-Hr Operation	400 mg/m^3	15.8
	Maximum 24-Hr Operation	200 mg/m^3	7.89
	Abnormal Operation(1)	400 mg/m^3	15.8

(1) Abnormal operation scenario based on an emission level of 400 mg/m^3 for 3% of the time (assumed to occur for one 24-hour period once per month (12 days per annum)).

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8.5.3 Comparison with Standards and Guidelines

The relevant air quality standard for Nitrogen Dioxide has been detailed in Table A8.25. In this report the ambient air concentrations have been referenced to Council Directive 2008/50/EC, which has been transposed into Irish Legislation as S.I. 180 of 2011. The directive also details margins of tolerance, which are trigger levels for certain types of action in the period leading to the attainment date. The margin of tolerance reached 0% in 2010.

An annual average limit for NO_x (NO and NO_2) is generally applicable for the protection of vegetation in highly rural areas away from major sources of NO_x such as large conurbations, factories and high road vehicle activity such as a dual carriageway or motorway. Annex VI of EU Directive 2008/50/EC identifies that monitoring to demonstrate compliance with the NO_X limit for the protection of vegetation should be carried out at distances greater than:

- 5 km from the nearest motorway or dual carriageway,
- 5 km from the nearest major industrial installation,
- 20 km from a major urban conurbation.

As a guideline, a monitoring station should be indicative of approximately 1000 km^2 of surrounding area. However, representing a worst-case approach, the standard has been applied in the region of the nearby proposed Lough Beg NHA and the Cork Harbour SPA.

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Table A8.25 EU Ambient Air Standards - Council Directive 2008/50/EC

Pollutant	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	0% After 2010	200 μg/m^3 NO_2
		Annual limit for protection of human health	0% After 2010	40 μg/m^3 NO_2
		Critical level for protection of vegetation	None	30 μg/m^3 NO + NO_2

8.5.4 Modelling Results

Modelling was carried out for the scenarios described in Section 8.5.2. Table A8.26 details the predicted annual average and maximum one-hour NO_2 GLC for each scenario at the worst-case locations whereas Table A8.27 details the spatial variation in nitrogen dioxide concentrations at specific locations in the surrounding region. Table A8.26 also details the predicted NO_X GLC for each scenario at the worst-case locations in the region of the proposed NHA and SPA.

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Table A8.26 Dispersion Model Results – Nitrogen Dioxide

Pollutant / Scenario	Averaging Period	Process Contribution (µg/m³)	Background Concentration (µg/m³)(1)	Predicted Emission Concentration (µg/Nm³)	Standard(2) (µg/Nm³)	Facility emissions as a % of ambient limit value
NO_2 / Maximum	Annual Mean(3)	1.2	12	13.2	40	3.1%
	99.8th%ile of 1-hr means(4)	72.1	N/A(4)	125.3	200	36.0%
NO_2 / Abnormal Operation	Annual Mean(3)	1.3	12	13.3	40	3.3%
	99.8th%ile of 1-hr means(4)	72.1	N/A(4)	125.3	200	36.0%
NO_X / Maximum	Annual Average (In NHA / SPA Only)	1.2	17	18.2	30	4.0%
NO_X / Abnormal Operation	Annual Average (In NHA / SPA Only)	1.25	17	18.3	30	4.2%

(1) Includes contribution from traffic and background sources (based on baseline monitoring results).
(2) Directive 2008/50/EC
(3) Conversion factor (annual average) based on the default ratio of 0.75.
(4) Derived using the UK LAQM(09) Guidance (Reference 13) as outlined in Section 8.4.3 with detailed results presented in Appendix A8.7.

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Table A8.27 Dispersion Model Results – Nitrogen Dioxide Maximum Operation, Specific Receptors

Pollutant / Location	Averaging Period	Process Contribution ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)(1)	Predicted Emission Concentration ($\mu g/Nm^3$)	Standard(2) ($\mu g/Nm^3$)	Facility emissions as a % of ambient limit value
NO_2 Maximum / Worst-case Residential Receptor	Annual Mean(3)	0.26	12	12.3	40	0.6
	99.8th%ile of 1-hr means(4)	33.8	N/A(4)	105.6	200	17
NO_2 Typical / Ringaskiddy School	Annual Mean(3)	0.11	12	12.1	40	0.3
	99.8th%ile of 1-hr means(4)	11.6	N/A(4)	105.3	200	5.8
NO_2 Typical / Ringaskiddy Centre	Annual Mean(3)	0.11	12	12.1	40	0.5
	99.8th%ile of 1-hr means(4)	22.4	N/A(4)	105.4	200	11
NO_2 Typical / Cobh	Annual Mean(3)	0.17	12	12.2	40	0.4
	99.8th%ile of 1-hr means(4)	12.8	N/A(4)	105.4	200	6.4
NO_2 Typical / Carrigaline	Annual Mean(3)	0.03	12	12.03	40	0.1
	99.8th%ile of 1-hr means(4)	4.3	N/A(4)	105.1	200	2.1
NO_2 Typical / Crosshaven	Annual Mean(3)	0.12	12	12.1	40	0.3
	99.8th%ile of 1-hr means(4)	15.6	N/A(4)	105.3	200	7.8

(1) Includes contribution from traffic and background sources (based on baseline monitoring results).
(2) Directive 2008/50/EC
(3) Conversion factor following based on default ratio of 0.75.
(4) Derived using the UK LAQM(09) Guidance (Reference 13) as outlined in Section 8.4.3.

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8.5.5 Concentration Contours

The geographical variation in NO_2 ground level concentrations beyond the facility boundary are illustrated as concentration contours in Figures 8.12 to 8.13. The contents of each figure are described below.

Figure 8.12 Maximum Operations: Predicted NO_2 99.8th Percentile Concentration

Figure 8.13 Maximum Operations: Predicted NO_2 Annual Average Concentration

8.5.6 Result Findings

In relation to the maximum one-hour limit value, modelling results indicate that the ambient ground level concentrations are below these ambient standards for the protection of human health under maximum and abnormal operation of the facility. Thus, no adverse impact on public health or the environment is envisaged to occur under these conditions at or beyond the facility boundary. Emissions at maximum operations equate to ambient NO_2 concentrations (including background concentrations) which are 63% of the maximum ambient 1-hour limit value (measured as a 99.8th%ile) at the worst-case receptor (to the south of the stack). The annual average NO_2 concentration (including background concentration) is also below the limit value for the protection of human health accounting for 33% of the annual limit value at the worst-case receptor which is located at the south-east boundary of the facility. The impact under abnormal operation is essentially unchanged compared to normal operation due to the infrequent nature of the occurrence (abnormal operation is assumed to occur for approximately 3% of the time in any one year).

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The modelling results indicate that the maximum 1-hour and annual average NO_2 concentrations occur at or near the facility's southern and south-eastern boundaries. Concentrations fall off rapidly away from this maximum and for the maximum 1-hour concentration (as a 99.8th%ile) will be only 17% of the limit value (not including background concentrations) at the nearest sensitive receptor to the facility (see Table A8.27). The annual average NO_2 concentration decreases away from the facility with concentrations from emissions at the proposed facility accounting for only 0.6% of the limit value (not including background concentrations) at worst case sensitive receptors near the facility. Thus, the results indicate that the potential impact from the proposed facility on human health and the environment is minor and limited to the immediate environs of the facility (i.e. close to the facility boundary).

In the surrounding areas of Cobh, Carrigaline and Monkstown, NO_2 levels are significantly lower than background sources with the concentration from emissions at the proposed facility accounting for less than 0.5% of the NO_2 annual limit value for the protection of human health.

The annual average NO_X concentration due to process emissions is 4% of the limit value for the protection of vegetation and when the background concentration is included accounts for 61% of this annual limit value at the worst-case receptor in the region of the nearby ecologically sensitive areas.

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8.6 Sulphur Dioxide, Carbon Monoxide and Total Dust (as PM_{10} and $PM_{2.5}$) Emissions and Results

8.6.1 Source Information

Source information including emission release heights, volume flows, locations and stack diameters has been summarised in Appendix 8.6.

Ambient Ground Level Concentrations (GLCs) of Sulphur Dioxide (SO_2), Carbon Monoxide (CO) and Total Dust (as PM_{10} and $PM_{2.5}$) have been predicted for the following scenarios in Table A8.28.

Table A8.28 Emission Scenario for Sulphur Dioxide, Carbon Monoxide and Total Dust (as PM_{10} and $PM_{2.5}$)

Pollutant	Scenario	Concentration	Emission Rate (g/s)
SO_2	Maximum 1-Hr Operation	200 mg/m^3	7.89
	Maximum 24-Hr Operation	50 mg/m^3	1.97
	Abnormal 24-Hr Operation(1)	200 mg/m^3	7.89
CO	Maximum 1-Hr Operation	150 mg/m^3	5.92
	Maximum 24-Hr Operation	50 mg/m^3	1.97
	Abnormal 24-Hr Operation(2)	200 mg/m^3	7.89
Total Dust	Maximum 1-Hr Operation	30 mg/m^3	1.18
	Maximum 24-Hr Operation	10 mg/m^3	0.40
	Abnormal 24-Hr Operation(3)	30 mg/m^3	1.18

(1) Abnormal operation scenario based on an emission level of 200 mg/m^3 for 3% of the time (assumed to occur for one 24-hour period once per month).
(2) Abnormal operation scenario based on an emission level of 200 mg/m^3 for 5% of the time (assumed to occur for one 36-hour period once per month).
(3) Abnormal operation scenario based on an emission level of 30 mg/m^3 for 3% of the time (assumed to occur for one 24-hour period once per month).

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8.6.2 Comparison with Standards And Guidelines

The relevant air quality standards for Sulphur Dioxide, Carbon Monoxide, PM_{10} and $PM_{2.5}$ have been detailed in Table A8.29. In this report the ambient air concentrations for SO_2, CO and PM_{10} / $PM_{2.5}$ have been referenced to Council Directive 2008/50/EC, which has been transposed into Irish Law as S.I. 180 of 2011.

An annual average and winter limit value for SO_2 is applicable for the protection of ecosystems in highly rural areas away from major sources of SO_2 such as large conurbations and industrial facilities. This standard has been applied in the region of the nearby proposed Lough Beg NHA and the Cork Harbour SPA.

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Table A8.29 EU Ambient Air Quality Current & Proposed Standards

Pollutant	Regulation	Limit Type	Current Margin of Tolerance	Value
Sulphur Dioxide	2008/50/EC	Hourly limit for protection of human health - not to be exceeded more than 24 times/year	None	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 critical level for the protection of ecosystems	None	20 μg/m^3
Carbon Monoxide	2008/50/EC	8-hour limit (on a rolling basis) for protection of human health	None	10 mg/m^3
PM_{10}	2008/50/EC	24-hour limit for protection of human health - not to be exceeded more than 35 times/year	None	50 μg/m^3
		Annual limit for protection of human health	None	40 μg/m^3
$PM_{2.5}$	2008/50/EC	Annual target value for protection of human health	None	25 μg/m^3

8.6.3 Modelling Results

Modelling was carried out for the three scenarios described in Section 8.6.1.

Tables A8.30 – A8.33 detail the predicted SO_2, CO, PM_{10} and $PM_{2.5}$ GLC for each scenario.

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Table A8.30 Dispersion Model Results – Sulphur Dioxide

Pollutant / Scenario	Averaging Period	Process Contribution (μg/m^3)	Background (μg/m^3)	Predicted Emission Concentration (μg/Nm^3)	Standard(1) (μg/Nm^3)
SO_2 / Maximum Operation	99.7th%ile of 1-hr means	35.7	N/A(3)	45.1	350
	99.2th%ile of 24-hr means	5.23	N/A(3)	14.6	125
SO_2 / Abnormal Operation(2)	99.7th%ile of 1-hr means	35.7	N/A(3)	45.1	350
	99.2th%ile of 24-hr means	5.54	N/A(3)	14.9	125
SO_2 / Maximum	Annual Average (In NHA / SPA Only)	0.30	4.7	5.0	20
SO_2 / Abnormal	Annual Average (In NHA / SPA Only)	0.34	4.7	5.0	20

(1) Directive 2008/50/EC
(2) Abnormal operation scenario based on an emission level of 200 mg/m^3 for 3% of the time (assumed to occur for one 24-hour period once per month).
(3) Derived using the UK LAQM(09) Guidance (Reference 13) as described in Section 8.4.3.

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Table A8.31 Dispersion Model Results – Carbon Monoxide

Pollutant / Scenario	Averaging Period	Process Contribution (µg/m³)	Background (µg/m³)(1)	Predicted Emission Concentration (µg/Nm³)	Standard(2) (µg/Nm³)
CO / Maximum	Rolling Eight Hour	26.1	1,000	1,026	10,000
CO / Abnormal Operation(3)	Rolling Eight Hour	34.8	1,000	1,035	10,000

(1) Based on two times the annual mean.
(2) Directive 2008/50/EC
(3) Abnormal operation scenario based on an emission level of 200 mg/m³ for 5% of the time (assumed to occur for one 36-hour period once per month).

Table A8.32 Dispersion Model Results – Total Dust (referenced to PM_{10})

Pollutant / Scenario	Averaging Period	Process Contribution (µg/m³)	Background (µg/m³)	Predicted Emission Concentration (µg/Nm³)	Standard(1) (µg/Nm³)
PM_{10} / Maximum	90th%ile of 24-hr means	0.30	N/A(3)	28.1	50
	Annual mean	0.08	20	20.1	40
PM_{10} / Abnormal Operation(2)	90th%ile of 24-hr means	0.30	N/A(3)	28.1	50
	Annual mean	0.09	20	20.1	40

(1) Directive 2008/50/EC
(2) Abnormal operation scenario based on an emission level of 30 mg/m³ for 3% of the time (assumed to occur for one 24-hour period once per month).
(3) Derived using the UK LAQM(09) Guidance (Reference 13) as discussed in Section 8.4.3.

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Table A8.33 Dispersion Model Results – Total Dust (referenced to $PM_{2.5}$)

Pollutant / Scenario	Averaging Period	Process Contribution (µg/m³)	Background (µg/m³)	Predicted Emission Concentration (µg/Nm³)	Limit Value(1) (µg/Nm³)
$PM_{2.5}$ / Maximum	Annual mean	0.08	12	12.1	25
$PM_{2.5}$ / Abnormal Operation(2)	Annual mean	0.09	12	12.1	25

(1) Council Directive 2008/50/EC
(2) Abnormal operation scenario based on an emission level of 30 mg/m³ for 3% of the time (assumed to occur for one 24-hour period once per month).

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8.6.4 Concentration Contours

The geographical variation in SO_2, PM_{10} and $PM_{2.5}$ ground level concentrations beyond the Facility boundary are illustrated as concentration contours in Figures 8.14 to 8.17. The contents of each figure are described below.

Figure 8.14 Maximum Operations: Predicted SO_2 99.7th Percentile of Hourly Concentrations

Figure 8.15 Maximum Operations: Predicted SO_2 99.2th Percentile of 24-Hourly Concentrations

Figure 8.16 Maximum Operations: Predicted PM_{10} 90th Percentile of 24-Hourly Concentrations

Figure 8.17 Maximum Operations: Predicted PM_{10} Annual Concentrations

8.6.5 Result Findings

SO_2

SO_2 modelling results indicate that the ambient ground level concentrations are below the relevant air quality standards for the protection of human health for sulphur dioxide under maximum and abnormal operation of the facility. Thus, no adverse impact on public health or the environment is envisaged to occur under these conditions at or beyond the facility boundary. Emissions at maximum operations equate to ambient SO_2 concentrations due to process emission which are 10% of the maximum ambient 1-hour limit value (measured as a 99.7th%ile) and 4% of the maximum ambient 24-hour limit value (measured as a 99.2th%ile) at the worst-case receptor. When background concentrations are included this rises to 13% of the maximum ambient 1-hour limit value (measured as a 99.7th%ile) and 12% of the maximum ambient 24-hour limit value (measured as a 99.2th%ile) at the worst-case receptor.

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Emissions at maximum operations equate to ambient SO_2 concentrations due to process emissions which are 1.5% of the annual limit value at the worst-case receptor in the region of the proposed Lough Beg NHA and the Cork Harbour SPA. When background concentrations are included this rises to 25% of the annual limit value at the worst-case receptor in the region of the NHA and SPA.

CO

CO modelling results indicate that the ambient ground level concentrations are below the relevant air quality standards for the protection of human health for CO under maximum and abnormal operation of the facility. Thus, no adverse impact on public health or the environment is envisaged to occur under these conditions at or beyond the facility boundary. Emissions at maximum operations equate to ambient CO concentrations due to process emission which is less than 0.3% of the maximum rolling 8-hour limit value at the worst-case receptor. When background concentrations are included this rises to 10% of the maximum rolling 8-hour limit value at the worst-case receptor.

PM_{10}

PM_{10} modelling results indicate that the ambient ground level concentrations are below the relevant air quality standards for the protection of human health for PM_{10} under maximum and abnormal operation of the facility. Thus, no adverse impact on public health or the environment is envisaged to occur under these conditions at or beyond the facility boundary. Emissions at maximum operations equate to ambient PM_{10}

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concentrations (including background concentrations) which are 56% of the maximum ambient 24-hour limit value (measured as a 90th%ile) with the contribution from the proposed facility equating to 0.6% of the limit value. Emissions at maximum operations equate to ambient PM_{10} concentrations which are 50% of the annual average limit value at the worst-case receptor with the contribution from the proposed facility equating to less than 0.3% of the limit value.

$PM_{2.5}$

$PM_{2.5}$ modelling results indicate that the ambient ground level concentrations are below the proposed air quality standard for the protection of human health for $PM_{2.5}$ under maximum and abnormal operation of the facility. Thus, no adverse impact on public health or the environment is envisaged to occur under these conditions at or beyond the facility boundary. Emissions at maximum operations equate to ambient $PM_{2.5}$ concentrations (including background concentrations) which are 48% of the proposed annual average limit value at the worst-case receptor, with the contribution from the proposed facility equating to less than 0.4% of the limit value.

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8.7 Total Organic Carbon (TOC), Hydrogen Chloride and Hydrogen Fluoride Emissions and Results

8.7.1 Source Information

Source information including emission release heights, volume flows, locations and stack diameters has been summarised in Appendix 8.6.

Ambient Ground Level Concentrations (GLCs) of Total Organic Carbon (TOC), Hydrogen Chloride (HCl) and Hydrogen Fluoride (HF) have been predicted for the following scenarios in Table A8.34.

Table A8.34 Emission Scenario for TOC, HCl and HF

Pollutant	Scenario	Concentration	Emission Rate (g/s)
TOC	Maximum 1-Hr Operation	30 mg/m^3	0.79
	Maximum 24-Hr Operation	10 mg/m^3	0.39
	Abnormal Operation(1)	30 mg/m^3	0.79
HCl	Maximum 1-Hr Operation	60 mg/m^3	2.37
	Maximum 24-Hr Operation	10 mg/m^3	0.39
	Abnormal Operation(2)	60 mg/m^3	2.37
HF	Maximum 1-Hr Operation	4 mg/m^3	0.16
	Maximum 24-Hr Operation	1 mg/m^3	0.04
	Abnormal Operation(3)	4 mg/m^3	0.16

(1) Abnormal operation scenario based on an emission level of 30 mg/m^3 for 3% of the time (assumed to occur for one 24-hour period once per month).
(2) Abnormal operation scenario based on an emission level of 60 mg/m^3 for 3% of the time (assumed to occur for one 24-hour period once per month).
(3) Abnormal operation scenario based on an emission level of 4 mg/m^3 for 3% of the time (assumed to occur for one 24-hour period once per month).

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8.7.2 Comparison With Standards And Guidelines

The organic compound emissions from the facility will consist of a range of aliphatic and aromatic compounds at low concentration. The toxicity of these compounds will vary by several orders of magnitude. Ambient benzene levels have been regulated by the EU (Council Directive 2008/50/EC) due to the higher toxicity of this compound compared to other common hydrocarbons (see Table A8.35). In this assessment, it has been assumed that all emissions from the facility are composed of benzene. This is a very pessimistic assumption and thus will significantly overestimate the impact of TOC emissions from the facility.

In the absence of specific Irish air quality guidelines, air quality guidelines for the protection of humans, which have been set by the UK DEFRA (Expert Panel on Air Quality Standards (2008)), have been used in the assessment. Ambient air quality standards for HCl and HF are based on the UK DEFRA environmental assessment levels (EALs) (see Table A8.35).

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Table A8.35 Air Standards for TOC, HCl and HF

Pollutant	Regulation	Limit Type	Value
TOC (assumed to be benzene)	EU Council Directive 2008/50/EC	Annual Average	5 μg/m^3
HCl	UK DEFRA EAL	Maximum 1-Hour	800 μg/m^3
HCl	UK DEFRA EAL	Annual Average	20 μg/m^3
HF	UK DEFRA EAL	Maximum 1-Hour	160 μg/m^3
HF	UK DEFRA EAL	Annual Average	16 μg/m^3

8.7.3 Modelling Results

Modelling was carried out for the three scenarios described in Section 8.7.1 for each pollutant.

Tables A8.36 – A8.38 details the predicted TOC, HCl and HF GLC for each scenario.

Table A8.36 Dispersion Model Results – TOC (assumed to be benzene)

Pollutant / Scenario	Averaging Period	Process Contribution (μg/m^3)	Background (μg/m^3)	Predicted Emission Concentration (μg/Nm^3)	Standard(1) (μg/Nm^3)
TOC / Maximum	Annual Average	0.083	1	1.1	5
TOC / Abnormal Operation(2)	Annual Average	0.099	1	1.1	5

(1) Council Directive 2008/50/EC
(2) Abnormal operation scenario based on an emission level of 30 mg/m^3 for 3% of the time (assumed to occur for one 24-hour period once per month).

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Table A8.37 Dispersion Model Results – HCl

Pollutant / Scenario	Averaging Period	Process Contribution (μg/m^3)	Background (μg/m^3)	Predicted Emission Concentration (μg/Nm^3)	Standard(1) (μg/Nm^3)
HCl / Maximum	Maximum 1-hour	15.7	2.4	18.1	800
HCl / Maximum	Annual	0.083	1.2	1.3	20
HCl / Abnormal Operation(2)	Maximum 1-hour	15.7	2.4	18.1	800
HCl / Abnormal Operation(2)	Annual	0.099	1.2	1.3	20

(1) UK DEFRA EAL
(2) Abnormal operation scenario based on an emission level of 60 mg/m^3 for 3% of the time (assumed to occur for one 24-hour period once per month).

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Table A8.38 Dispersion Model Results – HF

Pollutant / Scenario	Averaging Period	Process Contribution (µg/m³)	Annual Mean Background (µg/m³)	Predicted Emission Concentration (µg/Nm³)	Standard (µg/Nm³)(1)
HF / Maximum	Maximum 1-hr	1.04	0.1	1.1	160
	Annual Average	0.0083	0.05	0.058	16
HF / Abnormal Operation(2)	Maximum 1-hr	1.04	0.1	1.1	160
	Annual Average	0.0093	0.05	0.059	16

(1) UK DEFRA

(2) Abnormal operation scenario based on an emission level of 4 mg/m³ for 3% of the time (assumed to occur for one 24-hour period once per month).

8.7.4 Concentration Contours

The geographical variation in TOC (as benzene), HCl and HF ground level concentrations beyond the facility boundary is illustrated as concentration contours in Figures 8.18 – 8.20. The content of the figures is described below.

Figure 8.18 Maximum Operations: Predicted TOC (as benzene) Annual Average Concentration

Figure 8.19 Maximum Operations: Predicted HCl Maximum 1-Hour Concentration

Figure 8.20 Maximum Operations: Predicted HF Annual Average Concentration

8.7.5 Result Findings

TOC

TOC modelling results indicate that the ambient ground level concentrations are below the relevant air quality standard for the protection of human health for benzene under maximum and abnormal operation of the facility. Thus, no adverse impact on public health or the environment is predicted to occur under these conditions at or beyond the facility boundary. Emissions at maximum operations equate to a maximum ambient TOC concentration (including background concentration) which is 22% of the benzene annual limit value.

HCl

HCl modelling results indicate that the ambient ground level concentrations are below the relevant air quality guideline for the protection of human health for HCl under maximum and abnormal operation of the facility. Thus, no adverse impact on public health or the environment is envisaged to occur under these conditions at or beyond the facility boundary. Emissions at maximum operations equate to ambient HCl concentrations (including background concentrations) which are 2% of the maximum ambient 1-hour limit value and 6% of the annual mean limit value.

HF

HF modelling results indicate that the ambient ground level concentrations are below the relevant air quality standards and guidelines for HF for the protection of human health under maximum and abnormal operation of the facility. Thus, no adverse impact on public health or the environment is envisaged to occur under these conditions at or beyond the facility boundary. Emissions at maximum operations equate to ambient HF concentrations (including background concentrations) which are 0.7% of the maximum ambient 1-hour limit value and 0.4% of the annual limit value.

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8.8 Dioxin-Like Compounds

8.8.1 Description of Dioxin-Like Compounds

The term “Dioxin-like Compounds” generally refers to three classes of compounds; polychlorinated dibenzo-p-dioxins (PCDDs or CDDs), polychlorinated dibenzofurans (PCDFs or CDFs), and polychlorinated biphenyls (PCBs). PCDDs include 75 individual compounds, or congeners, PCDFs include 135 congeners and PCBs include 209 congeners (see Table A8.39). Both PCDDs and PCDFs are usually formed as unintentional by-products through a variety of chemical reactions and combustion processes. These compounds are lipophilic that bind to sediment and organic matter in the environment and tend to be absorbed in animal and human fatty tissue. They are also generally extremely resistant towards chemical and biological degradation processes, and, consequently, persist in the environment and accumulate in the food chain[14].

The toxic effects of dioxins are initiated at the cellular level, by the binding of the dioxin to a specific protein in the cytoplasm of the body cells, the aryl hydrocarbon receptor (AhR). The binding of TCDD to the AhR constitutes a first and necessary step to initiate the toxic and biochemical effects of this compound. Dioxins effects in humans include increased prevalence of diabetes, immunotoxic effects and effects on neurodevelopment and neurobehaviour in children. Studies have shown TCDD to be carcinogenic but a lack of direct DNA-damaging effects indicates that TCDD is not an initiator but a promoter of carcinogenesis[15].

130 of the 209 PCB congeners have historically been manufactured for a variety of uses including dielectric fluids in transformers and capacitors and as lubricants and adhesives. However, the marketing, use and disposal of PCBs has been severely restricted in the EU through Directives 85/467/EC and 96/59/EC[14].

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The toxicity of dioxins varies widely with 2, 3, 7, 8-TCDD being the most potent dioxin congener and with only particular configurations of these compounds thought to have dioxin-like toxicity (See Table A8.40). For PCDDs (Dioxins), only 7 of the 75 congeners have dioxin-like toxicity; these are the ones with chlorine substitutions in, at least, the 2, 3, 7 and 8 positions. For PCDFs (Furans), only 10 of the 135 congeners have dioxin-like toxicity; these are again the ones with chlorine substitutions in, at least, the 2, 3, 7 and 8 positions. In relation to PCBs, only 13 of the 209 congeners are likely to have dioxin-like toxicity; these are the PCBs with four or more chlorines with just one or no substitutions in the ortho position (coplanar)[14,15].

As dioxin-like compounds have varying degrees of toxicity, a toxicity equivalency procedure has been developed to describe the cumulative toxicity of these mixtures. The procedure involved assigning individual Toxicity Equivalency Factors (TEFs) to the 2, 3, 7, 8- substituted PCDD and PCDF congeners and to selected coplanar and mono-ortho PCBs. The TEFs are referenced to 2, 3, 7, 8-TCDD, which is assigned a TEF of 1.0. Calculation of the toxic equivalency (TEQ) of a mixture involves multiplying the concentration of individual congeners by their respective TEF. The sum of the TEQ concentrations for the individual congeners is the TEQ concentration for the mixture.

Since 1989, three different TEF schemes have been developed[16,17]:

I-TEQ$_{DF}$ – Developed by NATO/CCMS in 1988, the I-TEQ$_{DF}$ (DF = dioxin, furan, I = International) procedure assigns TEFs only for the 7 dioxins (PCDDs) and 10 furans (PCDFs). This scheme does not include dioxin-like PCBs. This scheme has been adopted in Council Directive 2010/75/EU and has been applied in the current assessment.

TEQ$_{DFP}$-WHO$_{94}$ – In 1994, the WHO added 13-dioxin-like PCBs to the TEF scheme for dioxins and furans. However, no changes were made to the TEFs for dioxins and furans I-TEQ$_{DF}$ (DFP = dioxin, furan, PCBs).

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TEQ_{DFP}-WHO_{98} – In 1998, the WHO re-evaluated the TEF scheme for dioxins, furans and dioxin-like PCBs. Changes were made to the TEFs for dioxins, furans and dioxin-like PCBs. Table A8.33 outlines the TEF for the most recent scheme for comparison with the scheme recommended in Council Directive 200/76/EC (I-TEQ_{DF}).

8.8.2 Modelling Strategy

The emissions of dioxin-like compounds from the facility have been evaluated in this chapter. Firstly, the stack emissions have been characterised in terms of mass of each Dioxin/Furan congener released, and the partitioning of these releases into a vapour and particle phase. Thereafter, air dispersion modelling has been used to translate these releases to ambient air vapour and particle phase concentrations, and wet and dry particulate deposition fluxes, in the vicinity of the release.

As recommended by the USEPA, individual dioxin congeners have been modelled from source to receptor. Only at the interface to human exposure, e.g., ingestion, inhalation, dermal absorption, etc., are the individual congeners recombined and converted into the toxic equivalence of 2, 3, 7, 8-TCDD to be factored into a quantitative risk assessment.

Emission Rate

The dioxin emission factor is defined as the total mass (in vapour and particulate form) of dioxin-like compound emitted per mass of feed material combusted. For the current proposal, a test burn is not possible as the Ringaskiddy Resource Recovery Centre has not been commissioned yet. However, Indaver has several flue gas cleaning systems similar to that proposed in the current facility in operation in Europe. An analysis of these flue gas cleaning systems has suggested that the likely emission rate will outperform the most stringent limit value set by the EU in the Council Directive on Industrial Emissions (2010/75/EU).

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Congener-specific emission data are needed for the analyses of the ambient air impacts and deposition flux of dioxin-like compounds using air dispersion and deposition models. As each specific congener has different physico-chemical properties, the proportion of each congener will affect the final result. Thus, the congener profile expected from the current facility must be derived. The congener profile will be dependent on various factors including the type of waste being burnt, the temperature of combustion, the type of combustion chamber being operated and the air pollution control devices (APCDs) installed. In the present case, no site-specific stack testing for specific congeners is possible as the facility is not yet built.

Shown in Table A8.41 are typical relative PCDD/PCDF congener emission factors for municipal waste incinerators (MWI) as reported by the USEPA (1998)[18] for the municipal waste incinerator most similar to that proposed in the current scheme, a mass burn refractometry system with wet scrubbing (MB-REF WS) taken from the Database of Sources of Environmental Releases of Dioxin-Like Compounds in the United States (USEPA, 1998 (CD-ROM))[18]. It would be expected that the relative congener profiles for this type of incinerator to be somewhat similar to the current case. Figures 8.21 – 8.22 show the ratio of congeners and the TEQ equivalent releases from this type of facility corrected to the maximum emission limit outlined in Council Directive 2010/75/EU.

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Vapour / Particulate Partitioning

In order to accurately model emissions of PCDD/PCDFs (Dioxins/Furans), PAHs and mercury, the partitioning of stack emissions into the vapour and particle (V/P) state is required.

In relation to PCDD/PCDFs (Dioxins/Furans), V/P partitioning based on stack tests data is highly uncertain[10]. Research has indicated that higher temperatures favour the vaporous states for the lower chlorinated congeners and the particulate state for the higher chlorinated congeners[10]. However, measured data has indicated significant variability in the V/P partitioning. For these reasons, the USEPA has indicated that V/P distributions obtained from stack sampling should not be used.

Data can also be obtained from ambient air sampling using a glass fibre particulate filter and polyurethane foam (PUF) absorbent trap. As the sampler is not subjected to artificial heating or cooling, the method can be used to imply the vapour phase and particle bound partitioning of PCDD/Fs (Dioxins/Furans) in ambient air. However, the results will be only approximate as mass transfer between the particulate matter on the filter and the vapour trap cannot be ruled out[10].

The recommended USEPA approach to obtaining the vapour/particulate partitioning at the current time is theoretical and based on the Junge-Pankow model for estimating the particle/gas distribution of PCDD/PCDFs (Dioxins/Furans)[10]. This model is the one most commonly used for estimating the adsorption of semi-volatile compounds to aerosols:

$$\Phi = c\Theta / (\rho^o_L + c\Theta)$$

where:

Φ = fraction of compound adsorbed to aerosol particles
c = constant (assumed 17.2 Pa-cm)
Θ = particle surface area per unit volume of air, cm^2 aerosol/cm^3 air
ρ^o_L = saturation liquid phase vapour pressure, Pa

The particulate fraction can also be expressed by:

$$\Phi = C_p(TSP) / (C_g + C_p(TSP))$$

where:

Φ = fraction of compound adsorbed to aerosol particles
C_p = concentration of semi-volatile compounds associated with aerosols, ng/μg particles
C_g = gas-phase concentration, ng/m^3
TSP = total suspended particle concentration, $\mu g/m^3$

In the above calculations, it is assumed that all compounds emitted from the combustion sources are freely exchangeable between vapour and particle fractions. This may be a simplification as some of the particulate fraction may be trapped and be unavailable for exchange.

As the ρ^o_L is referenced to 25ºC and an ambient temperature of 10ºC has been assumed which is appropriate for average annual temperatures in Ireland, the ρ^o_L has been converted to the ambient temperature as indicated in Table A8.42. Other relevant data used in the calculations and the derived particle fraction at 10ºC is also shown in Table A8.42.

The advantages of the theoretical approach is that it is based on current adsorption theory, considers the molecular weight and degree of halogenation of the congeners and uses the availability of surface area for adsorption of atmospheric particles corresponding to specific airsheds (background plus local sources used in the current case).

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8.8.3 Modelling of Vapours and Particles Concentrations

PCDD/PCDFs have a range of vapour pressures and thus exist in both vapour and particle-bound states to varying degrees. In order to adequately model dispersion and deposition of PCDD/PCDFs, modelling of both vapour and particle-bound states is thus necessary.

For the deposition modelling of PCDD/PCDFs, both wet and dry gaseous and particulate deposition were calculated.

Gaseous Deposition

Dry Gaseous Deposition

For the dry gaseous deposition modelling of PCDD/PCDFs, four physiochemical parameters are required for dioxins / furans. The dry gaseous deposition velocity formulation is based on three resistance terms; aerodynamic resistance, quasi-laminar resistance to bulk transfer and a bulk surface resistance term. The four physiochemical parameters required to calculate these resistance terms are D_a (diffusivity of modelled gas in air (cm/s)), D_w (diffusivity of modelled gas in water (cm/s)), Henry's Law constant for modelled gas (Pa-m^3/mol) and r_{cl} (leaf cuticular resistance (s/m). The values derived for the 2,3,7,8-TCDD is shown in Table A8.43.

Wet Gaseous Deposition

Wet gaseous deposition physically washes out the chemically contaminated vapours from the atmosphere. Wet gaseous deposition flux depends on the precipitation rate, the concentration of the pollutant in the liquid phase and the molecular weight of the pollutant. The AERMOD model formulation assumes that the wet gaseous deposition flux is the same for snow as for rain.

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For the vapour phase modelling, both dry and wet gaseous deposition was considered. Using the congener profile from Table A8.39 and the vapour – particle partitioning from Table A8.40, the vapour concentrations of the respective dioxin congeners was determined as outlined in Table A8.45 for the stack and diagrammatically in Figure 8.23. Results are shown under maximum operating conditions. The results from wet and dry gaseous deposition modelling have also been reported in Table A8.45 and diagrammatically in Figure 8.24.

Particulate Deposition

Dry Particulate Deposition

When modelling particulate PCDD/PCDFs, the surface area weighting rather than mass weighting is used for deposition. The surface weighting reflects the mode of formation where volatiles condense on the surface of particulates in the flue gas cleaning system (see Column 6 of Table A8.44). This distribution is suitable as a default for some combustion facilities equipped with either electrostatic precipitators (ESPs) or fabric filters, because the distribution is relatively typical of particle size arrays that have been measured at the outlet to advanced equipment designs[10]. Thus, the apportionment of emissions by particle size becomes a function of the surface area of the particle which is available for chemical adsorption.

Dry particulate deposition is based on a resistance scheme in which the deposition velocity is based on the predominant particle size distribution via two methods. Method 1 is used when a significant fraction (> 10%) of the total particulate mass has a diameter greater than 10 microns and the particle size distribution is reasonably well known. The method is based on the gravitational settling velocity and two resistance terms; aerodynamic resistance and quasi-laminar resistance to bulk transfer. Method 2 is used when the

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particle size distribution is not well known and when a small fraction (less than 10% of the mass) consists of particles with a diameter of 10 microns or larger. The deposition velocity for method 2 is given as the weighted average of the deposition velocity for the coarse mode and fine mode. In the results below method 1 has been used, based on the generalised particle-size distribution recommended by the USEPA as outlined in Table A8.44[6], as it gives similar concentrations to method 2 but significantly higher deposition results.

Wet Particulate Deposition

Wet particulate deposition physically washes out the chemically contaminated particulate from the atmosphere. Wet deposition flux depends on the fraction of the time precipitation occurs and the fraction of material removed by precipitation per unit of time by particle size. The AERMOD model formulation is based on a particle washout coefficient which is based on the collision efficiency and the mean diameter of raindrops. It is also assumed that the wet deposition flux is the same for snow as for rain.

For the particle-phase concentration, the congener profile from Table A8.39 and the vapour – particle partitioning from Table A8.40 were used to give the particulate concentrations of the respective dioxin congeners as determined in Table A8.46 and diagrammatically in Figure 8.23. Results are shown under maximum operating conditions.

For the particle-bound deposition, the congener profile from Table A8.39 and the vapour – particle partitioning from Table A8.40 were used to give the particulate emission rate of the respective dioxin congeners. The deposition flux for each congener was calculated by multiplying the emission rate of each congener by the unitised deposition flux as shown in Table A8.47 and diagrammatically in Figure 8.24. Results are shown under maximum operating conditions.

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8.8.4 Comparison with Standards And Guidelines

Currently, no internationally recognised ambient air quality concentration or deposition standards exist for PCDD/PCDFs (Dioxins/Furans). Both the USEPA and WHO recommended approach to assessing the risk to human health from Dioxins/Furans entails a detailed risk assessment analysis involving the determination of the impact of Dioxins/Furans in terms of the TDI (Tolerable Daily Intake) approach[17,18]. A TDI has been defined by the WHO as “an estimate of the intake of a substance over a lifetime that is considered to be without appreciable health risk”[19]. Occasional short term exceedances of the TDI would have no health consequences provided the long-term average is not exceeded. The WHO currently proposes a maximum TDI of between 1-4 pgTEQ/kg of body weight per day. A TDI of 4 pgTEQ/kg of body weight per day should be considered a maximal tolerable intake on a provisional basis and that the ultimate goal is to reduce human intake levels of below 1 pgTEQ/kg of body weight per day. This reflects the concept that guidance values for the protection of human health should consider total exposure to the substance including air, water, soil, food and other media sources (further details in Chapter 7 (Population And Human Health)).

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Table A8.39 The number of dioxin-like and total congeners within dioxin, furan, and coplanar PCB Homologue groups[1].

Homologue Group	n: Number of Dioxin-Like Congeners	N: Number of Congeners	1/N
I. Dioxins			
Tetra-CDD	1	22	0.022
Penta-CDD	1	14	0.071
Hexa-CDD	3	10	0.100
Hepta-CDD	1	2	0.500
Octa-CDD	1	1	1.000
II. Furans			
Tetra-CDF	1	38	0.026
Penta-CDF	2	28	0.036
Hexa-CDF	4	16	0.063
Hepta-CDF	2	4	0.250
Octa-CDF	1	1	1.000
III. Mono-ortho coplanar PCBs			
Tetrachloro-PCBs	1	42	0.024
Pentachloro-PCBs	5	46	0.022
Hexachloro-PCBs	4	42	0.024
Heptachloro-PCBs	3	24	0.042

(1) USEPA (2004) Estimating Exposure to Dioxin-Like Compounds Volume II, Chapter 3

Table A8.40 The TEF scheme for TEQ_{DFP}-WHO_{98} and I-TEQ_{DF} [1].

Dioxin Congeners	TEF	Furan Congeners	TEF
2,3,7,8-TCDD	1.0	2,3,7,8-TCDF	0.1
1,2,3,7,8-PeCDD	1.0 (0.5)[2]	1,2,3,7,8-PeCDF	0.05
1,2,3,4,7,8-HxCDD	0.1	2,3,4,7,8-PeCDF	0.5
1,2,3,6,7,8-HxCDD	0.1	1,2,3,4,7,8-HxCDF	0.1
1,2,3,7,8,9-HxCDD	0.1	1,2,3,6,7,8-HxCDF	0.1
1,2,3,4,6,7,8-HpCDD	0.01	1,2,3,7,8,9-HxCDF	0.1
OCDD	0.0001 (0.001)[2]	2,3,4,6,7,8-HxCDF	0.1
PCB Chemical Structure	**TEF**	1,2,3,4,6,7,8-HpCDF	0.01
3,3',4,4'-TeCB	0.0001	1,2,3,4,7,8,9-HpCDF	0.01
3,4,4',5-TCB	0.0001	OCDF	0.0001 (0.001)[2]
2,3,3',4,4'-PeCB	0.0001		
2,3,4,4',5-PeCB	0.0005		
2,3',4,4',5-PeCB	0.0001		
2',3,4,4',5-PeCB	0.0001		
3,3',4,4',5-PeCB	0.1		
2,3,3',4,4',5-HxCB	0.0005		
2,3,3',4,4',5'-HxCB	0.0005		
2,3',4,4',5,5'-HxCB	0.00001		
3,3',4,4',5,5'-HxCB	0.01		
2,3,3',4,4',5,5'-HpCB	0.0001		

(1) USEPA (2004) Estimating Exposure to Dioxin-Like Compounds Volume II, Chapter 1
(2) Values in parentheses are those given in Annex VI, Council Directive 2010/75/EU and equate to I-TEQ_{DF}.

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Table A8.41 PCDD/PCDF Relative Emission Factors for Municipal Waste Incinerator (MB-Ref WS)[18]

	Emission Factor (relative to sum of toxic congeners)	**Emission Concentration (ng/m^3 from stack)**	**Grate Incinerator Emission Factor (ng/sec from stack)**
Congener Group	Nondetects set to zero	Nondetects set to zero	Nondetects set to zero
2,3,7,8-TCDD	0.00088	0.0023	0.054
1,2,3,7,8-PeCDD	0.00681	0.0090	0.303
1,2,3,4,7,8-HxCDD	0.01168	0.0031	0.105
1,2,3,6,7,8-HxCDD	0.02355	0.0062	0.128
1,2,3,7,8,9-HxCDD	0.02836	0.0075	0.240
1,2,3,4,6,7,8-HpCDD	0.20633	0.0054	0.111
OCDD	0.31520	0.0008	0.019
2,3,7,8-TCDF	0.03103	0.0082	0.038
1,2,3,7,8-PeCDF	0.00623	0.0008	0.049
2,3,4,7,8-PeCDF	0.01633	0.0215	1.066
1,2,3,4,7,8-HxCDF	0.04845	0.0128	0.756
1,2,3,6,7,8-HxCDF	0.01605	0.0042	0.322
1,2,3,7,8,9-HxCDF	0.00322	0.0008	0.000
2,3,4,6,7,8-HxCDF	0.05353	0.0141	0.538
1,2,3,4,6,7,8-HpCDF	0.08777	0.0023	0.185
1,2,3,4,7,8,9-HpCDF	0.02675	0.0007	0.021
OCDF	0.11783	0.0003	0.011
Total PCDD/PCDF	**1.0**	**0.1 ng/m^3**	**3.95 ng/sec**

(1) Database of Sources of Environmental Releases of Dioxin-Like Compounds in the United States (1998, USEPA (CD-ROM)).

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Table A8.42 PCDD/PCDF Particle Fraction, Φ at 10ºC In Airshed (Background plus Local Sources)[10]

Congener Group	**E-Hρ^o_L (25ºC)**	**E-Hρ^o_L (10ºC)[2]**	**Particle Fraction**
2,3,7,8-TCDD	1.14 x 10 $^{-4}$	1.87 x 10 $^{-5}$	0.763
1,2,3,7,8-PeCDD	1.74 x 10 $^{-5}$	2.47 x 10 $^{-6}$	0.961
1,2,3,4,7,8-HxCDD	3.96 x 10 $^{-6}$	4.98 x 10 $^{-7}$	0.992
1,2,3,6,7,8-HxCDD	3.96 x 10 $^{-6}$	4.98 x 10 $^{-7}$	0.992
1,2,3,7,8,9-HxCDD	3.96 x 10 $^{-6}$	4.98 x 10 $^{-7}$	0.992
1,2,3,4,6,7,8-HpCDD	1.02 x 10 $^{-6}$	1.18 x 10 $^{-7}$	0.998
OCDD	2.77 x 10 $^{-7}$	2.91 x 10 $^{-8}$	0.9995
2,3,7,8-TCDF	1.23 x 10 $^{-4}$	2.01 x 10 $^{-5}$	0.75
1,2,3,7,8-PeCDF	3.64 x 10 $^{-5}$	5.46 x 10 $^{-6}$	0.917
2,3,4,7,8-PeCDF	2.17 x 10 $^{-5}$	3.11 x 10 $^{-6}$	0.951
1,2,3,4,7,8-HxCDF	10.09 x 10 $^{-6}$	1.09 x 10 $^{-6}$	0.982
1,2,3,6,7,8-HxCDF	10.09 x 10 $^{-6}$	1.09 x 10 $^{-6}$	0.982
1,2,3,7,8,9-HxCDF	4.99 x 10 $^{-6}$	6.49 x 10 $^{-7}$	0.989
2,3,4,6,7,8-HxCDF	4.99 x 10 $^{-6}$	6.49 x 10 $^{-7}$	0.989
1,2,3,4,6,7,8-HpCDF	2.24 x 10 $^{-6}$	2.77 x 10 $^{-7}$	0.995
1,2,3,4,7,8,9-HpCDF	1.31 x 10 $^{-6}$	1.56 x 10 $^{-7}$	0.9974
OCDF	2.60 x 10 $^{-7}$	2.71 x 10 $^{-8}$	0.9995

(1) USEPA (2004) Estimating Exposure to Dioxin-Like Compounds Volume II, Chapter 3

(2) Background plus local sources default values: $\Theta = 3.5 \times 10^{-6}$ cm^2 aerosol/cm^3 air, TSP = 60 μg/m^3.

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Table A8.43 Gas Deposition Physiochemical Parameters for 2,3,7,8-TCDD

Compound	D_a (cm/s)	D_w (cm/s)	H (Pa m^3 mol^{-1})	r_{cl} (sm^{-1})
2,3,7,8-TCDD	0.052	0.00000439	3.34	7.84

Table A8.44 Generalized Particle Size Distribution & Proportion of Available Surface Area(10)

Mean Particle Diameter (μm)	Particle Radius (μm)	Surface Area/Volume (μm^{-1})	Fraction of Total Mass(2)	Proportion Available Surface Area	Fraction of Total Surface Area(3)
>15.0	7.50	0.400	0.128	0.0512	0.0149
12.5	6.25	0.480	0.105	0.0504	0.0146
8.1	4.05	0.741	0.104	0.0771	0.0224
5.5	2.75	1.091	0.073	0.0796	0.0231
3.6	1.80	1.667	0.103	0.1717	0.0499
2.0	1.00	3.000	0.105	0.3150	0.0915
1.1	0.55	5.455	0.082	0.4473	0.1290
0.7	0.40	7.500	0.076	0.5700	0.1656
>0.7	0.40	7.500	0.224	1.6800	0.4880

(1) USEPA (2004) Chapter 3: Air Dispersion and Deposition Modelling, Human Health Risk Assessment Protocol, Region 6 Centre for Combustion Science and Engineering
(2) Used in the deposition modelling of metals (except Hg)
(3) Used in the deposition modelling of PCDD/PCDFs, PAHs and Hg

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8.8.5 Modelling Results

Tables A8.45 – A8.50 details the predicted PCCD/PCDFs (Dioxins/Furans) GLC and deposition flux for the maximum scenario based on a default municipal waste incinerator profile under maximum operating conditions.

Table A8.45 PCDD/PCDF Annual Vapour Concentrations and Deposition Under Maximum Operations

Congener Group	Vapour Fraction	Vapour Emission Rate (ng/sec)	Annual Vapour Concentration (fg/m^3)	Annual Dry Vapour Deposition (ng/m^2)	Annual Wet Vapour Deposition (ng/m^2)
2,3,7,8-TCDD	0.237	1.29E-02	2.72E-03	7.28E-04	8.26E-06
1,2,3,7,8-PeCDD	0.039	1.18E-02	2.49E-03	6.67E-04	7.56E-06
1,2,3,4,7,8-HxCDD	0.008	8.40E-04	1.77E-04	4.74E-05	5.38E-07
1,2,3,6,7,8-HxCDD	0.008	1.03E-03	2.17E-04	5.79E-05	6.57E-07
1,2,3,7,8,9-HxCDD	0.008	1.92E-03	4.05E-04	1.08E-04	1.23E-06
1,2,3,4,6,7,8-HpCDD	0.002	2.22E-04	4.68E-05	1.25E-05	1.42E-07
OCDD	0.0005	9.37E-06	1.98E-06	5.28E-07	6.00E-09
2,3,7,8-TCDF	0.25	9.52E-03	2.01E-03	5.37E-04	6.09E-06
1,2,3,7,8-PeCDF	0.083	4.09E-03	8.63E-04	2.31E-04	2.62E-06
2,3,4,7,8-PeCDF	0.049	5.22E-02	1.10E-02	2.95E-03	3.34E-05
1,2,3,4,7,8-HxCDF	0.018	1.36E-02	2.87E-03	7.67E-04	8.70E-06
1,2,3,6,7,8-HxCDF	0.018	5.79E-03	1.22E-03	3.26E-04	3.70E-06
1,2,3,7,8,9-HxCDF	0.011	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2,3,4,6,7,8-HxCDF	0.011	5.92E-03	1.25E-03	3.34E-04	3.79E-06
1,2,3,4,6,7,8-HpCDF	0.005	9.25E-04	1.95E-04	5.21E-05	5.92E-07
1,2,3,4,7,8,9-HpCDF	0.0026	5.55E-05	1.17E-05	3.13E-06	3.55E-08
OCDF	0.0005	5.66E-06	1.19E-06	3.19E-07	3.62E-09
Sum			**0.026 fg/m^3**	**0.007 ng/m^2**	**0.00008 ng/m^2**
Equivalent Daily Deposition Flux				**0.019 pg/m^2/day**	**0.0021 pg/m^2/day**

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Table A8.46 PCDD/PCDF Annual Particulate Concentrations Under Maximum Operations

Congener Group	Particulate Fraction	Particulate Emission Rate (ng/sec)	Annual Particulate Concentration (fg/m^3)
2,3,7,8-TCDD	0.763	4.16E-02	8.98E-03
1,2,3,7,8-PeCDD	0.961	2.91E-01	6.29E-02
1,2,3,4,7,8-HxCDD	0.992	1.04E-01	2.25E-02
1,2,3,6,7,8-HxCDD	0.992	1.27E-01	2.75E-02
1,2,3,7,8,9-HxCDD	0.992	2.38E-01	5.14E-02
1,2,3,4,6,7,8-HpCDD	0.998	1.11E-01	2.39E-02
OCDD	0.9995	1.87E-02	4.05E-03
2,3,7,8-TCDF	0.75	2.86E-02	6.17E-03
1,2,3,7,8-PeCDF	0.917	4.52E-02	9.76E-03
2,3,4,7,8-PeCDF	0.951	1.01E+00	2.19E-01
1,2,3,4,7,8-HxCDF	0.982	7.42E-01	1.60E-01
1,2,3,6,7,8-HxCDF	0.982	3.16E-01	6.82E-02
1,2,3,7,8,9-HxCDF	0.989	0.00E+00	0.00E+00
2,3,4,6,7,8-HxCDF	0.989	5.33E-01	1.15E-01
1,2,3,4,6,7,8-HpCDF	0.995	1.84E-01	3.97E-02
1,2,3,4,7,8,9-HpCDF	0.9974	2.13E-02	4.60E-03
OCDF	0.9995	1.13E-02	2.44E-03
Sum			**0.826 fg/m^3**

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Table A8.47 PCDD/PCDF Annual Particulate Deposition Fluxes Under Maximum Operations

Congener Group	Particulate Emission Rate (ng/sec)	Dry Particulate Deposition Flux (ng/m^2)	Wet Particulate Deposition Flux (ng/m^2)	Combined Particulate Deposition Flux (ng/m^2)
2,3,7,8-TCDD	4.16E-02	1.20E-03	1.93E-03	1.94E-03
1,2,3,7,8-PeCDD	2.91E-01	8.42E-03	1.35E-02	1.36E-02
1,2,3,4,7,8-HxCDD	1.04E-01	3.01E-03	4.84E-03	4.85E-03
1,2,3,6,7,8-HxCDD	1.27E-01	3.68E-03	5.92E-03	5.93E-03
1,2,3,7,8,9-HxCDD	2.38E-01	6.88E-03	1.11E-02	1.11E-02
1,2,3,4,6,7,8-HpCDD	1.11E-01	3.20E-03	5.14E-03	5.15E-03
OCDD	1.87E-02	5.41E-04	8.71E-04	8.73E-04
2,3,7,8-TCDF	2.86E-02	8.25E-04	1.33E-03	1.33E-03
1,2,3,7,8-PeCDF	4.52E-02	1.31E-03	2.10E-03	2.11E-03
2,3,4,7,8-PeCDF	1.01E+00	2.93E-02	4.71E-02	4.72E-02
1,2,3,4,7,8-HxCDF	7.42E-01	2.14E-02	3.45E-02	3.46E-02
1,2,3,6,7,8-HxCDF	3.16E-01	9.13E-03	1.47E-02	1.47E-02
1,2,3,7,8,9-HxCDF	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2,3,4,6,7,8-HxCDF	5.33E-01	1.54E-02	2.48E-02	2.48E-02
1,2,3,4,6,7,8-HpCDF	1.84E-01	5.32E-03	8.55E-03	8.57E-03
1,2,3,4,7,8,9-HpCDF	2.13E-02	6.15E-04	9.90E-04	9.92E-04
OCDF	1.13E-02	3.27E-04	5.26E-04	5.27E-04
Sum		**0.111 ng/m^2**	**0.178 ng/m^2**	**0.178 ng/m^2**
Equivalent Daily Deposition Flux		**0.303 pg/m^2/day**	**0.487 pg/m^2/day**	**0.488 pg/m^2/day**

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Table A8.48 Dispersion Model Summary of Combined Vapour and Particulate Concentrations – PCCD/PCDFs

Pollutant / Scenario	Annual Mean Background(1) (fg/m^3)	Averaging Period	Process Contribution (fg/m^3)	Predicted Emission Concentration (fg/Nm^3)
PCCD/PCDFs / Maximum Operation	14	Annual Average	0.85	14.9
PCCD/PCDFs / Abnormal Operation	14	Annual Average	0.98	15.0

(1) Baseline results for dioxins given as sum of cumulative impacts (in the absence of the proposed facility) and baseline monitoring data as Non-detects = limit of detection.

(2) Abnormal operation scenario based on an emission level of 0.5 ng/m^3 for 3% of the time (assumed to occur for one 24-hour period once per month).

Table A8.49 Deposition Model Summary of Combined Particulate & Gaseous Deposition Flux

Pollutant / Scenario	Averaging Period	Background Particulate Deposition Flux (pg/m^2/day)	Process Contribution (pg/m^2/day)	Predicted Total Particulate Deposition Flux (pg/m^2/day)
PCCD/PCDFs / Maximum	Annual Average	30	0.51	30.5
PCCD/PCDFs / Abnormal	Annual Average	30	0.58	30.6

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Table A8.50 I-TEQ values derived from measurements of airborne dioxins in various locations

Location	Site Type	I-TEQ[1] (fg/m^3)
Kilcock , Co. Meath (1998)[2]	Rural	Range 2.8 – 7
Ireland[2]	Baseline	Mean – 26
	Potential Impact Areas	Mean – 49
Ringaskiddy (2001)[3]	Industrial	Lower Limit – 4.0[6] Upper Limit – 16.4[7]
Poolbeg (2003-2006)[8]	Industrial	Lower Limit – 42[6] Upper Limit – 44[7]
Germany (1992)[4]	Rural	< 70
	Urban	71 – 350
	Close to Major Source	351 – 1600
Manchester (2008 - 2010)[5]	Urban	Range – 19 - 48
London (2008 - 2010)[5]	Urban	Range –- 11 - 41
Auchencorth (2008 - 2010)[5]	Semi-rural	Range – 1 - 6
High Muffles (2008 - 2010)[5]	Rural	Range – 2 - 9
Haulbowline (2008)[9]	Industrial	19.2[9]

(1) I-TEQ_{DF} values based on NATO/CCMS (1988) and as used in Annex 1, Council Directive 2010/75/EU.
(2) Taken from Chapter 8 of Thermal Waste Treatment Plant, Kilcock EIS, Air Environment (1998)
(3) Taken from Chapter 9 of Waste Management Facility, Indaver Ringaskiddy EIS, Baseline Dioxin Survey (2001)
(4) Raffe, C (1996) Sources and environmental concentrations of dioxins and related compounds, *Pure & Appl. Chem* **Vol. 68**, No. 9, pp 1781-1789
(5) Taken from TOMPS Network website, http://uk-air.defra.gov.uk/data/tomps-data
(6) Lower Limit TEQ calculated assuming non-detects are equal to zero.
(7) Upper limit assuming non-detects are equal to limit of detection.
(8) Taken from Chapter 8 of Dublin Waste To Energy Facility EIS, Baseline Dioxin Survey (2006).
(9) Taken From REC Ltd Monitoring Report For WYG In 2008, Haulbowline Island.

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Table A8.51 Mean I-TEQ Deposition Fluxes Of Dioxins In Various Locations

Location	Site Type	Mean I-TEQ[1] (pg/m^2/ day)
Germany (1992)[2]	Rural	5 – 22
	Urban	10 – 100
	Close to Major Source	123 – 1293
UK[3]	Stevenage	3.2
	London	5.3
	Cardiff	12
	Manchester	28

(1) I-TEQ_{DF} values based on NATO/CCMS (1988) and as used in Annex 1, Council Directive 2010/75/EU.
(2) Raffe, C (1996) Sources and environmental concentrations of dioxins and related compounds, *Pure & Appl. Chem* Vol. 68, No. 9, pp 1781-1789
(3) Duarte-Davidson et al (1994) Polychlorinated Dibenzo-*p*-Dioxins (PCDDs) and Furans (PCDFs) in Urban Air and Deposition, *Environ. Sci. & Pollut. Res.*, 1 (4), 262-270

8.8.6 Concentration Contours

The maximum PCCD/PCDFs (Dioxins/Furans) ground level concentrations and deposition fluxes beyond the Facility boundary are shown in Figures 8.25 - 8.26. The content of the figure is described below.

Figure 8.25 Maximum Operations: Predicted PCCD/PCDFs (Dioxins/Furans) Annual Average Particulate Concentration

Figure 8.26 Maximum Operations: Predicted PCCD/PCDFs (Dioxins/Furans) Annual Average Total Particulate Deposition

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8.8.7 Result Findings

Background levels of PCDD/PCDFs (Dioxins/Furans) occur everywhere and existing levels in the surrounding area have been extensively monitored as part of this study. Monitoring results indicate that the existing levels are typical of rural areas in Ireland and the UK (as shown in Table A8.50). The contribution from the facility in this context is minor with levels under maximum and abnormal scenarios remaining significantly below levels which would be expected in urban areas even at the worst-case receptor located at the southern and south-eastern boundaries of the facility. Levels at the nearest residential receptor will be minor, with the annual contribution from the proposed facility accounting for less than 10% of the existing background concentration under maximum and abnormal operating conditions.

Shown in Table A8.49 is the maximum dioxin deposition rate. Modelled total dioxin particulate deposition flux indicate that deposition levels under maximum and abnormal operations would be expected to be significantly less than that experienced in urban background locations (see Table A8.51).

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8.9 Polycyclic Aromatic Hydrocarbons (PAHs)

Polycyclic aromatic hydrocarbons (PAHs) are ubiquitous chemicals found in urban airsheds throughout the world[20]. They are formed from the incomplete combustion of organic matter and are released into ambient air as constituents of highly complex mixtures of polycyclic organic matter (POM). They are also found in crude oil, coal tar, creosote and asphalt. In towns and cities, road traffic emissions are the dominant source of PAHs. In a recent study in Birmingham, 88% of the concentration of benzo[*a*]pyrene (B[*a*]P) in air was due to road traffic emissions[21].

PAHs can occur in the form of gases (e.g. 2-ringed naphthalene), solids adsorbed to surfaces of fine particles (e.g. 5-ringed benzo[*a*]pyrene) and in both gas- and particle-phases (e.g. 3-ringed phenanthrene). The air concentrations of gas-phase 2- and 3-ring PAHs are generally significantly higher than those of the 5- and 6- ring particle phase species. Moreover, the percentage found in the gas phase decreases with the size of the PAH. It has also been found that at higher masses of suspended particulate matter (TSP) in the air parcel the percentage of PAHs in the particle phase increases significantly[20].

The International Agency for Research on Cancer (IARC) has classified 48 PAHs according to their likely human carcinogenicity in 1987[20]. The three potent animal carcinogens benzo[*a*]pyrene, benz[*a*]anthracene and dibenz[*ah*]anthracene are classified as "probably carcinogenic to humans". "Possible human carcinogens" consists of four compounds – benzo[*b*]fluoranthene, benzo[*k*]fluoranthene, indeno[123-*cd*]pyrene and chrysene. The USEPA has also classified seven chemicals as probable human carcinogens (USEPA Class B2). In 1993, the USEPA formally adopted provisional guidance for estimating cancer risks associated with PAHs[22]. The procedure makes use of the relative potencies of several PAHs with respect to benzo[*a*]pyrene which is thought to be one of the most potent PAHs[20-24].

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Various approaches have been adopted to quantify exposure to the complex mixtures of PAHs including Total PAH levels or the level of a marker substance such as benzo[*a*]pyrene. Recent studies have found that the relation of B[*a*]P to the levels of 18 other individual PAHs was relatively stable[25]. Together these 19 PAH compounds constitute 90-95% of the PAHs measured in the air in this study[25]. The UK DETR Expert Panel on PAHs[24] has reviewed extensively the data available in terms of animal toxicology in deriving an ambient air quality standard for PAHs. The approach used by the Panel was to compare the sum of potential carcinogenic contribution of 7 individual PAHs (possible & probable carcinogens, see above) in ambient air with that of B[*a*]P. Contributions to total carcinogenicity from other PAH compounds are expected to be small relative to those considered above. Results from the comparison indicated that the estimated contribution of B[*a*]P to the total carcinogenicity of the seven chosen PAH compounds was similar in the three locations studied (ranging from 37.5% - 49.3%)[24]. The overall conclusion from this approach was that using B[*a*]P as a marker of PAH exposure in the environment was suitable so long as major changes in the ambient mixture of PAH compounds do not occur in the future and that an air quality standard for PAH mixtures could be expressed in terms of the ambient concentration of B[*a*]P.

The EU has confirmed the validity of this approach in Council Directive 2004/107/EC which designates B[*a*]P as a marker for PAHs in general. The Directive set a target value for the protection of human health for B[*a*]P of 1.0 ng/m^3 to be achieved in 2012.

Background PAHs are monitored at five sites in Ireland over the period 2009 - 2014[26]. Shown in Table A8.52 are B[*a*]P concentrations at these sites. Annual average background concentrations of B[*a*]P in this network ranged from 0.10 - 0.71 ng/m^3 over the period 2009 - 2014. Shown in Table A8.53 are B[*a*]P deposition rates at two sites in Ireland. Annual average background deposition rates of B[*a*]P ranged from 1.2 – 6.9 ng/m^2/day over the period 2009 - 2014.

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Table A8.52 Annual average B[a]P concentration at selected sites in Ireland In 2009 - 2014[26]

Year	B[a]P Annual Mean Concentration (ng/m^3) in 2009 - 2014				
	Rathmines	**Winetavern Street**	**Heatherton Park**	**Galway**	**Kilkitt**
	Zone A		Zone B	Zone C	Zone D
2009	0.4	0.3	0.5	0.5	0.1
2010	1.0	0.7	1.0	0.5	0.2
2011	0.25	0.44	0.97	0.14	0.14
2012	0.16	0.21	0.18	0.13	0.04
2013	0.17	0.15	0.46	0.19	0.07
2014	0.26	-	1.16	0.38	0.05
Average	0.37	0.36	0.71	0.31	0.10

Table A8.53 Annual average B[a]P deposition rate at selected sites in Ireland In 2011 - 2014[26]

Year	B[a]P Annual Mean Deposition (ng/m^2/day) in 2011 - 2014	
	Rosemount, UCD	**Shannon Estuary**
	Zone A	Zone D
2011	2.4	1.2
2012	1.7	1.9
2013	1.7	1.9
2014	6.9	6.0
Average	3.2	2.8

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8.9.1 Modelling Strategy

For the purposes of this assessment, emissions of B[*a*]P from the facility have been assumed to be at the upper range of the levels outlined in the Waste Incineration BREF document (1.0 μg/m^3). Literature data has indicated that B[*a*]P exists almost solely in the particulate phase[20] and the EU reference method for the monitoring of B[*a*]P is based on particulate sampling only[21]. Therefore, the current analysis assumes that B[a]P exists in the particulate phase only.

The emission of B[*a*]P from the facility has thus been evaluated in terms of mass of release into the particle-bound phase. Thereafter, air dispersion and deposition modelling has been employed to translate these releases to ambient air particle phase concentration and wet and dry particulate deposition amounts, in the vicinity of the release. The maximum scenario has been modelled as outlined in Table A8.54.

When modelling PAHs the surface area weighting rather than mass weighting is used for deposition. The surface weighting reflects the mode of formation where volatiles condense on the surface of particulates in the flue gas cleaning system (see Column 6 of Table A8.44). Thus, the apportionment of emissions by particle size becomes a function of the surface area of the particles which is available for chemical adsorption.

The ambient particulate concentration of B[a]P was determined as shown in Table A8.56. Results are shown under both maximum and abnormal operating conditions.

8.9.2 Deposition Modelling of Particulates

In order to model dry deposition of PAHs, using AERMOD, the generalised particle-size distribution recommended by the USEPA has again been used as outlined in Table A8.44[10,11]. For the deposition modelling of B[*a*]P both wet and dry particulate deposition were calculated. Results are shown in Table A8.57 for maximum operating conditions.

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Table A8.54 Emission Scenario for B[*a*]P

Pollutant	Scenario	Emission Concentration	Emission Rate (mg/s)
B[*a*]P	Maximum Operation	1.0 µg/m^3	0.0395

8.9.3 Comparison With Standards And Guidelines

Predicted GLCs have been compared with the applicable EU ambient air quality target value for B[*a*]P as set out in Table A8.55.

Table A8.55 B[a]P Ambient Air Quality Standards & Guidelines

Pollutant	Regulation	Limit Type	Target Value
B[a]P	Council Directive 2004/107/EC	Annual Average	1.0 ng/m^3

8.9.4 Modelling Results

Tables A8.56 – A8.58 details the predicted B[*a*]P GLC for the particulate concentration and deposition scenarios.

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Table A8.56 B[a]P Particulate Concentrations Under Maximum Operating Conditions

Compound	Particulate Fraction	Particulate Emission Rate (µg/sec)	Annual Averaged Particulate Concentration (pg/m^3)
B[a]P	1.0	Maximum - 40	8.5

Table A8.57 B[*a*]P Deposition Fluxes - Maximum Operating Conditions

Compound	Fraction	Emission Rate (µg/sec)	Annual Deposition Flux (µg/m^2)
B[a]P - Maximum Operation	Dry particulate	68	1.14
	Wet particulate		1.84
	Total particulate		1.84
Sum of Total Particulate Deposition			**1.8 µg/m^2**
			5.0 ng/m^2/day

Table A8.58 Dispersion Model Summary Of Particulate B[a]P Concentrations Under Maximum Operating Conditions.

Pollutant / Scenario	Annual Mean Background (pg/m^3)	Averaging Period	Process Contribution (pg/m^3)	Predicted Emission Concentration (pg/Nm^3)	Standard (pg/Nm^3)
B[a]P / Maximum	710	Annual mean	8.5	719	1000

8.9.5 Result Findings

B[*a*]P modelling results indicate that the ambient ground level concentrations are significantly below the EU target value for the protection of human health under maximum operation of the facility. Thus, no adverse impact on public health or the environment is envisaged to occur under these conditions at or beyond the facility boundary. Emissions at maximum operations lead to ambient B[a]P particle-bound concentrations (excluding background concentrations) which are only 0.9% of the annual average limit value at the boundary of the facility.

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8.10 Mercury

8.10.1 Mercury's Environmental Transport & Fate

Mercury exists in three oxidation states; metallic or elemental (Hg^0); mercurous (Hg_2^{2+}); and mercuric (Hg^{2+}). Elemental Hg is a liquid at room temperature with low volatility. Other forms of mercury are solids with low vapour pressures. It is naturally occurring and cycles between the atmosphere, land and water through a series of complex transformations. Elemental mercury is the most common form of mercury found in the atmosphere whereas in all other environmental media, mercury is found in the form of inorganic mercuric salts and organo-mercury compounds[28].

USEPA methodology assumes that stack emissions containing mercury include both vapour and particle-bound phases. Additionally, the USEPA assumes that mercury exits the stack in only the elemental and divalent species. These assumptions were also used for the current assessment. Of the total mercury in the stack, 80% is estimated to be in the vapour phase and 20% is particle-bound. In addition, the USEPA assumes that speciation of the total mercury is 80% divalent (20% in the particle-bound and 60% in the vapour phase) and 20% elemental (all 20% in the vapour phase)[28]. Although the USEPA allows a loss to the global cycle for each form of mercury (99% of the elemental vapour form, 32% of the divalent vapour form, and 64% of the particle-bound form are assumed lost to the global cycle and do not deposit within the localized study area), this has not been incorporated into the current assessment in keeping with the worst-case approached adopted throughout.

8.10.2 Comparison With Standards And Guidelines

Predicted GLCs have been compared with the applicable WHO ambient air quality guideline for mercury as set out in Table A8.59.

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Table A8.59 Hg Ambient Air Quality Standards & Guidelines

Pollutant	Regulation	Limit Type	Value
Inorganic Mercury (as Hg)	WHO	Annual Average	1.0 μg/m^3

8.10.3 Deposition Modelling of Mercury Vapours

Dry Gaseous Deposition

For the dry gaseous deposition modelling of mercury, four physiochemical parameters are required for both elemental gaseous mercury and divalent gaseous mercury. The dry gaseous deposition velocity formulation is based on three resistance terms; aerodynamic resistance, quasi-laminar resistance to bulk transfer and a bulk surface resistance term. The four physiochemical parameters required to calculate these resistance terms are D_a (diffusivity of modelled gas in air (cm/s)), D_w (diffusivity of modelled gas in water (cm/s)), Henry's Law constant for modelled gas (Pa-m^3/mol) and r_{cl} (leaf cuticular resistance (s/m)). The values derived for the two relevant mercury states are shown in Table A8.60.

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Table A8.60 Gas Deposition Physiochemical Parameters[3]

Mercury Phase	D_a (cm/s)	D_w (cm/s)	H (Pa m^3 mol^{-1})	r_{cl} (sm^{-1})
Elemental Gas	0.07	0.0000063	150	1E+7
Divalent Gas	0.06	0.00032	6E-6	1E+7

Wet Gaseous Deposition

Wet gaseous deposition physically washes out the chemically contaminated vapours from the atmosphere. Wet gaseous deposition flux depends on the precipitation rate, the concentration of the pollutant in the liquid phase and the molecular weight of the pollutant. The AERMOD model formulation assumes that the wet gaseous deposition flux is the same for snow as for rain.

8.10.4 Modelling of Particulate Mercury

When modelling particulate mercury (Hg), the surface area weighting rather than mass weighting is used for deposition. The surface weighting reflects the mode of formation where volatiles condense on the surface of particulates in the flue gas cleaning system (see Column 6 of Table A8.44). Thus, the apportionment of emissions by particle size becomes a function of the surface area of the particle which is available for chemical adsorption.

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Dry Particulate Deposition

Dry particulate deposition is based on a resistance scheme in which the deposition velocity is based on the predominant particle size distribution via two methods. Method 1 is used when a significant fraction (> 10%) of the total particulate mass has a diameter greater than 10 microns and the particle size distribution is reasonably well known. The method is based on the gravitational settling velocity and two resistance terms; aerodynamic resistance and quasi-laminar resistance to bulk transfer. Method 2 is used when the particle size distribution is not well known and when a small fraction (less than 10% of the mass) consists of particles with a diameter of 10 microns or larger. The deposition velocity for method 2 is given as the weighted average of the deposition velocity for the coarse mode and fine mode. In the results below method 1 has been used, based on the generalised particle-size distribution recommended by the USEPA as outlined in Table A8.44[11], as it gives similar concentrations to method 2 but significantly higher deposition results.

Wet Particulate Deposition

Wet particulate deposition physically washes out the chemically contaminated particulate from the atmosphere. Wet deposition flux depends on the fraction of the time precipitation occurs and the fraction of material removed by precipitation per unit of time by particle size. The AERMOD model formulation is based on a particle washout coefficient which is based on the collision efficiency and the mean diameter of raindrops. It is also assumed that the wet deposition flux is the same for snow as for rain.

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8.10.5 Modelling Strategy

The emissions of mercury from the stack have been evaluated in terms of mass of release into both vapour and particle-bound phases. Thereafter, air dispersion and deposition modelling has been employed to translate these releases into ambient air vapour and particle phase concentrations, and wet and dry gaseous and particulate deposition amounts, in the vicinity of the release. The maximum emission scenario has been modelled as outlined in Table A8.61.

Table A8.61 Emission Scenario for Mercury

Pollutant	Scenario	Emission Concentration	Emission Rate (g/s)
Hg	Maximum	0.05 mg/m^3	0.00197
Hg	Abnormal(1)	1 mg/m^3	0.0395

(1) Abnormal operation scenario based on an emission level of 1 mg/m^3 for 3% of the time (assumed to occur for one 24-hour period once per month).

For the deposition modelling of mercury both wet and dry particulate and gaseous deposition were calculated. Results are shown in Table A8.62 - A8.65 for maximum operating conditions.

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8.10.6 Modelling Results

Tables A8.62 – A8.65 detail the predicted mercury GLC for each vapour and particulate concentration and deposition scenario.

Table A8.62 Mercury Vapour Concentrations Under Maximum Operating Conditions

Oxidation State	Vapour Fraction	Vapour Emission Rate (g/sec)	Vapour Concentration (ng/m^3)
Elemental Hg	0.20	Maximum - 0.00040	0.084
Divalent Hg^{2+}	0.60	Maximum - 0.0012	0.25
Sum			**0.34 ng/m^3**

Table A8.63 Mercury Particulate Concentrations Under Maximum Operating Conditions

Oxidation State	Particulate Fraction	Particulate Emission Rate (g/sec)	Particulate Concentration (ng/m^3)
Divalent Hg^{2+}	0.20	Maximum - 0.00040	0.085

Table A8.64 Mercury Deposition Fluxes – Maximum Operating Conditions

Oxidation State	Fraction	Emission Rate (g/sec)	Annual Deposition Flux (µg/m^2/year)
Elemental Hg	Dry Gas	0.00040	17
	Wet Gas		0.01
	Total Gas		17
Divalent Hg^{2+}	Dry Gas & Particle	0.0016	203
	Wet Gas & Particle		108
	Total Gas & Particle		216
Sum of Total Deposition			**233 µg/m^2/year**

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Table A8.65 Dispersion Model Summary Of Combined Vapour And Particulate Hg Concentrations Under Maximum And Abnormal Operating Conditions.

Pollutant / Scenario	Annual Mean Background (ng/m^3)	Averaging Period	Process Contribution (ng/m^3)	Predicted Emission Concentration (ng/Nm^3)	Standard (ng/Nm^3)
Hg / Maximum	1	Annual mean	0.42	1.4	1000
Hg / Abnormal	1	Annual mean	0.74	1.7	1000

8.10.7 Concentration Contours

The geographical variation in vapour mercury ground level concentrations beyond the Facility boundary is illustrated as concentration contours in Figure 8.27.

Figure 8.27 Maximum Operations: Predicted Mercury Annual Average Vapour and Particulate Concentration

8.10.8 Result Findings

Hg modelling results indicate that the ambient ground level concentrations are significantly below the WHO guideline under both typical and maximum operation of the facility. Thus, no adverse environmental impact is envisaged to occur under these conditions at or beyond the facility boundary. Emissions at maximum operations equate to ambient mercury combined concentration (both vapour and particle-bound) (including background concentrations) which are less than 0.2% of the annual average limit value at the boundary of the facility.

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8.11 Heavy Metal Emissions and Results (excluding Mercury)

8.11.1 Modelling Approach

The emissions of heavy metals (except Hg) from the Ringaskiddy Resource Recovery Centre have been evaluated in terms of mass of release into the particulate phase only as recommended by the USEPA[10,11]. Thereafter, air dispersion and deposition modelling has been employed to translate these releases to ambient particle phase concentrations, and wet and dry particulate deposition amounts, in the vicinity of the release.

When modelling heavy metals (except Hg) the mass weighting rather than surface weighting is used for deposition as it is assumed that the metals are all in the particulate state (see Column 4 of Table A8.44). Results are shown under both maximum and abnormal operating conditions.

For the deposition modelling of heavy metals (except Hg) both wet and dry particulate deposition were calculated.

Ambient ground level concentrations (GLCs) and deposition values of Cadium and Thallium (Cd & Tl) and the Sum of antimony (Sb), arsenic (As), lead (Pb), chromium (Cr), cobalt (Co), copper (Cu), manganese (Mn), nickel (Ni) and vanadium (V) have been investigated using the concentration limits outlined in Council Directive 2010/75/EU (see Table A8.66 and Table A8.67 respectively) and also under abnormal operations at the facility.

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Table A8.66 Maximum And Abnormal Operations for Cd & Tl

Pollutant	Scenario	Concentration	Emission Rate (g/s)
Cd & Tl	Maximum 24-Hr Operation	0.05 mg/m^3	0.0020
	Abnormal Operation(1)	0.2 mg/m^3	0.0079

(1) Abnormal operation scenario based on an emission level of 0.2 mg/m^3 for 3% of the time (assumed to occur for one 24-hour period once per month).

Table A8.67 Emission Scenario for Heavy Metals Taken From Council Directive 2010/75/EU

Pollutant	Scenario	Concentration	Emission Rate (g/s)
Sum of Sb, As, Pb, Cr, Co, Cu, Mn, Ni and V	Maximum Operation	0.50 mg/m^3	0.020
	Abnormal Operation(1)	30 mg/m^3	1.18

(1) Abnormal operation scenario based on an emission level of 30 mg/m^3 for 3% of the time (assumed to occur for one 24-hour period once per month).

Data is available from the Carranstown incinerator facility operated by Indaver in Duleek, County Meath (see Table A8.68) indicating the emission levels of these metals based on typical and maximum recorded levels over the period 2013 - 2014. This source of data has been used to identify the likely ratio of metals when emitting under both maximum and abnormal operations (Table A8.69).

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Table A8.68 Actual Measured Emission Data From An Incinerator Facility operated by Indaver In Duleek, County Meath Over The Period 2013 - 2014 (mg/Nm^3) (*Italics = below limit of detection).*

	2013				2014				Average	Maximum
Parameter	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**2013-2014**	**2013-2015**
As	0.0019	0.0009	0.0013	0.0009	*0.0005*	0.0008	0.0005	0.0005	**0.0009**	**0.0019**
Co	0.0008	0.0004	0.0006	0.0005	*0.0005*	*0.0037*	*0.0005*	*0.0004*	**0.0009**	**0.0037**
Cr	0.0066	0.0009	0.0268	0.0307	0.0075	0.0040	0.0058	0.0098	**0.0115**	**0.0307**
Cu	0.0014	0.0007	0.0044	0.0023	0.0023	0.0039	0.1340	0.0193	**0.0210**	**0.1340**
Mn	0.0014	0.0007	0.0023	0.00627	0.0039	0.0007	0.0018	0.0005	**0.0022**	**0.0063**
Ni	0.0024	0.0012	0.0032	0.0203	0.0075	0.0036	0.0272	0.0172	**0.0103**	**0.0272**
Pb	0.0037	0.0012	0.0023	0.0084	0.0020	0.0026	0.0009	0.0016	**0.0028**	**0.0084**
Sb	0.0024	0.0012	0.0016	0.0006	0.0006	0.0025	*0.0006*	0.0005	**0.0013**	**0.0025**
V	0.0006	0.0003	0.0004	0.0004	0.0004	0.0004	0.0005	0.0003	**0.0004**	**0.0006**
Cd	0.0024	0.0012	0.0016	0.0008	0.0007	0.0007	0.0008	*0.0004*	**0.0011**	**0.0024**
Sum Cd+Tl	0.004	0.0018	0.002	0.001	0.0010	0.0010	0.0010	0.0008	**0.0016**	**0.0040**
Hg	0.0005	0.0002	0.0003	0.0003	*0.0004*	*0.0003*	0.0004	0.0004	**0.0004**	**0.0005**
Dioxins (ng/m^3)		0.0011	0.0097			0.0026		0.0004	**0.0035**	**0.0097**

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Table A8.69 Ratio Of Metals Emitting Based On Actual Measured Emission Data From Indaver In Duleek, County Meath Over The Period 2013 - 2014 (mg/Nm^3)

Parameter	**Average(1)**	**Maximum(1)**	**Maximum Operation(2)**	**Abnormal Operation(2)**
	2013 - 2014 (mg/m^3)	**2013 - 2014 (mg/m^3)**	**0.50 mg/m^3**	**30 mg/m^3**
As	0.0009	0.0019	0.0044	0.26
Co	0.0009	0.0037	0.0086	0.52
Cr	0.0115	0.0307	0.0713	4.28
Cu	0.0210	0.1340	0.311	18.67
Mn	0.0022	0.0063	0.0146	0.87
Ni	0.0103	0.0272	0.0632	3.79
Pb	0.0028	0.0084	0.0195	1.17
Sb	0.0013	0.0025	0.0059	0.35
V	0.0004	0.0006	0.0014	0.08
Cd	0.0011	0.0024		
Sum Cd+Tl	0.0016	0.0040		
Hg	0.0004	0.0005		
Sum Sb/As/Pb/Cr/Co/Cu/Mn/Ni/V	0.11 mg/m^3	0.56 mg/m^3	0.50 mg/m^3	30 mg/m^3

(1) Non-detects reported at the detection limit.
(2) Based on the ratio under maximum operation.

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8.11.2 Comparison with Standards And Guidelines

In the absence of statutory standards, ambient air quality guidelines can also be derived from occupational exposure limits (OEL). Guidance has issued by the UK Environment Agency entitled "IPPC Environmental Assessment for BAT" (Environment Agency, 2002)[29]. The guidance outlines the approach for deriving both short-term and long-term environmental assessment levels (EAL). In relation to the long-term (annual) EAL, this can be derived by applying a factor of 100 to the 8-hour OEL. The factor of 100 allows for both the greater period of exposure and the greater sensitivity of the general population. For short-term (1-hour) exposure, the EAL is derived by applying a factor of 10 to the short term exposure limit (STEL). In this case, only the sensitivity of the general population need be taken into account as there is no need for additional safety factors in terms of the period of exposure. Where STELs are not listed then a value of 3 times the 8-hour time weighted average occupational exposure limit may be used. Predicted GLCs have been compared with the applicable ambient air quality guidelines and standards for the protection of human health as set out in Table A8.70 and A8.71.

A comparison of Tables A8.68 and A8.69 with Table A8.71 indicates that Arsenic is the metal which is emitted at the most significant level relative to its annual average limit value and thus has been reported below. All other metals will have a lower impact on the ambient environment. Vanadium has also been investigated as it is emitted at the most significant level relative to the short-term limit values.

Table A8.70 Cd and Tl Ambient Air Quality Standards & Guidelines For The Protection of Human Health

Metal	Short-Term EAL (1-Hr)	Long-Term EAL (Annual)	Regulation
Cd	-	0.005 µg/m^3	WHO[3]
Cd	1.5 µg/m^3	0.005 µg/m^3	EU[1] / EAL[2]
Tl	30 µg/m^3	1.0 µg/m^3	EAL[2]

(1) Council Directive 2004/107/EC[22]
(2) Environmental Agency (2003) "IPPC H1 - Environmental Assessment & Appraisal of BAT"[29]
(3) WHO (2006) Air Quality Guidelines[23]

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Table A8.71 Sb, As, Pb, Cr, Co, Cu, Mn, Ni and V Ambient Air Quality Standards & Guidelines For The Protection of Human Health

Metal	Short-Term EAL (1-Hr)	Long-Term EAL (Annual)	Regulation
Sb	150 µg/m^3	5 µg/m^3	EAL[2]
As	15 µg/m^3	0.006 µg/m^3[1]	EU[1] / EAL[2]
Pb	-	0.5 µg/m^3	EU[1]
Cr (except VI)	150 µg/m^3	5.0 µg/m^3	EAL[2]
Cr (VI)[4]	-	0.0002 µg/m^3	EAL[2]
Co	6 µg/m^3	0.2 µg/m^3	EAL[2]
Cu (fumes)	60 µg/m^3	2.0 µg/m^3	EAL[2]
Cu (dust & mists)	200 µg/m^3	10 µg/m^3	EAL[2]
Mn	1500 µg/m^3	1.0 µg/m^3	WHO[3]
Ni (inorganic)	30 µg/m^3	0.020 µg/m^3[1]	EU[1]
V	1.0 µg/m^3	5.0 µg/m^3	EAL[2]

(1) Council Directive 2004/107/EC[27]
(2) Environmental Agency (2003) "IPPC H1 - Environmental Assessment & Appraisal of BAT"[29]
(3) WHO (2000) Air Quality Guidelines for Europe[23]
(4) Environmental Agency (2011) "H1 Annex F Air Emissions v 2.2"[30]

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8.11.3 Modelling Results

Air dispersion and deposition modelling was carried out for the two scenarios described in Section 8.11.1. Tables A8.72 – A8.74 details the predicted Cd & Tl GLC and deposition value for each scenario and averaging period.

Table A8.72 Cd & Tl Particulate Concentrations Under Maximum And Abnormal Operation

Heavy Metal	Emission Rate (g/sec)	Ambient Concentration (ng/m^3)
Cd & Tl	Maximum Operation - 0.00197	0.42
	Abnormal Operation - 0.00789	0.47

(1) Abnormal operation scenario based on an emission level of 0.2 mg/m^3 for 3% of the time (assumed to occur for one 24-hour period once per month).

Table A8.73 Cadmium Deposition Fluxes – Maximum Operation

Heavy Metal	Fraction	Emission Rate (g/sec)	Annual Deposition Flux (mg/m^2)
Cd & Tl / Maximum Operation	Dry particulate	0.00197	0.33
	Wet particulate		0.58
Sum of Total Deposition			0.58 mg/m^2
			1.6 µg/m^2/day

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Table A8.74 Cadmium & Thallium Particulate Concentration Summary

Pollutant / Scenario	Averaging Period	Process Contribution (ng/m^3)	Annual Mean Background (ng/m^3)	Predicted Emission Concentration (ng/Nm^3)	Standard (ng/Nm^3)(1)
Cd / Maximum	Annual mean	0.42	1	1.4	5.0
Cd / Abnormal	Annual mean	0.47	1	1.5	5.0

(1) Council Directive 2004/107/EC[23]

Tables A8.75 – A8.78 details the predicted GLC and deposition values for each scenario for Arsenic, Nickel and Vanadium. In terms of Vanadium, emission levels are based on the ratio of the Sum of Other Metals (Mn, Sb, Sn, V, Pb, Cr, Cu, Co & Ni) as outlined in Table A8.69.

Table A8.75 Arsenic, Nickel and Vanadium Particulate Concentration Under Maximum & Abnormal Operating Conditions

Heavy Metal	Emission Rate (g/sec)	Maximum 1-hour Concentration (ng/m^3)	Annual Concentration (ng/m^3)
Arsenic	Maximum - 0.000174		0.037
Nickel	Maximum - 0.00025		0.54
Vanadium	Maximum - 0.000055	0.48	
Arsenic(1)	Abnormal - 0.0104		0.129
Nickel(2)	Abnormal - 0.15		1.84
Vanadium(3)	Abnormal - 0.0033	19.9	

(1) Abnormal operation scenario based on an emission level of 0.26 mg/m^3 for 3% of the time (assumed to occur for one 24-hour period once per month).
(2) Abnormal operation scenario based on an emission level of 3.8 mg/m^3 for 3% of the time (assumed to occur for one 24-hour period once per month).
(3) Abnormal operation scenario based on an emission level of 0.084 mg/m^3 for 3% of the time (assumed to occur for one 24-hour period once per month).

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Table A8.76 Arsenic Deposition Fluxes – Maximum & Abnormal Operating Conditions

Heavy Metal	Fraction	Emission Rate (g/sec)	Annual Deposition Flux (mg/m^2)
Arsenic / Maximum	Dry particulate	0.000174	0.029
	Wet particulate		0.051
Sum of Total Deposition			0.051 mg/m^2
			0.141 $\mu g/m^2$/day
Arsenic / Abnormal(1)	Dry particulate	0.0104	0.101
	Wet particulate		0.086
Sum of Total Deposition			0.108 mg/m^2
			0.296 $\mu g/m^2$/day

(1) Abnormal operation scenario based on an emission level of 0.0104 g/sec for 3% of the time (assumed to occur for one 24-hour period once per month).

Table A8.77 Nickel Deposition Fluxes – Maximum & Abnormal Operating Conditions

Heavy Metal	Fraction	Emission Rate (g/sec)	Annual Deposition Flux (mg/m^2)
Nickel / Maximum	Dry particulate	0.0025	0.411
	Wet particulate		0.735
Sum of Total Deposition			0.735 mg/m^2
			2.02 $\mu g/m^2$/day
Nickel / Abnormal(1)	Dry particulate	0.15	1.44
	Wet particulate		1.23
Sum of Total Deposition			1.55 mg/m^2
			4.24 $\mu g/m^2$/day

(1) Abnormal operation scenario based on an emission level of 0.15 g/sec for 3% of the time (assumed to occur for one 24-hour period once per month).

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Table A8.78 Dispersion Model Results – Arsenic and Vanadium

Heavy Metal / Scenario	Averaging Period	Process Contribution (ng/m^3)	Background (ng/m^3)	Predicted Emission Concentration (ng/Nm^3)	Standard (ng/Nm^3)
Arsenic / Maximum	Annual mean	0.037	1.0(1)	1.04	**6.0(4)**
Nickel / Maximum	Annual mean	0.54	7.0(2)	7.54	**20(5)**
Vanadium / Maximum	Maximum One-Hour	0.48	4.0(3)	4.5	**1000(6)**
Arsenic / Abnormal	Annual mean	0.13	1.0(1)	1.1	**6.0(4)**
Nickel / Abnormal	Annual mean	1.8	7.0(2)	8.8	**20.0(5)**
Vanadium / Abnormal	Maximum One-Hour	19.9	4.0(3)	23.9	**1000(6)**

(1) Background concentration for arsenic based on on-site monitoring
(2) Background concentration for arsenic based on on-site monitoring
(3) Background concentration for vanadium based on on-site monitoring
(4) Ambient standard for arsenic which is the most stringent applicable limit value for this averaging period
(5) Ambient standard for nickel which is the most stringent applicable limit value for this averaging period
(6) Ambient standard for vanadium which is the most stringent applicable limit value for this averaging period.

Chromium (VI)

The UK Environment Agency (UKEA) has issued guidance on the release of Chromium (VI) from municipal waste incinerators(31). The UKEA has recently published a substantially lower EAL for Cr(VI) of 0.2 ng/m^3. The guidance indicates that data on the release of Cr(VI) is limited but that in relation to the data gathered to date from 13 incinerators in the UK, based on measurements of total chromium and the ratio of Cr(VI) to total chromium in Air Pollution Control (APC) residues, the range in emission data is as follows:

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- Mean = $3.5*10^{-5}$ mg/Nm^3
- Minimum = $2.3*10^{-6}$ mg/Nm^3
- Maximum = $1.3*10^{-4}$ mg/Nm^3

Shown in Table A8.79 is the estimated Cr(VI) release from the Ringaskiddy Resource Recovery facility and the predicted process contribution to the ambient environment as a results of these estimated releases.

Table A8.79 Dispersion Model Results – Arsenic and Vanadium

Heavy Metal / Scenario	Emission Concentration ($\mu g/Nm^3$)(1)	Emission Rate (mg/s)	Averaging Period	Ambient Process Contribution (ng/m^3)	Standard (ng/Nm^3)(2)
Cr(VI) / Mean	0.035	0.00138	Annual mean	0.00029	**0.02**
Cr(VI) / Maximum	0.13	0.00513	Annual mean	0.0011	**0.02**

(1) Cr(VI) emission rate taken from UKEA guidance(31)
(2) Ambient standard for Cr(VI) taken from H1 Annex F(30)

The results indicate that under typically conditions the Cr(VI) emissions from the facility are likely to lead to an ambient Cr(VI) concentration which is less than 0.15% of the EAL. Assuming maximum emissions of Cr(VI) for a full year at maximum operations leads to an ambient Cr(VI) concentration which is 0.5% of the EAL. Thus, Cr(VI) emissions from the facility are insignificant and will not increase existing background levels of this pollutant by a significant amount.

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8.11.4 Concentration Contours

The geographical variations in heavy metal ground level concentrations beyond the Facility boundary are illustrated as a concentration contours in Figures 8.28 to 8.29. The content of the figure is described below.

Figure 8.28 Maximum Operation: Predicted Cd Annual Average Concentration

Figure 8.29 Maximum Operation: Predicted Ni Annual Average Concentration

8.11.5 Result Findings

Cd and Tl

Modelling results indicate that the ambient ground level concentrations will be below the relevant air quality standards for the protection of human health for cadmium under maximum and abnormal operations of the facility. Emissions at maximum operations equate to an ambient Cd and Tl concentration (including background concentration) which is 28% of the annual target value for Cd close to the facility boundary (the comparison is made with the Cd limit value as this is more stringent than that for Tl).

Sum of As, Ni, Sb, Pb, Cr, Co, Cu, Mn and V

Modelling results indicate that the ambient ground level concentrations are below the relevant air quality standards for the protection of human health for arsenic, nickel and vanadium (the metals with the most stringent limit values) under maximum and abnormal emissions from the facility. Thus, no adverse impact on public health or the environment is envisaged to occur under these conditions at or beyond the facility boundary. Emissions at maximum operations equate to ambient As and Ni concentrations (including background concentrations) which are 17% and 38% of the annual limit value respectively at the worst-case receptor whilst emissions at maximum operations equate to ambient V concentrations (including background concentrations) which are only 0.1% of the maximum 1-hour limit value at the worst-case receptor. Emissions under abnormal operations equate to ambient As and Ni concentrations (including background concentrations) which are 18% and 44% of the annual limit value respectively at the worst-case receptor whilst emissions at maximum operations equate to ambient V concentrations (including background concentrations) which are 0.2% of the maximum 1-hour limit value at the worst-case receptor.

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8.11.6 Summary Of Impacts

Based on the emission guidelines outlined in Council Directive 2010/75/EU, detailed air dispersion modelling has shown that the most stringent ambient air quality standards for the protection of human health are not exceeded either as a result of operating under maximum or abnormal operating conditions.

The modelling results indicate that the maximum long-term ambient GLC occurs at or near the facility's southern and south-east boundaries. The spatial impact of the facility is limited with concentrations falling off rapidly away from the maximum peak. Concentrations fall off rapidly away from this maximum and for the short-term averaging periods, at the nearest residential receptors, concentrations will be less than 17% of the short-term limit values under the maximum operating scenario (not including background concentrations). The annual average concentration has an even more dramatic decrease in maximum concentration away from the facility with concentrations from emissions at the proposed Facility accounting for less than 1% of the limit value (not including background concentrations) at worst case sensitive receptors near the facility under the maximum operating scenario for the facility.

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In the surrounding areas of Cobh, Carrigaline and Monkstown levels are significantly lower than most background sources with the concentrations from emissions at the proposed facility accounting for less than 1% of the annual limit values for the protection of human health for all pollutants under maximum operations of the facility.

8.12 CALPUFF Assessment

The CALPUFF modelling system has been recommended by the USEPA as a Guideline Model for source-receptor distances of greater than 50km and for use on a case-by-case basis in complex flow situations within 50km[(1)]. CALPUFF has some important advantages over steady-state Gaussian models such as AERMOD in areas of complex meteorology. Firstly, AERMOD, being a steady state straight line plume model cannot respond to the terrain-induced spatial variability in wind fields. Secondly, as AERMOD is based on a single-station wind observation, the wind fields do not vary spatially within the modelling domain. Thirdly, AERMOD cannot treat calm conditions and does not calculate concentrations during these hours. Because of these limitations, CALPUFF would be expected to more accurately reflect the meteorological and dispersion characteristics of the modelling domain and thus lead to more accurate ambient air concentrations. As shoreline fumigation was also raised as a possible concern in the previous application and AERMOD does not have the capability to model this phenomenon, CALPUFF (version 7.2.1) was selected as the most appropriate model which could assess all possible meteorological conditions within the one air dispersion model.

8.12.1 MM5 / CALMET Set-Up

Meteorological data is an important input into the air dispersion model. The local airflow pattern will be influenced by the geographical location. Important features will be the location of hills and valleys or land-water-air interfaces and whether the existing and proposed facilities are located in simple or complex terrain.

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Meteorological data for the assessment was based on various sources of information. Firstly, the Fifth Generation Penn State/NCAR (National Centre for Atmospheric Research) Mesoscale Model (known as MM5) was used for the years 2006 and 2007. The model output consists of hourly values of wind speed, wind direction, temperature and pressure on a grid size of 100 km x 100 km centred in Ringaskiddy. The data had 18 vertical levels with a base level of 15 m and a horizontal resolution of 12 km.

CALMET meteorological pre-processor used the three-dimensional MM5 data along with all available surface observations within the 100km x 100km grid. As no upper air observations station were located within or near to the modelling domain, upper air data was obtained from MM5 and extrapolation of surface observations. One synoptic meteorological station operated by Met Eireann was identified near the site – Cork Airport. Data collection of greater than 90% for all parameters is required for air dispersion modelling. Cork Airport fulfils this requirement. A second surface station operated by Indaver as part of the current application was available for the year 2007 and thus was also used in the assessment. Buoy data for the stations M3 and M5 for 2006 and 2007 was obtained from the Marine Institute.

The CALMET modelling domain covered an area of 100km x 100km centred in Ringaskiddy. The CALMET wind field data had 11 vertical levels with a base level of 10m and a horizontal resolution of 1 km. The eleven vertical levels are at 20, 40, 80, 160, 320, 650, 1000, 1500, 2200, 3000 and 4000 metres.

The horizontal resolution of 500 metres was used to resolve the terrain variations in the region. Terrain data was obtained from the Shuttle Radar Topography Mission (SRTM) which is a digital elevation data set that spans the globe from 60° north latitude to 56° south latitude. It has a horizontal grid spacing of 1 arc-seconds (approximately 30m) and is shown in Figure 8.30 for the CALMET modelling domain.

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Land use data from the U.S. Geological Survey (USGS) and the European Commission's Joint Research Centre (JRC) based on a 1-km resolution Global Land Cover Characteristics (GLCC) database was processed to generate a gridded field of dominant land use categories and land-use weighted values of surface and vegetation properties for each grid cell. The predominant land use in the CALMET domain is shown in Figure 8.31.

Gridded MM5 meteorological fields which were purchased from TRC (Lowell, MA, USA), were used to define the initial guess fields for the CALMET simulations. The MM5 simulations were made for the periods January to December 2006 and January to December 2007, the same period selected for the CALMET/CALPUFF runs. The MM5 data were produced at a horizontal resolution of 12 km and at 18 vertical sigma levels.

Two stages are involved in developing the CALMET wind field. The first step, the Step 1 wind field, CALMET adjusts the initial guess field to reflect slope flows and blocking effects. Slope flows are a function of the local slope and altitude of the nearest crest. The crest is defined as the highest peak within a radius TERRAD around each grid point. A value of TERRAD of 15 km was considered most appropriate for the computational domain. The Step 1 field produces a flow field consistent with the fine-scale CALMET terrain resolution (0.5 km).

In the second step, the Step 2 wind field, observations are incorporated into the Step 1 wind field to produce a final wind field. The philosophy behind the Step 2 wind field is to ensure that observational data strongly influences the final wind field in the region of the observational stations whilst the MM5 data is strongly weighted in the region were no observational data is available. Parameters R1 at the surface and R2 aloft determine the weighting of the Step 1 (MM5 data) and observational data. In the current application, relatively small values (5 km) for R1 and R2 were selected because the two meteorological stations (Cork Airport and the On-site Station) in the vicinity of the proposed facility and existing facilities are located quite close to each other (at a distance of less than 15 km), and each of these stations should have an important weighting in the vicinity of each station.

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A second set of parameters defines the area of influence of each station (parameters RMAX1 at the surface and RMAX2 aloft). Since the initial guess field is driven by the MM5 winds and terrain effects are expected to be important, RMAX1 and RMAX2 were set to 10 km in order to give greater weight to the surface station and RMIN=0.1 km. As the buoys (M3 and M5) are located at a distance of up to 60 km off-shore, RMAX3 which defines the radius of influence of the buoy was set to 100km.

8.12.2 CALPUFF Set-Up

Emissions from the proposed site have been modelled using the CALPUFF dispersion model (Version 7.2.1) which has been developed by Earth Tech (now part of TRC Companies, Inc) and has been approved by the U.S. Environmental Protection Agency (USEPA)[(1)] for long-range transport and on a case-by-case basis for near-field (less than 50km) applications involving complex meteorological conditions. The model is a non-steady-state Lagrangian puff model used to assess pollutant concentrations associated with a wide range of sources including industrial sources.

A receptor grid measuring 100 km by 100 km with the site at the centre was mapped out with terrain information at each receptor, derived from Shuttle Radar Topography Mission (SRTM) with 30 m resolution as input into the model. The model receptor grid entailed a total of 49,980 receptor points at which ambient ground levels concentrations were determined for each pollutant (inner grid at 25 m resolution, middle at 100 m resolution and outer grid at 500 m grid resolution as shown in Figure 8.5).

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8.12.3 CALPUFF Modelling Results

The main study conclusions are presented below for each substance in turn with a graphical summary of results in comparison to the previously obtained AERMOD results presented in Figures 8.6 and 8.7 and in Table 8.80. Modelling was undertaken for both 2006 and 2007 with the worst-case result for either year reported for each averaging period.

NO_2 & NO_X

NO_2 modelling results indicate that the ambient ground level concentrations will be below the relevant air quality standards for the protection of human health for nitrogen dioxide under maximum and abnormal operation of the facility. Thus, no adverse impact on public health or the environment is envisaged to occur under these conditions at or beyond the facility boundary. Emissions at maximum operations lead to ambient NO_2 concentrations (including background concentrations) which are 69% of the maximum ambient 1-hour limit value (measured as a 99.8th%ile) and 32% of the annual average limit value at the respective worst-case receptors.

SO_2, CO, PM_{10} & $PM_{2.5}$

Modelling results indicate that ambient ground level concentrations will be below the relevant air quality standards for the protection of human health for sulphur dioxide, carbon monoxide and PM_{10} under maximum and abnormal operation of the facility. Results will also be below the air quality standard for $PM_{2.5}$ under maximum and abnormal operation of the facility. Thus, no adverse impact on public health or the environment is envisaged to occur under these conditions at or beyond the facility boundary. Emissions at maximum operations equate to ambient concentrations (including background concentrations) ranging from 10% - 50% of the respective limit values at the worst-case receptors.

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TOC, HCl & HF

Modelling results indicate that the ambient ground level concentrations will be below the relevant air quality guidelines for the protection of human health for TOC (assumed pessimistically to consist solely of benzene), HCl and HF under maximum and abnormal operation of the facility. Thus, no adverse impact on public health or the environment is envisaged to occur under these conditions at or beyond the facility boundary. Emissions at maximum operations equate to ambient concentrations (including background concentrations) for HCl and TOC of only 14% and 21% respectively of the ambient limit values.

HF modelling results indicate that emissions at maximum operations equate to ambient HF concentrations (including background concentrations) which will be 5% of the maximum ambient 1-hour limit value and 0.3% of the annual limit value.

PCDD / PCDFs (Dioxins/Furans)

Currently, no internationally recognised ambient air quality concentration or deposition standards exist for PCDD/PCDFs (Dioxins/Furans). Both the USEPA and WHO recommended approach to assessing the risk to human health from Dioxins/Furans entails a detailed risk assessment analysis involving the determination of the impact of Dioxins/Furans in terms of the TDI (Tolerable Daily Intake) approach. The WHO currently proposes a maximum TDI of between 1-4 pgTEQ/kg of body weight per day.

Background levels of Dioxins/Furans occur everywhere and existing levels in the surrounding area have been extensively monitored as part of this study. Monitoring results indicate that the existing levels are similar to rural areas in the UK and Ireland.

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The contribution from the facility in this context is minor, with levels at the worst-case receptor to the south of the Facility, under maximum and abnormal operation, accounting for only a small fraction of existing levels. Levels at the nearest residential receptor will be minor, with the annual contribution from the proposed facility accounting for less than 1% of the existing background concentration under maximum operating conditions.

PAHs

PAHs modelling results indicate that the ambient ground level concentrations will be below the relevant air quality target value for the protection of human health under maximum and abnormal operation of the Facility. Thus, no adverse impact on public health or the environment is envisaged to occur under these conditions at or beyond the facility boundary. Emissions at maximum operations equate to ambient benzo[*a*]pyrene concentrations (excluding background concentrations) which are only 0.5% of the EU annual average target value at the worst-case receptor.

Hg

Hg modelling results indicate that the ambient ground level concentrations will be below the relevant air quality standards for the protection of human health under maximum and abnormal operation of the facility. Thus, no adverse impact on public health or the environment is envisaged to occur under these conditions at or beyond the facility boundary. Emissions at maximum operations equate to ambient mercury concentrations (including background concentrations) which are only 0.1% of the annual average limit value at the worst-case receptor.

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Cd and Tl

Modelling results indicate that the ambient ground level concentrations will be below the relevant air quality standard for the protection of human health for cadmium under maximum and abnormal operation from the facility. Emissions at maximum levels equate to ambient Cd and Tl concentrations (including background concentrations) which are 25% of the EU annual target value for Cd close to the facility boundary (the comparison is made with the Cd limit value as this is more stringent than that for Tl).

Sum of As, Sb, Pb, Cr, Co, Cu, Ni, Mn and V

Modelling results indicate that the ambient ground level concentrations will be below the relevant air quality standards for the protection of human health for arsenic (As), Nickel (Ni) and vanadium (V) (the metals with the most stringent limit values) under maximum and abnormal operation emissions from the facility (based on the ratio of metals measured at a Waste to Energy facility in Carranstown, County Meath). Thus, no adverse impact on public health or the environment is envisaged to occur under these conditions at or beyond the facility boundary. Ambient concentrations have been compared to the annual target value for As and Ni and the maximum 1-hour limit value for V as these represent the most stringent limit values for the suite of metals. Emissions at maximum operations equate to ambient As and Ni concentrations (including background concentrations) which are 17% and 37% of the EU annual target value respectively at the worst-case receptor whilst emissions at maximum operations equate to ambient V concentrations (including background concentrations) which are only 0.5% of the maximum 1-hour limit value at the worst-case receptor.

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Table A8.80 CALPUFF Modelling Results Under Maximum Operations (μg/m^3).

Pollutant	**NO_2**		**NO_x**	**SO_2**			**PM_{10}**		**$PM_{2.5}$**	**CO**	**TOC**	**HCl**	
Averaging Period	1-hr	Annual	Annual	1-hr	24-hr	Annual	24-hr	Annual	Annual	8-Hr	Ann	1-hr	Annual
Annual Baseline & Site Traffic Concentration (Year 2020)	24	12	17	20.7	12.8	10	28.1	20	12	500	1	2.4	1.2
Process Emissions	113.0	0.8	1.1	41.4	4.6	0.3	0.5	0.05	0.05	35.0	0.053	111.8	0.053
Predicted Environmental Concentration (Year 2020)	83	12.6	17.8	52.2	15.4	10.3	28.2	20.1	12.1	535	1.04	114.2	1.25
Ambient Air Quality Standard	**200**	**40**	**30**	**350**	**125**	**20**	**50**	**40**	**25**	**10000**	**5.0**	**800**	**20**

Table A8.80(continued) CALPUFF Modelling Results Under Maximum Operations (μg/m^3).

Pollutant	**HF**		**Dioxins (fg/m^3)**	**PAHs**	**Hg**	**Cd (ng/m^3)**	**As (ng/m^3)**	**Ni (ng/m^3)**	**V**
Averaging Period	1-hr	Annual	Annual	Annual	Annual	Annual	Annual	Annual	Maximum 1-Hr
Annual Baseline & Site Traffic Concentration (Year 2020)	0.100	0.05	14	0.620	0.001	1	1	7	0.0026
Process Emissions	7.45	0.0053	0.53	0.005	0.0003	0.27	0.02	0.34	0.003
Predicted Environmental Concentration (Year 2020)	7.55	0.055	14.5	0.625	0.001	1.27	1.02	7.34	0.005
Ambient Air Quality Standard	**160**	**16**	**N/A**	**1,000**	**1**	**5**	**6**	**20**	**1**

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8.13 National Emissions Ceilings

In 1999, Ireland signed the Gothenburg Protocol to the 1979 UN Convention on Long Range Transboundary Air Pollution. The initial objective of the Protocol was to control and reduce emissions of Sulphur Dioxide (SO_2), Nitrogen Oxides (NO_X), Volatile Organic Compounds (VOCs) and Ammonia (NH_3). To achieve the initial targets Ireland was obliged, by 2010, to meet national emission ceilings of 42 kt for SO_2 (67% below 2001 levels), 65 kt for NO_X (52% reduction), 55 kt for VOCs (37% reduction) and 116 kt for NH_3 (6% reduction). In 2012, the Gothenburg Protocol was revised to include national emission reduction commitments for the main air pollutants to be achieved in 2020 and beyond and to include emission reduction commitments for $PM_{2.5}$. In relation to Ireland, 2020 emission targets are 25 kt for SO_2 (65% below 2005 levels), 65 kt for NO_X (49% reduction), 43 kt for VOCs (25% reduction), 108 kt for NH3 (1% reduction) and 10 kt for $PM_{2.5}$ (18% reduction). COM (2013) 917 Final is the "*Proposal for a Council Decision for the acceptance of the Amendment to the 1999 Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution to Abate Acidification, Eutrophication and Ground-level Ozone*"[32].

European Commission Directive 2001/81/EC[33], the National Emissions Ceiling Directive (NECD), prescribes the same emission limits as the 1999 Gothenburg Protocol. A National Programme for the progressive reduction of emissions of these four transboundary pollutants has been in place since April 2005[34]. The most recent data available from the EU in 2010 indicated that Ireland complied with the emissions ceilings for SO_2, VOCs and NH_3 but failed to comply with the ceiling for NO_X[35]. COM (2013) 920 Final is the *"Proposal for a Directive on the reduction of national emissions of certain atmospheric pollutants and amending Directive 2003/35/EC"*[36]. The proposal will apply the 2010 NECD limits until 2020 and establish new national emission reduction commitments which will be applicable from 2020 and 2030 for SO_2, NO_X, NMVOC, NH_3, $PM_{2.5}$ and CH_4. In relation to Ireland, 2020-29 emission targets are for SO_2 (65% below 2005 levels), for NO_X (49% reduction), for VOCs (25% reduction), for NH_3 (1% reduction) and for $PM_{2.5}$ (18% reduction). In relation to 2030, Ireland's emission targets are for SO_2 (83% below 2005 levels), for NO_X (75% reduction), for VOCs (32% reduction), for NH_3 (7% reduction), for $PM_{2.5}$ (35% reduction) and for CH_4 (7% reduction).

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The impact of the facility on emissions of SO_2, NO_X and VOCs has been assessed. Results, outlined in Table A8.81, indicate that the impact of the Facility on Ireland's obligations under the Gothenburg Protocol is slight. The overall impact of the development is to increase SO_2 levels by 0.25% of the ceiling levels to be complied with in 2020, NO_X levels by 0.38% of the ceiling levels, VOC levels will be increased by 0.03% of the ceiling limits whilst $PM_{2.5}$ levels will be increased by 0.14% of the ceiling limits.

Table A8.81 Impact of Ringaskiddy WTE Facility on the Ireland's National Emission Ceiling Obligations.

Year	Scenario	SO_2 (tonnes/ annum)	VOC (tonnes/ annum)	NO_X (tonnes/ annum)	$PM_{2.5}$ (tonnes/ annum)
2020	**Facility In Operation (8760 Hours)**	62	12	249	12
Emission Ceiling (kilo-tonnes) In 2020		24.9(1)	42.8(1)	64.8(1)	9.0(1)
Impact of Facility (%) (National)		**0.25%**	**0.03%**	**0.38%**	**0.14%**

(1) Proposal for a Council Decision for the acceptance of the Amendment to the 1999 Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution to Abate Acidification, Eutrophication and Ground-level Ozone. (COM2013) 917 Final

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8.14 Conclusions

Based on the emission guidelines outlined in Council Directive 2010/75/EU, detailed air dispersion modelling has shown that the most stringent ambient air quality standards for the protection of human health are not exceeded either as a result of operating under maximum or abnormal operating conditions.

The modelling results, using both the USEPA regulatory model AERMOD and the more advanced CALPUFF model, indicate that the maximum ambient GLC occurs at or near the facility's southern and south-eastern boundaries. The spatial impact of the facility is limited with concentrations falling off rapidly away from the maximum peak. For example, the short-term limit values at the nearest residential receptor will be less than 17% of the short-term ambient air quality limit values. The annual average concentration has an even more dramatic decrease in maximum concentration away from the facility with concentrations from emissions at the proposed facility accounting for less than 1% of the limit value (not including background concentrations) at worst case sensitive receptors near the facility.

In the surrounding areas of Cobh, Carrigaline and Monkstown, levels are significantly lower than most background sources with the concentrations from emissions at the proposed facility accounting for less than 1% of the annual limit values for the protection of human health for all pollutants under maximum operations of the facility.

In terms of Ireland's obligations under the Gothenburg Protocol and the POPs Convention, the impact of the facility will not be significant.

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8.15 References

(1) USEPA (2005) Guidelines on Air Quality Models, Appendix W to Part 51, 40 CFR Ch.1
(2) USEPA (2004) Minimum Meteorological Data Requirements For AERMOD – Study & Recommendations", 1998, USEPA
(3) USEPA (2004) AERMOD Description of Model Formulation
(4) USEPA (2004) AERMAP Users Guide
(5) USEPA (2008) AERSURFACE User's Guide
(6) Alaska Department of Environmental Conservation (2008) ADEC Guidance re AERMET Geometric Means (http://dec.alaska.gov/air/ap/modeling.htm)
(7) Schulman, L.L; Strimaitis, D.G.; Scire, J.S. (2000) Development and evaluation of the PRIME plume rise and building downwash model. Journal of the Air & Waste Management Association, 50, 378-390.
(8) Paine, R & Lew, F. "Consequence Analysis for Adoption of PRIME: an Advanced Building Downwash Model" Prepared for the EPRI, ENSR Document No. 2460-026-450 (1997).
(9) EPA (2010) Guidance Note On Air Dispersion Modelling – AG04
(10) USEPA (2004) Estimating Exposure to Dioxin-Like Compounds Volume IV, Chapter 3 Evaluating Atmospheric Releases of Dioxin-Like Compounds from Combustion Sources (Draft)
(11) USEPA (2005) Human Health Risk Assessment Protocol, Chapter 3: Air Dispersion and Deposition Modelling, Region 6 Centre for Combustion Science and Engineering
(12) Auer Jr, (1978) Correlation of Land Use and Cover with Meteorological Anomalies, *Journal of Applied Meteorology* 17(5):636-643
(13) UK DEFRA (2009) Part IV of the Environment Act 1995: Local Air Quality Management, LAQM. TG(09)
(14) European Commission (2000) Assessment of Dietary Intake of Dioxins & Related PCBs by the Population of EU Member States (SCOOP Task 3.2.5)
(15) AEA Technology (1999) Compilation of EU Dioxin Exposure & Health Data Task 2 – Environmental Levels
(16) WHO (1989) Polychlorinated dibenzo-p-dioxins and dibenzofurans, EHC 810.
(17) USEPA (2004) Estimating Exposure to Dioxin-Like Compounds Volume I, Chapter 1 Introduction (Draft)
(18) Database of Sources of Environmental Releases of Dioxin-Like Compounds in the United States (1998, USEPA (CD-ROM))
(19) USEPA (2004) Estimating Exposure to Dioxin-Like Compounds Volume IV, Chapter 5 Demonstration of Methodology (Draft)
(20) Chemistry of the Upper & Lower Atmosphere, Finlayson-Pitts & Pitts (1999), Academic Press
(21) Harrison et al, (1996) Source apportionment of atmospheric polycyclic aromatic hydrocarbons collected from an urban location in Birmingham, UK *Environmental Science & Technology*; 30 (825-832)
(22) USEPA (1993) Exposure & Risk Assessment for Benzo[a]pyrene and other Polycyclic Aromatic Hydrocarbons, Volume 1 Summary
(23) World Health Organisation (2006) Air Quality Guidelines - Global Update 2005 (and previous Air Quality Guideline Reports 1999 & 2000)
(24) UK DETR (2000) Polycyclic Aromatic Hydrocarbons
(25) Farant & Gariepy (1998) Relationship between benzo[a]pyrene and individual polycyclic aromatic hydrocarbons in a Soderberg primary aluminium smelter *American Industrial Hygiene Association Journal* 59 (758-765)
(26) EPA (2015) Air Quality Monitoring Report 2014 (& earlier reports)
(27) European Commission (2004) Council Directive 2004/107/EC Relating To As, Cd, Hg, Ni and PAHs In Ambient Air
(28) USEPA (2000) Implementation Issues: Mercury Transport & Fate, Combustion Risk Assessments in Region 6
(29) Environmental Agency (2003) "IPPC H1 - Environmental Assessment & Appraisal of BAT"
(30) Environmental Agency (2011) "H1 Annex F Air Emissions v 2.2"
(31) Environment Agency (2012) "Releases From Municipal Waste Incinerators – Guidance To Applicants On Impact Assessment For Group 3 Metals Stack"
(32) EU (2013) *Proposal for a Council Decision for the acceptance of the Amendment to the 1999 Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution to Abate Acidification, Eutrophication and Ground-level Ozone*
(33) European Commission (2001) Council Directive 2001/81/EC Relating To National Emission Ceilings for Certain Atmospheric Pollutants
(34) DEHLG (2003) Strategy to Reduce Emissions of Trans-boundary Pollution by 2010 to Comply with National Emission Ceilings - Discussion Document
(35) EEA (2011) NEC Directive Status Reports 2010
(36) EU (2013) COM (2013) 920 Final - *Proposal for a Directive on the reduction of national emissions of certain atmospheric pollutants and amending Directive 2003/35/EC*
(37) USEPA (2004) User's Guide to the AERMOD Meteorological Preprocessor (AERMET)
(38) UK DEFRA (2007) Design Manual for Roads and Bridges Vol 11 Chapter 3 (Spreadsheet)

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Appendix 8.2
Description of AERMOD Model

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APPENDIX 8.2

Description of the AERMOD Model

The AERMOD (version 15181) dispersion model has been developed, in part, by the U.S. Environmental Protection Agency (USEPA)[3]. The model is a steady-state Gaussian model used to assess pollutant concentrations associated with industrial sources. The model is an enhancement on the Industrial Source Complex-Short Term 3 (ISCST3) model which has been widely used for emissions from industrial sources. The 2005 Guidelines on Air Quality Models has promulgated AERMOD as the preferred model for a refined analysis from industrial sources, in all terrains[1].

Improvements over the ISCST3 model include the treatment of the vertical distribution of concentration within the plume. ISCST3 assumes a Gaussian distribution in both the horizontal and vertical direction under all weather conditions. AERMOD, however, treats the vertical distribution as non-Gaussian under convective (unstable) conditions while maintaining a Gaussian distribution in both the horizontal and vertical direction during stable conditions. This treatment reflects the fact that the plume is skewed upwards under convective conditions due to the greater intensity of turbulence above the plume than below. The result is a more accurate portrayal of actual conditions using the AERMOD model. AERMOD also enhances the turbulence of night-time urban boundary layers thus simulating the influence of the urban heat island.

In contrast to ISCST3, AERMOD is widely applicable in all types of terrain. Differentiation of the simple versus complex terrain is unnecessary with AERMOD. In complex terrain, AERMOD employs the dividing-streamline concept in a simplified simulation of the effects of plume-terrain interactions. In the dividing-streamline concept, flow below this height remains horizontal, and flow above this height tends to rise up and over terrain. Extensive validation studies have found that AERMOD performs better than ISCST3 for many applications and as well or better than CTDMPLUS for several complex terrain data sets[3]

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AERMOD has made substantial improvements in the area of plume growth rates in comparison to ISCST3[3]. ISCST3 approximates turbulence using six Pasquill-Gifford-Turner Stability Classes and bases the resulting dispersion curves upon surface release experiments. This treatment, however, cannot explicitly account for turbulence in the formulation. AERMOD is based on the more realistic modern planetary boundary layer (PBL) theory which allows turbulence to vary with height. This use of turbulence-based plume growth with height leads to a substantial advancement over the ISCST3 treatment.

Improvements have also been made in relation to mixing height[3]. The treatment of mixing height by ISCST3 is based on a single morning upper air sounding each day. AERMOD, however, calculates mixing height on an hourly basis based on the morning upper air sounding and the surface energy balance, accounting for the solar radiation, cloud cover, reflectivity of the ground and the latent heat due to evaporation from the ground cover. This more advanced formulation provides a more realistic sequence of the diurnal mixing height changes.

AERMOD also contains improved algorithms for dealing with low wind speed (near calm) conditions. As a result, AERMOD can produce model estimates for conditions when the wind speed may be less than 1 m/s, but still greater than the instrument threshold.

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AERMET

AERMOD incorporates a meteorological pre-processor AERMET[37]. AERMET allows AERMOD to account for changes in the plume behaviour with height. AERMET calculates hourly boundary layer parameters for use by AERMOD, including friction velocity, Monin-Obukhov length, convective velocity scale, convective (CBL) and stable boundary layer (SBL) height and surface heat flux. AERMOD uses this information to calculate concentrations in a manner that accounts for changes in dispersion rate with height, allows for a non-Gaussian plume in convective conditions, and accounts for a dispersion rate that is a continuous function of meteorology.

The AERMET meteorological preprocessor requires the input of surface characteristics, including surface roughness (z_0), Bowen Ratio and albedo by sector and season, as well as hourly observations of wind speed, wind direction, cloud cover, and temperature. A morning sounding from a representative upper air station, latitude, longitude, time zone, and wind speed threshold are also required.

Two files are produced by AERMET for input to the AERMOD dispersion model. The surface file contains observed and calculated surface variables, one record per hour. The profile file contains the observations made at each level of a meteorological tower, if available, or the one-level observations taken from other representative data, one record level per hour.

From the surface characteristics (i.e. surface roughness, albedo and amount of moisture available (Bowen Ratio)) AERMET calculates several boundary layer parameters that are important in the evolution of the boundary layer, which, in turn, influences the dispersion of pollutants. These parameters include the surface friction velocity, which is a measure of the vertical transport of horizontal momentum; the sensible heat flux, which is the vertical transport of heat to/from the surface; the Monin-Obukhov length which is a stability parameter relating the surface friction velocity to the sensible heat flux; the daytime mixed layer height; the nocturnal surface layer height and the convective velocity scale which combines the daytime mixed layer height and the sensible heat flux. These parameters all depend on the underlying surface.

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The values of albedo, Bowen Ratio and surface roughness depend on land-use type (e.g., urban, cultivated land etc) and vary with seasons and wind direction. The assessment of appropriate land-use type was carried out to a distance of 10km from the location of the meteorological station in line with USEPA recommendations[4-6] for albedo and Bowen ratio with a 1km geometric determination undertaken for the surface roughness. In relation to wind direction, a minimum sector arc of 30 degrees is recommended. In the current model, the surface characteristics of Cork Airport were assessed and two sectors identified with distinctly varying land use characteristics.

Surface roughness

Surface roughness length is the height above the ground at which the wind speed goes to zero. Surface roughness length is defined by the individual elements on the landscape such as trees and buildings. In order to determine surface roughness length, the USEPA recommends that a representative length be defined for each sector, based on an upwind area-weighted average of the land use within the sector, by using the eight land use categories outlined by the USEPA. The inverse-distance weighted surface roughness length derived from the land use classification within a radius of 1km from Cork Airport Meteorological Station is shown in Table A8.82.

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Table A8.82 Surface Roughness based on an inverse distance weighted average of the land use within a 1km radius of Cork Airport Meteorological Station.

Sector	Area Weighted Land Use Classification	Spring	Summer	Autumn	Winter[Note 1]
350-50	60% Urban, 40% Grassland	0.213	0.305	0.093	0.093
50-350	100% Grassland	0.050	0.100	0.010	0.010

(1) Winter defined as periods when surfaces covered permanently by snow whereas autumn is defined as periods when freezing conditions are common, deciduous trees are leafless and no snow is present (Iqbal (1983))[4]. Thus for the current location autumn more accurately defines "winter" conditions in Ireland.

Albedo

Noon-time albedo is the fraction of the incoming solar radiation that is reflected from the ground when the sun is directly overhead. Albedo is used in calculating the hourly net heat balance at the surface for calculating hourly values of Monin-Obuklov length. A 10km x 10km square area is drawn around the meteorological station to determine the albedo based on a simple average for the land use types within the area independent of both distance from the station and the near-field sector. The classification within 10km from Cork Airport Meteorological Station is shown in Table A8.83.

Table A8.83 Albedo based on a simple average of the land use within a 10km × 10km grid centred on Cork Airport Meteorological Station.

Area Weighted Land Use Classification	Spring	Summer	Autumn	Winter[Note 1]
19% Urban, 81% Grassland	0.17	0.18	0.20	0.20

(1) For the current location autumn more accurately defines "winter" conditions in Ireland.

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Bowen Ratio

The Bowen ratio is a measure of the amount of moisture at the surface of the earth. The presence of moisture affects the heat balance resulting from evaporative cooling which, in turn, affects the Monin-Obukhov length which is used in the formulation of the boundary layer. A 10km x 10km square area is drawn around the meteorological station to determine the Bowen Ratio based on geometric mean of the land use types within the area independent of both distance from the station and the near-field sector. The classification within 10km from Cork Airport Meteorological Station is shown in Table A8.84.

Table A8.84 Bowen Ratio based on a geometric mean of the land use within a 10km × 10km grid centred on Cork Airport Meteorological Station.

Area Weighted Land Use Classification	Spring	Summer	Autumn	Winter[Note 1]
19% Urban, 81% Grassland	0.47	0.95	1.14	1.14

(1) For the current location autumn more accurately defines "winter" conditions in Ireland.

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Detailed Meteorological Data – Cork Airport 2010 - 2014

Cork Airport 2010

Dir \ Spd	<= 1.54	<= 3.09	<= 5.14	<= 8.23	<= 10.80	> 10.80	Total
0.0	3	35	310	174	13	0	535
22.5	9	26	183	88	9	0	315
45.0	10	25	161	116	5	0	317
67.5	10	22	110	52	5	0	199
90.0	10	44	190	99	27	6	376
112.5	6	32	176	106	36	13	369
135.0	4	27	153	144	45	16	389
157.5	9	26	152	103	33	10	333
180.0	22	74	249	133	59	10	547
202.5	23	91	325	214	50	6	709
225.0	15	70	479	211	68	5	848
247.5	14	55	365	142	34	7	617
270.0	29	76	235	103	13	3	459
292.5	17	70	450	166	35	12	750
315.0	8	71	671	269	54	9	1,082
337.5	6	31	441	382	25	6	891
Total	195	775	4,650	2,502	511	103	8,736
Calms							24
Missing							0
Total							8,760

Cork Airport 2011

Dir \ Spd	<= 1.54	<= 3.09	<= 5.14	<= 8.23	<= 10.80	> 10.80	Total
0.0	3	35	146	27	2	0	213
22.5	9	18	82	16	0	0	125
45.0	6	38	77	29	5	0	155
67.5	6	33	98	35	8	0	180
90.0	17	64	164	70	17	0	332
112.5	11	43	165	82	22	1	324
135.0	12	49	116	78	39	7	301
157.5	14	35	118	152	58	34	411
180.0	25	79	269	244	104	10	731
202.5	31	90	337	269	129	55	911
225.0	20	73	627	454	168	99	1,441
247.5	16	42	519	319	69	14	979
270.0	13	71	304	256	76	15	735
292.5	11	55	357	234	107	10	774
315.0	9	65	341	171	49	5	640
337.5	7	38	241	168	22	1	477
Total	210	828	3,961	2,604	875	251	8,729
Calms							31
Missing							0
Total							8,760

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Cork Airport 2012

Dir \ Spd	<= 1.54	<= 3.09	<= 5.14	<= 8.23	<= 10.80	> 10.80	Total
0.0	8	26	134	117	32	10	327
22.5	3	15	91	37	18	7	171
45.0	6	18	85	75	16	2	202
67.5	8	19	101	40	14	1	183
90.0	7	30	184	108	26	5	360
112.5	11	40	183	118	25	9	386
135.0	10	30	177	123	57	13	410
157.5	21	29	172	89	28	1	340
180.0	21	83	345	159	44	13	665
202.5	22	69	330	230	89	26	766
225.0	13	78	599	354	71	17	1,132
247.5	15	48	521	298	34	2	918
270.0	33	59	388	206	51	9	746
292.5	24	52	390	207	72	16	761
315.0	16	59	402	233	63	7	780
337.5	8	18	205	251	66	15	563
Total	226	673	4,307	2,645	706	153	8,710
Calms							66
Missing							8
Total							8,784

Cork Airport 2013

Dir \ Spd	<= 1.54	<= 3.09	<= 5.14	<= 8.23	<= 10.80	> 10.80	Total
0.0	39	84	194	98	15	2	432
22.5	12	36	94	32	2	0	176
45.0	17	30	93	47	21	2	210
67.5	9	32	49	33	8	5	136
90.0	34	93	212	273	117	29	758
112.5	24	51	165	155	86	8	489
135.0	27	47	102	99	40	7	322
157.5	16	22	83	68	15	3	207
180.0	77	88	257	288	69	38	817
202.5	71	92	247	193	52	48	703
225.0	46	103	435	254	67	38	943
247.5	34	85	267	145	43	17	591
270.0	64	154	356	267	80	15	936
292.5	54	111	268	162	55	14	664
315.0	26	118	376	238	68	18	844
337.5	23	52	182	168	54	3	482
Total	573	1,198	3,380	2,520	792	247	8,710
Calms							50
Missing							0
Total							8,760

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Cork Airport 2014

Dir \ Spd	<= 1.54	<= 3.09	<= 5.14	<= 8.23	<= 10.80	> 10.80	Total
0.0	34	38	168	46	12	0	298
22.5	20	32	81	9	0	0	142
45.0	30	43	70	18	1	0	162
67.5	37	26	58	21	1	0	143
90.0	52	74	185	131	43	2	487
112.5	49	58	119	93	23	8	350
135.0	39	45	115	70	20	20	309
157.5	35	82	152	91	34	32	426
180.0	109	150	333	272	79	20	963
202.5	88	103	251	213	122	46	823
225.0	60	134	551	239	103	43	1,130
247.5	45	89	350	194	61	14	753
270.0	52	148	351	271	91	39	952
292.5	51	109	255	166	18	7	606
315.0	41	90	318	257	31	0	737
337.5	36	66	173	141	16	3	435
Total	778	1,287	3,530	2,232	655	234	8,716
Calms							44
Missing							0
Total							8,760

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Appendix 8.3

Air Quality Impact from Traffic Sources

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APPENDIX 8.3

Air Quality Impact From Traffic Sources

The impact of the operational traffic accessing the Ringaskiddy Resource Recovery facility has been assessed using the UK DMRB Screening Model[38] which is a recommended screening model to assess air quality impacts from road traffic[13]. The worst-case operational impact in the region of the facility has been assessed and is outlined in Table A8.85. Cumulative impacts due to the Port of Cork expansion project have also been included in the "do-something" scenario. Development traffic data was taken from Table 7.9 of the Traffic Chapter of the EIS (Chapter 7).

Peak contributions to ambient air quality concentration tend not to overlap between traffic sources and industrial releases both temporally and spatially as these peak contributions from each source often occur under different weather conditions. However, for the purposes of this assessment, the maximum ambient levels due to operational traffic sources and process emissions have been combined to derive the worst-case cumulative impact from the facility.

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Table A8.85 Summary Of Predicted Traffic Derived Pollutant Levels At Nearest Receptor To The Proposed Ringaskiddy Resource Recovery Facility.

Scenarios	Traffic Speed	Carbon Monoxide (mg/m^3)		Benzene (µg/m^3)		Nitrogen Dioxide (µg/m^3)			Particulates (PM_{10}) (µg/m^3)	
	(km/hr)	Annual Mean	Maximum 8-hour	Annual mean benzene	Rolling annual mean benzene	Annual average NO_x	Annual average NO_2	Maximum 1-Hour NO_2	Annual average	No of Days > 50 µg/m^3
2020 Existing Traffic	30	0.01	0.05	0.01	0.01	0.80	0.44	1.5	0.09	0
2020 Do Something Traffic (Including Port Of Cork)	30	0.005	0.025	0.005	0.005	1.2	0.61	2.1	0.12	0
Standards			10[(1)]		5[(1)]	-	40[(2)]	200[(2,3)]	40[2]	35[(2,4)]

[(1)] EU Council Directive 2000/69/EC (S.I. 180 of 2011)
[(2)] EU Council Directive 2008/50/EC (S.I. 180 of 2011)
[(3)] 1-hr limit of 200 µg/m^3 not to be exceeded > 18 times/year (99.8th %ile)
[(4)] 24-Hr limit of 50 µg/m^3 not to be exceeded > 35 times/year (90.1th %ile)

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Appendix 8.4
Cumulative Impact Assessment

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APPENDIX 8.4

Cumulative Impact Assessment

As the region around Ringaskiddy is industrialised and thus has several other potentially significant point sources of air emissions, a detailed cumulative assessment has been carried out using the methodology outlined by the USEPA.

The impact of nearby point sources should be examined where interactions between the plume of the point source under consideration and those of nearby sources can occur. These include:

a. the area of maximum impact of the point source,
b. the area of maximum impact of nearby sources,
c. the area where all sources combine to cause maximum impact(1).

In the context of the cumulative assessment, all significant sources should be taken into account. The USEPA has defined "significance" in the current context as an impact leading to a 1 $\mu g/m^3$ annual increase in the annual average concentration of the applicable criteria pollutant. However, no significant ambient impact levels have been established for non-criteria pollutants (defined as all pollutants except PM_{10}, NO_2, SO_2, CO and lead). The USEPA does not require a full cumulative assessment for a particular pollutant when emissions of that pollutant from a proposed source would not increase ambient levels by more than the significant ambient impact level (annual average of 1 $\mu g/m^3$). A similar approach has been applied in the current assessment. A significance criterion of 2% of the ambient air quality standard or guideline has been applied for all non-criteria pollutants. These releases consist of NO_2, SO_2, HCl, HF, Dioxins, Cd, PAHs, As and Ni. As emissions of Total Dust (as PM_{10}), CO and TOC are not significant, no cumulative assessment will be carried out for these pollutants. Furthermore, as there are no significant releases of HCl, HF, PAHs, Cd, As and Ni in the vicinity of the facility, no detailed cumulative assessment is necessary for these compounds. Table A8.86 outlines the significant releases from Indaver which also have a nearby facility which is releasing the same pollutants at significance levels.

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In order to determine compliance, the predicted ground level concentration (based on the full impact analysis and existing air quality data) at each model receptor is compared to the applicable ambient air quality limit value or PSD increment. If the predicted pollutant concentration increase over the baseline concentration is below the applicable increment, and the predicted total ground level concentrations are below the ambient air quality standards, then the applicant has successfully demonstrated compliance.

When an air quality standard or PSD increment is predicted to be exceeded at one or more receptor in the impact area, it should be determined whether the net emissions increase from the proposed source will result in a significant ambient impact at the point of each violation, and at the time the violation is predicted to occur. The source will not be considered to cause or contribute to the violation if its own impact is not significant at any violating receptor at the time of each violation.

In relation to nearby sources, several significant sources of releases were identified as outlined in Table A8.87. The emission data used in the cumulative assessment is based on the maximum emission limits and volume flows contained in each facilities' IED Licence. For each significant nearby source, an assessment was made of which pollutants from each source were significant. The significant pollutants from each site have been outlined in Table A8.87. In addition, air modelling of road emissions associated with the project have also been undertaken and added to the existing worst-case background pollutant levels. Cumulative impacts due to the Port of Cork expansion project have also been included in both the "do-nothing" and "do-something" scenario.

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Table A8.86 Assessment of Significant Releases from Indaver

Pollutant	Significance Criteria ($\mu g/m^3$ annual average)	Indaver GLC ($\mu g/m^3$ annual average)	Significance
NO_2	1	1.25	√
SO_2	1	0.42	x
Dioxins	-	0.83 fg/m^3	x

Table A8.87 Assessment of Significant Releases From Nearby Sources

Pollutant	Plant 1	Plant 2	Plant 3	Plant 4	Plant 5	Plant 6	Plant 7
NO_2	√	√	√		√	√	√
SO_2	√	√	√	√	√	√	√
Dioxins		√		√	√	√	

Summary of Nearby Sources

Plant 1: Janssen Biologics Ltd
Plant 2: Hovione Cork
Plant 3: ESB Aghada
Plant 4: Novartis Ringaskiddy Ltd.
Plant 5: GSK Ireland
Plant 6: Pfizer Ireland Pharmaceuticals (Ballintaggart)
Plant 7: BGE Whitegate

The cumulative impact assessment has been carried out to assess the impact of emissions from Indaver on the surrounding environment. As such, several conservative approximations have been made in regards to the operating details and physical characteristics of the surrounding sources. Furthermore, the guidance for assessing cumulative impacts includes assessing everywhere off-site, including within the site boundary of all nearby sources[1]. Thus, the results outlined in this chapter, in regards to emissions from nearby sources, may apply to areas on-site within each source (and thus will not fall under the domain of ambient legislation) and will also most likely over-estimate the impact of these sources in the surrounding environment.

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Table A8.87 Assessment of Cumulative Impact of Nitrogen Dioxide Emissions (μg/m^3)

Pollutant	Indaver	All Point Sources Except Indaver	Significance Criteria	All Point Sources[5]	Limit Value[3]
Impact of each source at Indaver Maximum – 99.8th%ile[1]	28.8 (547925, 5742125)	20.7 (547925, 5742125)	100[4]	52.8 (547925, 5742125)	200
Impact of each source at Indaver Maximum – Annual Average[2]	1.2 (547900, 5742150)	2.9 (547900, 5742150)	20[4]	16.1 (547900, 5742150)	40
Impact of each source of maximum of All Sources – 99.8th%ile[1]	3.6 (545900, 5742900)	126.0 (545900, 5742900)	100[4]	150.0 (545900, 5742900)	200
Impact of each source of maximum of All Sources – Annual Average[2]	0.16 (545900, 5742900)	27.1 (545900, 5742900)	20[4]	39.3 (545900, 5742900)	40

(1) Conversion factor, following guidance from USEPA (Tier 3 analysis), based on empirically derived site-specific maximum 1-hour value for NO_2 / NO_X of 0.40

(2) Conversion factor following guidance from USEPA (Tier 2 analysis, annual average) based on a default ratio of 0.75 (worst-case).

(3) Directive 2008/50/EC

(4) PSD Increment for Nitrogen Dioxide applicable in the current application (except for the All Sources scenario).

(5) All sources include the background concentration (12 μg/m^3 for the annual mean and 24 μg/m^3 for 1-hr maximum (as a 99.8th%ile)).

Note: Grid co-ordinates are UTM co-ordinates and refer to the location of local maximum

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Table A8.88 Assessment of Cumulative Impact of Sulphur Dioxide Emissions (μg/m^3)

Pollutant	Indaver	All Point Sources Except Indaver	Significance Criteria	All Point Sources[4]	Limit Value
Impact of each source at Indaver Maximum – 99.7th%ile of 1-hr averages[1]	35.7 (547925, 5742100)	12.7 (547925, 5742100)	88[3]	56.4 (547925, 5742100)	350
Impact of each source at Indaver Maximum – 99.2th%ile of 24-hr averages[2]	5.2 (547875, 5742150)	3.5 (547875, 5742150)	31.25[3]	18.1 (547875, 5742150)	125
Impact of each source of maximum of All Sources – 99.7th%ile of 1-hr averages[2]	3.1 (545700, 5742100)	136.6 (545700, 5742100)	88[3]	157.3 (545700, 5742100)	350
Impact of each source of maximum of All Sources – 99.2th%ile of 24-hr averages(1)	0.67 (545600, 5741900)	62.8 (545600, 5741900)	31.25[3]	75.7 (545600, 5741900)	125

(1) Directive 2008/50/EC – Maximum one-hour concentration not to be exceeded more than 24 times per year (99.7th%ile)

(2) Directive 2008/50/EC – Maximum 24-hour concentration not to be exceeded more than 3 times per year (99.2th%ile)

(3) PSD Increment for Sulphur Dioxide applicable in the current application (except for the All Sources scenario)

(4) All sources include the background concentration (20.7 μg/m^3 for the 1-hr maximum (as a 99.7th%ile) and 12.8 μg/m^3 for the 24-hr (as a 99.2th%ile)).

Note: Grid co-ordinates are National Grid co-ordinates and refer to the location of local maximum

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Table A8.89 Assessment of Cumulative Impact of PCDD/PCDF Particulate Emissions (fg/m^3)

Pollutant	Indaver Ireland	All Point Sources Except Indaver	All Point Sources	Limit Value
Impact of each source at Indaver Maximum – Annual Average [1]	0.83 (547900, 5742150)	1.1 (547900, 57421250)	1.9 (547900, 5742150)	-
Impact of each source of maximum of All Sources – Annual Average [1]	0.3 (547875, 5741225)	8.4 (547875, 5741225)	8.7 (547875, 5741225)	-

Note: Grid co-ordinates are National Grid co-ordinates and refer to the location of local maximum

Note: Refer to Appendix 8.6 for input information on nearby sources

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NO_2

The cumulative impact of nitrogen dioxide has been assessed in Table A8.87. In the area of the maximum impact of Indaver (Grid Co-ordinate 547925, 5742125), the impact from all sources was minor. In relation to the 99.8th%ile of maximum one-hour concentrations, the cumulative impact at this point was only 10% of the limit value in the absence of Indaver. In the presence of Indaver, the cumulative impact with maximum concentrations rose to 26% of the limit value (not including background concentration), which is minor increase to the maximum concentration of Indaver alone (at 14% of the limit value). The results therefore indicate that the contribution of each nearby sources were generally separated in time and thus did not lead to any significant increase in levels above the impact of Indaver alone.

The annual average cumulative assessment was likewise minor at the area of the maximum impact of Indaver (Grid Co-ordinate 547900, 5742150). The overall impact leads to an increase of 7% in the annual average levels leading to a cumulative level of 11% of the limit value (not including background concentration).

In the area of the overall maximum impact, the impact from Indaver was very small. In relation to the 99.8th%ile of maximum one-hour concentrations, the impact of Indaver at the point of maximum impact of all nearby sources was 1.8% of the limit value. Moreover, the maximum one-hour impact of Indaver at each nearby source was separated in time and thus did not lead to any significant increase in levels above the impact of each individual source separately.

The annual average cumulative assessment was likewise minor at the area of the maximum impact of all nearby sources. In the region where all sources combine to cause the maximum impact, the impact of Indaver represents only 0.4% of the limit value.

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SO_2

The cumulative impact of sulphur dioxide has been assessed in Table A8.88. In the area of the maximum impact of Indaver (Grid Co-ordinate 547925, 5742100), the impact from all sources was minor. In relation to the 99.7th%ile of maximum one-hour concentrations, the cumulative impact at this point was less than 4% of the limit value in the absence of Indaver. In the presence of Indaver, the cumulative impact with maximum concentrations rose to 10% of the limit value (not including background concentration), which is very similar to the maximum concentration of Indaver alone (at 10% of the limit value).

The cumulative assessment of 99.2nd%ile of 24-hour concentrations also showed insignificant impacts at the area of the maximum impact of Indaver (Grid Co-ordinate 547875, 5742150).

In the area of the maximum impact of all nearby sources, the impact from Indaver was very small. In relation to the 99.7th%ile of maximum one-hour concentrations, the impact of Indaver at the point of maximum impact of all nearby sources represents only 0.9% of the limit value. With regard to the 99.2nd%ile of 24-hour concentrations, the impact of Indaver at the point of maximum impact of all nearby sources represents only 0.5% of the limit value.

PCDD/PCDFs

The cumulative impact of PCDD/PCDFs has been assessed in Table A8.89. In the area of the maximum impact of Indaver (Grid Co-ordinate 547900, 5742150), the impact from each source was minor. In relation to the annual concentration, the cumulative impact was only 1.1 fg/m^3 in the absence of Indaver, at the location of the maximum impact from Indaver. In the presence of Indaver, the assessment indicated that the cumulative annual concentrations is 1.9 fg/m^3 at this location which includes the contribution from Indaver and all other nearby

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sources. Thus the cumulative impact leads to an increase in dioxin levels of approximately 7.8% as compared to Indaver alone in the area of the maximum impact of Indaver (relative to existing background concentration).

In the area of the maximum impact of all nearby sources, the impact from Indaver was very small. In relation to the annual concentration, the impact of Indaver at the point of maximum impact of each nearby source was 0.3 fg/m^3. In the region where all sources combine to cause the maximum impact (not including Indaver's maximum), an examination of the impact of Indaver reveals an insignificant impact.

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Appendix 8.5

Sensitivity Assessment of Modelling Input Parameters

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APPENDIX 8.5

Sensitivity assessment of modelling input parameters

The sensitivity of the modelling results to variations in the model input parameters was investigated. The key parameters which are likely to influence the air dispersion modelling algorithms are outlined below:

- Meteorological Station
- Surface roughness
- Urban boundary layer options / rural option
- Land Use Characterisation

Meteorological Station

The influence of the meteorological station on the ambient ground level concentration has been investigated. For the detailed modelling Cork Airport (2010 – 2014) and the onsite station (2007) was used. As part of the sensitivity assessment Roches Point data (1986 – 1990) was also modelled to determine the sensitivity of this parameter to the modelled concentration (Roches Point manned station closed in 1991). As shown in Table A8.90, changing the meteorological station leads to a small increase in the annual average concentration and 99.8th%ile of one hour means compared to the onsite station in 2007.

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Surface Roughness

The influence of surface roughness on the ambient ground level concentration has been investigated. For the detailed modelling the surface roughness for the rural boundary layer option was selected which is representative of the area as outlined in Table A8.82. As part of the sensitivity assessment surface roughness of 0.001 and 1.0 were also modelled to determine the sensitivity of this parameter to the modelled concentration. As shown in Table A8.90, changing the surface roughness to 1.0 which is representative of an urban area leads to a small increase in the annual average concentration and a small decrease in the 99.8th%ile of one hour means. Reducing the surface roughness to 0.001 leads to a small increase in both the maximum one hour (as a 99.8th%ile) and a small decrease in the annual average.

Land Use Characterisation

The influence of the land use characterisation near the facility on the ambient ground level concentration has been investigated. For the detailed modelling, land use characterisation was undertaken as outlined in Table A8.83 based on the location of the facility at an urban / rural interface. As part of the sensitivity assessment modelling assuming solely a rural character (0-360°) consisting of grasslands was also modelled to determine the sensitivity of this parameter to the modelled concentration. As shown in Table A8.90 assuming that the land use surrounding the facility is entirely grasslands leads to a minor short-term increase relative to the predicted level (base case). Table A8.90 also shows that the scenario where the urban boundary layer was used (instead of the default rural boundary layer) leads to a small change in the predicted level (relative to the base case).

Average / Wet Bowen Ratio Comparison

The influence of the Bowen ratio (which characterises the available surface moisture) on the ambient ground level concentration has been investigated. For the detailed modelling an

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average bowen ratio was selected based on the rainfall totals for Cork. As part of the sensitivity assessment modelling assuming higher rainfall pattern (wet) was undertaken to determine the sensitivity of this parameter to the modelled concentration. As shown in Table A8.90, the effect of changing the Bowen ratio from average to wet is a negligible for the maximum one hour (as a 99.8th%ile) and the annual average.

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Table A8.90 Dispersion Model Results – Sensitivity Study (Based on Ringaskiddy Onsite data 2007)

Pollutant / Scenario	Mean Background ($\mu g/m^3$)(1)	Averaging Period	Process Contribution NO_X ($\mu g/m^3$)	Predicted Emission Concentration ($\mu g/Nm^3$)	Standard ($\mu g/Nm^3$)	Ringaskiddy Facility emissions as a % of ambient limit value
NO_2 / Default (Varying Surface Roughness as shown in Table 8.75, Rural Boundary Layer, Average Bowen ratio, Land Use as shown in Table 8.75)	12	Annual Mean(3)	0.85	12.9	40(2)	3%
	105.1	99.8th%ile of 1-hr means(4)	71.6	124.8	200(2)	36%
NO_2 / Roches Point 1986 - 1990	12	Annual Mean(3)	1.28	13.3	40(2)	3%
	105.1	99.8th%ile of 1-hr means(4)	72.3	125.5	200(2)	36%
NO_2 / Surface Roughness 0.001	12	Annual Mean(3)	0.76	12.8	40(2)	2%
	105.1	99.8th%ile of 1-hr means(4)	73.3	126.5	200(2)	36%
NO_2 / Surface Roughness 1.0	12	Annual Mean(3)	0.92	12.9	40(2)	2%
	105.1	99.8th%ile of 1-hr means(4)	64.3	117.5	200(2)	32%
NO_2 / Rural Option (All grassland)	12	Annual Mean(3)	0.84	12.8	40(2)	2%
	105.1	99.8th%ile of 1-hr means(4)	73.3	126.5	200(2)	37%
NO_2 / Urban Boundary Layer	12	Annual Mean(3)	0.88	12.9	40(2)	2%
	105.1	99.8th%ile of 1-hr means(4)	72.6	125.8	200(2)	36%
NO_2 / Bowen Ratio - Wet	12	Annual Mean(3)	0.85	12.9	40(2)	2%
	105.1	99.8th%ile of 1-hr means(4)	71.7	124.9	200(2)	36%

(1) Includes contribution from traffic and background sources and incorporating the cumulative assessment results.
(2) S.I. 180 of 2011.
(3) Conversion factor following guidance from USEPA (Tier 2 analysis, annual average) based on a site-specific ratio of 0.75.
(4) Conversion factor following guidance from UK (IPPC H1).

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Appendix 8.6
Process Information

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APPENDIX 8.6 - Process Information

Table A8.91a Source Emission Data for Maximum Emissions From The Ringaskiddy Resource Recovery Facility

Stack Reference	Stack Height (m)	Exit Diameter (m)	Cross-Sectional Area (m^2)	Temperature (K)	Max Volume Flow (Nm^3/hr)	Exit Velocity (m/sec actual)	Concentration (mg/Nm^3)	Mass Emission (g/s)
Maximum Stack - Grate Incinerator	70	2.3	4.15	418.15	142,089	13.5	NO_2 – 400 SO_2 – 200 Dust – 30 CO – 150 TOC – 20 HCl – 60 HF – 4.0 Dioxins – 0.1 ng/m^3 Cd & Tl – 0.05 Hg – 0.05 Sum of Metals – 0.5	NO_2 – 15.79 SO_2 – 7.9 Dust – 1.18 CO – 5.9 TOC – 0.79 HCl – 2.4 HF – 0.16 Dioxins – 3.5E-9 Cd & Tl – 0.00197 Hg – 0.00197 Sum of Metals – 0.0197

Table A8.91b Source Emission Data for Average Emissions From The Ringaskiddy Resource Recovery Facility

Stack Reference	Stack Height (m)	Exit Diameter (m)	Cross-Sectional Area (m^2)	Temperature (K)	Max Volume Flow (Nm^3/hr)	Exit Velocity (m/sec actual)	Concentration (mg/Nm^3)	Mass Emission (g/s)
Nominal Stack - Grate Incinerator	70	2.3	4.15	418.15	106,922	10.5	NO_2 – 200 SO_2 – 50 Dust – 10 CO – 50 TOC – 10 HCl – 10 HF – 1.0 Dioxins – 0.05 ng/m^3 Cd & Tl – 0.05 Hg – 0.05 Sum of Metals – 0.5	NO_2 – 5.9 SO_2 – 1.5 Dust – 0.30 CO – 1.5 TOC – 0.30 HCl – 0.30 HF – 0.030 Dioxins – 3.0E-9 Cd & Tl – 0.0015 Hg – 0.0015 Sum of Metals – 0.015

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Appendix 8.7
Detailed NOx Process Calculations

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APPENDIX 8.7 - Detailed NO_X Process Calculations

A) 99.8th%ile hourly background total oxidant (O_3 & NO_2) + 0.05 x (99.8th%ile process contribution NO_X)

Year	99.8th%ile hourly background total oxidant (O_3 & NO_2)	99.8th%ile process contribution NO_X	NO_2 PEC
2007	133.9	71.6	**137.5**
2010	133.9	72.1	**137.5**
2011	133.9	64.8	**137.2**
2012	133.9	71.3	**137.5**
2013	133.9	67.7	**137.3**
2014	133.9	65.7	**137.2**

B) 1 99.8th%ile process contribution NO_X + 2 x (annual mean background NO_2)

Year	99.8th%ile process contribution	Annual Mean Background NO_2	NO_2 PEC
2007	71.6	26.6	**124.8**
2010	72.1	26.6	**125.3**
2011	64.8	26.6	**118.0**
2012	71.3	26.6	**124.5**
2013	67.7	26.6	**120.9**
2014	65.7	26.6	**118.9**

B) 2 99.8th%ile hourly background NO_2 + 2 x (annual mean process contribution NO_X).

Year	99.8th%ile hourly background NO_2	Annual Mean Process NO_X	NO_2 PEC
2007	105.05	1.13	**107.3**
2010	105.05	1.67	**108.4**
2011	105.05	1.00	**107.1**
2012	105.05	1.05	**107.2**
2013	105.05	1.33	**107.7**
2014	105.05	1.19	**107.4**

Minimum
124.8
125.3
118.0
124.5
120.9
118.9

Maximum
124.8
125.3
118.0
124.5
120.9
118.9

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Appendix 12

Noise and Vibration

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