16 Major Accidents and Disasters

16.1 Introduction

This chapter of the EIAR presents an assessment of the likely significant adverse effects on the environment arising from the vulnerability of the proposed resource recovery centre at Ringaskiddy to risks of major accidents and/or disasters.

Indaver carried out a hazard identification and risk assessment (HAZID&RA) for the development. In accordance with the European Commission's EIA guidance, there are two key considerations to consider:

- The Project's potential to cause major accidents and/or disasters for human health, cultural heritage and/or the environment;
- The vulnerability of the Project to potential disaster/accident.

The assessment of the vulnerability of the development to risks of major accidents and disasters is included in this EIAR in accordance with the EIA Directive 2014/52/EU which states the need to provide

"*a description of the expected significant adverse effects of the project on the environment deriving from the vulnerability of the project to risks of major accidents and/or disasters which are relevant to the project concerned*".

The HAZID&RA was drawn up to provide a systematic methodology for assessing these aspects. This is in accordance with the requirements of Directive 2014/52/EU and is structured in the following manner:

- Identification of the relevant major accidents (end events) that could arise at the site.
- Identification of the potential initiating event(s) that could give rise to each end event, including consideration of external events such as disasters.
- Assessment of the level of risk presented by each scenario.
- Identification of the measures that are in place, or that need to be in place, to reduce the risks and/or mitigate the impacts of these scenarios.

The underlying objective of the assessment is to ensure that appropriate precautionary actions are taken for those projects which "*because of their vulnerability to major accidents and/or natural disasters, […] are likely to have significant adverse effects on the environment*".

This Chapter was written by Thomas Leonard BE MEngSc CEng MIEI, Partner at Byrne Ó Cléirigh.

16.2 Assessment Methodology

16.2.1 General

The starting point for the scope and methodology of this assessment is that the proposed project will be designed, built and operated in line with current international best practice and, as such, major accidents will be very unlikely.

A formal HAZID&RA was carried out to identify all potential accident scenarios that could arise at each area of the site where dangerous substances are stored or handled. This HAZID&RA is presented in **Appendix 6.1** of the EIAR. Each scenario was assessed using the HAZID&RA methodology to determine its likelihood of occurrence and the severity of impact to people and the environment if it did occur. This approach gives a semi-quantitative assessment of the overall level of risk associated with each accident scenario identified. When carrying out this assessment consideration was taken of any relevant prevention or mitigation measures in place when determining the risks associated with each scenario.

Each scenario was assigned a semi-quantitative Risk Rating, based on the findings of this analysis. The Risk Ratings were then compared with the various criteria established in the risk assessment methodology in order to determine the significance of the risks associated with each scenario. This approach allowed Indaver to prioritise attention on the scenarios presenting the highest risk and to ensure that all necessary measures would be in place to prevent accidents occurring and to limit the consequences of any such accidents for population and human health and for the environment. The assessment was also to determine the risks to the proposed development from major accidents and disasters.

When assessing the risks associated with scenarios identified in the risk assessment, consideration was given to potentially vulnerable receptors in the surrounding environs, i.e. occupied areas, culturally significant developments and environmental receptors such as land, soil and water.

In carrying out this assessment, a systematic approach was adopted to identify credible scenarios and to assess the probability of occurrence for scenarios. For each scenario identified, an assessment was made of the expected significant adverse effects. Consideration was also given to the range of mechanisms by which these scenarios could arise, for both on-site and off-site initiating events, including those caused by major accidents and/or disasters. These events were identified, evaluated and their potential contribution to the risks presented at the site were considered when drawing up the scenarios in the worksheets.

The approach to carrying out the risk assessment, and consequence modelling, for this development is consistent with the approach used by other industrial operators covered by the Cork County Council Major Emergency Plan. Although this approach is primarily used for “Seveso” establishments under the COMAH Regulations (SI No. 209 of 2015). This project is not such an establishment; however, the methodology provides a robust framework to identify all such major accident hazards and risks as outlined below.

16.2.2 Guidance and Legislation

16.2.2.1 Legislative Requirements

In accordance with the requirements of the EIA Directive 2014/52/EU and associated Regulations, Indaver carried out a risk assessment for the proposed development of the resource recovery centre at Ringaskiddy. This was conducted using a systematic methodology, to assess the severities of impacts and likelihoods of occurrence for accident scenarios at the plant. This assessment examined the risks of these accident scenarios to human health and to the environment.

Recital 15 of the EIA Directive states that:

(15) In order to ensure a high level of protection of the environment, precautionary actions need to be taken for certain projects which, because of their vulnerability to major accidents, and/or natural disasters (such as flooding, sea level rise, or earthquakes) are likely to have significant adverse effects on the environment.

For such projects, it is important to consider their vulnerability (exposure and resilience) to major accidents and/or disasters, the risk of those accidents and/or disasters occurring and the implications for the likelihood of significant adverse effects on the environment. In order to avoid duplications, it should be possible to use any relevant information available and obtained through risk assessments carried out pursuant to Union legislation, such as Directive 2012/18/EU of the European Parliament and the Council1 and Council Directive 2009/71/Euratom, or through relevant assessments carried out pursuant to national legislation provided that the requirements of this Directive are met.

It is clear from the Directive that a major accident and/or disaster assessment should be mainly applied to establishments under the COMAH Directive or to nuclear installations. However, the EIAR requirements must be satisfied by all developments which qualify under the EIA Directive and so the risks have been assessed and this chapter has been prepared accordingly.

16.2.2.2 Guidance Documents

The Environmental Protection Agency (EPA) has published *Draft Guidelines on the Information to be contained in Environmental Impact Assessment Reports,* which are referred to when identifying the information requirements for this chapter.

In accordance with the provisions in **Section 3.3.5** of the EPA guidance, the scoping of this chapter considers the extent to which other assessments may address some types of effects adequately and appropriately. As such, much of the information that supports this chapter of the EIAR is described in the HAZID&RA report for the development, which is referenced throughout this chapter. A copy of the HAZID&RA report is included in **Appendix 6.1** to **Chapter 6**, ***Population and Human Health*** of this EIAR.

The HAZID&RA methodology is a semi-quantitative approach, as described in **Section 16.2.4.2**. This approach enables the operator to identify the relevant accident scenarios at their site and to determine the significance of the risk that each scenario presents using a calibrated ranking system. This approach also enables the operator to identify scenarios that require further assessment, as described in this chapter and in the accompanying HAZID&RA report.

This approach is comparable to the approaches used when carrying out risk assessments for e.g. Seveso establishments, ATEX risk assessments or environmental liabilities risk assessments.

16.2.3 Study Area

As part of the process of conducting the risk assessment, details of the surrounding environment were collated, to ensure that full consideration was given to the specific nature of surrounding environs when determining the severity of impact in the event of an accident at the site. The surrounding environment is discussed in the following sub-sections.

16.2.3.1 Geology and Hydrogeology

The majority of site (including the area proposed for the waste to energy facility) is underlain by Lower Carboniferous marine interbedded grey/brown sandstone, siltstone and mudstone. Bedrock encountered during the site investigations was noted as pale green MUDSTONE/green grey fine-grained SANDSTONE, and depth to bedrock was found to vary across the site, from 0.3m below ground level (bgl) in the centre of the site, to 10.1mbgl to the east of the site.

The bedrock aquifer beneath the site and Ringaskiddy area is classified as “LI: Locally Important Aquifer – Bedrock which is moderately productive only in local zones” and “LK: Locally Important Aquifer – Karstified” (see **Figure 13.9** in **Chapter 13** ***Soils, Geology, Hydrogeology, Hydrology and Coastal Recession***). The site is not underlain by karst and so the LK designation is not applicable to the aquifer under the site. There is no indication of any naturally occurring springs in the earlier OSI maps which show the site prior to the cutting of the southern steep slope.

According to the GSI Well Database and the Groundwater Vulnerability map for South Cork, groundwater is not used for public or private water supply in the Ringaskiddy area.

Aquifer or groundwater vulnerability is the ease with which the groundwater may be contaminated by human activity and depends upon the aquifer’s intrinsic geological and hydrogeological characteristics. The vulnerability is determined by the permeability and the attenuation capacity of any overlying deposits. For example: bedrock with a thick, low permeability, and clay-rich overburden is less vulnerable than bedrock with a thin, high permeability, and gravelly overburden.

The aquifer at the Site is classified by the GSI as having ‘Extreme’ vulnerability, with some areas classified as ‘Rock at or near Surface, or Karst’ (**Figure 13.11**). (Note - as the bedrock geology at this site is not limestone no karst is present).

Within an area of 2 km from the proposed development, the majority of the aquifer falls into 'Extreme' vulnerability classes, becoming 'High' further west and south. The groundwater vulnerability rating of the site is dictated by the shallow depth of bedrock rather than the site being underlain by limestone bedrock.

Chapter 13 of the EIAR provides a more detailed description of the geology and hydrogeology of the site and surrounding environs.

The HAZID&RA took note of the vulnerability of the surrounding geology and hydrogeology when determining the severity ratings for scenarios involving an environmental release at the site.

16.2.3.2 Flora and Fauna

There are no environmental designations pertaining to the site footprint; in other words, the site 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. However, there are several such sites in the vicinity of the proposed resource recovery centre. **Table 12.1** (**Chapter 12**) identifies the designated conservation areas within a 20 km radius and shows the distances to each from the development site.

Cork Harbour is also as an Important Bird Area (IBA). The reasons for this classification are set out in **Table 12.2**. Details of other habitats in the surrounding area are provided in **Table 12.3**.

There are approximately 298 flowering plants listed by the National Biodiversity Data Centre (NBDC) within the 10 × 10 km grid square the site is located in. There are no rare species identified. **Table 12.4** shows the flowering and endangered flowering plants within this grid square.

The HAZID&RA considered the proximity of the development to protected sites and proposed natural heritage areas when determining the severity ratings for the accident scenarios.

16.2.3.3 Watercourses (tides and currents)

Cork Harbour is an important and attractive water body with many beneficial uses. The harbour, a drowned river valley, is the tidal estuary of the River Lee and extends about 20 km from Cork City to the open sea. In simple terms, the upper harbour estuary widens uniformly in the direction of the open sea and the tidal currents move simply up and down the estuary as the tide ebbs and flows.

The eastern part of the site is located adjacent to the West Channel of Cork Harbour. The nearest stream/river to the site is the stream Glounatouig, which is approximately 3 km west from the site boundary.

According to the Admiralty Chart, the tidal data for Passage West and for Cobh are as shown in **Table 16.1**.

Table 16.1 Tidal data for Cobh

Location	Lat N	Long W	Heights in metres above datum				Datum and remarks
			MHWS	MHWN	MLWN	MLWS	
Cobh	51°50'	8°18'	4.1	3.3	1.3	0.5	0.13 m above OD (Dublin)
Passage West	51°52'	8°20'	4.4	3.6	1.5	0.7	0.13 m above OD (Dublin)

There were no implications for accident hazards at the site associated with tidal activity. Further discussion of flood risk and coastal erosion is provided in **Section 16.3.1.2** below.

16.2.3.4 Weather conditions

For the purposes of the HAZID&RA exercise, the meteorological parameters of most interest are ambient temperature, wind speed, atmospheric stability and rainfall. High ambient temperatures lead to increased evaporation rates from spilled materials. Low wind speeds and high atmospheric stability lead to reduced dispersion of a release, allowing higher concentrations to accumulate in the atmosphere. High wind speeds on the other hand can give rise to high angles of flame tilt in the event of a pool fire.

Cork Airport is the closest weather monitoring station to the site and weather data for this station was obtained from Met Éireann for the period 1981 to 2010, which is the latest 30-year period reported on by Met Éireann. The data is shown in **Table 1.3** of the HAZID&RA report.

The temperature data shows that the average daily maximum temperature varies from 8.2°C in January to 18.7°C in July. The highest temperature recorded at the station over the 30-year reporting period was 28.7°C.

Wind speed and atmospheric stability are strongly interrelated. Greater atmospheric stability is found at low wind speeds and only certain combinations of wind speed and stability can occur. The data shows an average wind speed of 10.5 knots or 5.4 m/s.

The primary concerns with respect to rainfall is to determine whether there is the potential for flooding. This is discussed in **Section 16.3.1.2.** Aside from the risks presented by rainfall, there is also the potential for the road drainage network to become tide-locked at high tide, which can give rise to flooding of the road. This hazard, and the measures that will be put in place to mitigate it, is described in **Section 13.3.7** of **Chapter 13**.

16.2.3.5 Listed buildings and monuments

There are no recorded archaeological sites within the proposed development site, including the area proposed for coastal protection and the section of L2545 to be upgraded, refer to **Figure 14.1** of **Chapter 14** ***Archaeology, Architectural and Cultural Heritage***.

There are no protected structures within the proposed development site that are listed in the Cork County Development Plan 2014 or the National Inventory of Architectural Heritage for County Cork. There are no cultural heritage sites within the proposed development site.

A Martello tower, listed in the Record of Monuments and Places, (RMP No. CO087-053) stands approximately 70m to the south of the proposed development site and part of the site lies within the Zone of Archaeological Potential (ZAP) or Zone of Notification for this recorded monument. Ordnance Survey maps show that a path once led north-east through the proposed development site from the Martello tower to the sea shore at the eastern end of the Ringaskiddy peninsula. The Martello tower is also listed in the Record of Protected Structures (RPS 00575) in the Cork County Development Plan 2014 and the National Inventory of Architectural Heritage for County Cork (Registration No. 20987047). The path associated with the tower is considered to be a part of the curtilage of the Protected Structure.

In total there are 50 recorded archaeological sites within a 2km radius of the proposed development site that are listed in the Record of Monuments and Places for County Cork (RMP) and the Sites and Monuments Record (SMR) Database of the Archaeological Survey of Ireland (ASI). These are identified in **Table 14.1** (**Chapter 14**).

16.2.4 Impact Assessment Modelling

Due to the range of materials stored at the site, the HAZID&RA examined scenarios involving flammable risks (fires and explosions), risks of acute toxic exposure to human health and risks of spills to the environment.

When assessing the impacts of accident scenarios to people in the vicinity, a consequence modelling exercise was carried out, using a range of pre-determined endpoints.

16.2.4.1 Current Practice

The methodology that was used for the risk assessment is based on a technique outlined in Annex D of BS 8800: 1996, Guide to Occupational Health and Safety Management Systems. Similar risk assessment techniques have also been outlined by the IChemE and the US Naval Weapons Centre's Practical Risk Analysis for Safety Management. The methodology that was used at the Ringaskiddy site is one that has been built on and developed over many years, based on operational experience of applying it at numerous industrial facilities, both in Ireland and overseas.

The approach that was adopted is consistent with guidance from the Health & Safety Authority[1]. The assessment includes the elements of risk identification, risk analysis and risk evaluation.

- Risk identification is the process of finding and recognising risks and includes the process of hazard identification.

[1] "Guidance to Inspectors on the Assessment of Safety Reports under the COMAH Regulations 2015"

- Risk analysis consists of determining the range of consequences and probabilities of identified events and the effectiveness of existing controls. The methods used may be qualitative, semi-quantitative or quantitative.
- Risk evaluation is the process of comparing estimated risk levels with pre-defined tolerance criteria to inform decisions. For the operator, risk evaluation will be about evaluating the risks that have been identified and analysed to determine whether they are tolerable.

16.2.4.2 Site Specific Risk Assessment Methodology

This section describes the risk assessment methodology that was used when carrying out the risk assessment at the site. This methodology is described in more detail in the accompanying HAZID&RA report.

The risk assessment was carried out by a team of personnel from Indaver and from Byrne Ó Cléirigh (external consultants). The team divided the resource recovery centre into a series of installations (i.e. areas where dangerous substances are stored or handled, and which were identified as potentially presenting a significant accident scenario), each of which was assessed in turn.

Each installation identified a series of scenarios, or end events, and documented them in the HAZID&RA worksheets. The potential consequences of each scenario were described, and a Severity Rating was assigned, using the descriptors shown in **Table 16.2**.

Table 16.2 Severity Ratings for Accident Scenarios

Severity Rating	Category Description	Health & Safety		Environmental Impact
		On-Site	Off-Site	
0	Negligible	None	None	None
1	Minor	Minor injury	None	None
2	Appreciable	Multiple injuries with return to work	Discomfort	Discoloration of water or air
3	Severe	Major permanent disability	Some hospitalisation for screening	Minor short term damage to adjacent land or water courses
4	Very Severe	Single fatality	Minor injuries	Significant short term damage or minor long term damage requiring clean up action
5	Catastrophic	Multiple fatalities	Major injuries or fatalities	Major incident with significant loss of species or habitat

When assessing impacts to health & safety, consideration is given to both on-site and off-site impacts, based on the descriptors shown above, to determine the appropriate Severity Rating.

The range of impacts covered by this scale enables Indaver to assess and rank the impacts of a wide range of scenarios, from relatively minor events to major accidents.

To support this assessment, a representative selection of credible worst case scenarios was identified and consequence modelling was carried out to calculate the impacts of these scenarios to the surrounding area. The consequence modelling endpoints that were used in this assessment are described in the accompanying HAZID&RA report.

Once the various accident scenarios for a particular installation were identified and Severity Ratings assigned to each, the Team then examined the various initiating events which could potentially give rise to each scenario and the details were set out in the Risk Assessment Register (RAR) sheet. The potential initiating events which were considered included, inter alia, mechanical failure, human error, control equipment failure, as well as external events such as domino effects from an external event or a disaster such as flooding or earthquake. A copy of the RAR worksheets is included in the HAZID&RA report.

Each initiating event – end event combination was assigned a Frequency Rating by the team, based on the descriptors shown in **Table 16.3.**

Table 16.3 Frequency Ratings for Accident Scenarios

Frequency Rating	Descriptor	Frequency Range per Annum
1	Virtually Impossible	$< 1 \times 10^{-8}$
2	Improbable	1×10^{-8} to 1×10^{-5}
3	Unlikely	1×10^{-5} to 1×10^{-3}
4	Infrequent	1×10^{-3} to 0.1
5	Occasional	0.1 to 10
6	Frequent	> 10

Numerical Risk Ratings were determined for each scenario identified in the course of the exercise using the following equations:

$$R_H = S_H \times L$$

$$R_E = S_E \times L$$

Where:

RH is the Risk Rating with respect to health and safety

RE is the Risk Rating with respect to the environment

SH is the Severity Rating with respect to health and safety

SE is the Severity Rating with respect to the environment

L is the Likelihood Rating for a specific initiating event – end event combination.

The significance of the Risk Rating for each scenario was assessed using the matrix shown in **Table 16.4.**

Table 16.4 Matrix of Risk Ratings

Risk Rating		Severity				
		1	2	3	4	5
Frequency	1	1 - Trivial	2 - Trivial	3 - Trivial	4 - Trivial	5 - Minor
	2	2 - Trivial	4 - Trivial	6 - Minor	8 - Minor	10 - Moderate
	3	3 - Trivial	6 - Minor	9 - Moderate	12 - Substantial	15 - Priority
	4	4 - Trivial	8 - Minor	12 - Substantial	16 - Priority	20 - Priority
	5	5 - Minor	10 - Moderate	15 - Priority	20 - Priority	25 - Priority
	6	6 - Minor	12 - Substantial	18 - Priority	24 - Priority	30 - Priority

A Risk Reduction Register (RRR) was then completed for each scenario on the back of this assessment. This was used to set out any specific scenarios or locations at the site where the HAZID&RA Team identified or recommended additional risk reduction or mitigation measures.

When making these recommendations, consideration was given to the risk level associated with each scenario using the criteria set out in **Table 16.5**.

Table 16.5 Significance of Risk Ratings for Accident Scenarios

Risk Rating	Risk Level	Action and Timescale
≤ 4	Trivial	Generally no action is required for scenarios with such low risk levels and if so there would be no need for detailed working to demonstrate ALARP (i.e. are As Low As Reasonably Practicable).
5 to 8	Minor	No additional controls are required in most cases. Consideration may be given to a more cost-effective solution or improvement that imposes no additional cost burden. Monitoring is required to ensure that controls are maintained.
9 to 11	Moderate	Efforts should be made to reduce the risk, but the cost of prevention should be carefully measured and limited. Risk reduction measures should be implemented within a defined time period. Where a moderate risk is associated with a scenario whose consequences are in the category of Very Severe or Catastrophic (Severity Rating 4 or 5) further assessments may be necessary to establish more precisely the likelihood of harm as a basis for determining the need for improved control measures.
12 to 14	Substantial	The activity should not be started until the risk has been reduced. Considerable resources may have to be allocated to reduce the risk. Where the risk involves a current activity, urgent action should be taken.
≥ 15	Priority	The activity should not be started or continued until the risk has been reduced. If it is not possible to reduce risk, even with unlimited resources, this activity must be prohibited.

16.3 Receiving Environment

16.3.1 Disasters / External Impacts

In carrying out the risk assessment, the team considered worst case scenarios, including scenarios involving complete loss of containment from a vessel or tank, or scenarios involving a fully developed fire. The risk assessment worksheets in the HAZID&RA report show that a variety of initiating events was considered when determining the probabilities of occurrence for these scenarios. As part of this assessment, consideration was also given to the potential for an accident to arise at the site as a result of a disaster or other external impact. These are discussed in the following sub-sections.

16.3.1.1 Earthquakes

The School of Cosmic Physics (part of the Dublin Institute for Advanced Studies) was consulted regarding the risks posed by seismic activity in Ireland. The School has had a seismic network in operation in Ireland since 1978.

They have indicated that Ireland is seismically very stable and that there is nothing to suggest that this will change in the coming millennia.

The HAZID&RA report includes a series of maps (**Figures 2.1** to **2.3** incl.) showing earthquake incidents and earthquake risk.

- There is a map with incidents of earthquakes in Europe between 1900 and 2006. This shows that there were no earthquakes exceeding the threshold of M3.5 recorded in Ireland during that time period.
- The maps of earthquake hazards shows that the risk of an earthquake in Ireland is amongst the lowest in Europe.

These maps are included in **Section 2.4.1** of the HAZID&RA report.

Referring to **Section 13.3.2.4** (**Chapter 13**), the potential landslide risk in the vicinity of the site is primarily confined to the shoreline. As described in **Section 13.8**, Indaver proposes the placement of sacrificial material above the foreshore on Gobby Beach to mitigate the risks associated with shoreline erosion.

Based on these considerations, the risk associated with earthquakes or ground movement at the site is extremely remote. If this did occur, there would be the potential for loss of containment of materials from vessels. These loss of containment events are identified and assessed in the HAZID&RA worksheets. It was considered that the risk from an earthquake or ground movement would have a negligible contribution to the probabilities of occurrence of these scenarios.

16.3.1.2 Flooding

Referring to the meteorological data in **Table 1.3** of the HAZID&RA report, in the worst case rainfall event, the highest quantity of rainfall that could fall onto a bund area would be 73.2 mm in 24-hours.

Any build-up of water in the bunds could therefore be easily managed by Indaver operators by allowing the rainwater to drain via oil-water separators, in accordance with normal operating procedures at the site.

The risk of flooding in the surrounding area was also considered. As noted in **Section 13.3.7.2** (**Chapter 13**), the risk of flooding is very low. Historically there have been events where the road adjoining the Indaver site has flooded. This has occurred in instances of high rainfall and high tides, where the surface water drainage outfall was 'tide-locked'.

Indaver will upgrade the road drainage network in the vicinity of the site to further protect against this flood risk. Upgrade works will be conducted on the L2545 road as part of the proposed development, including improvement of the drainage systems in order to mitigate against future flood risks. In addition, the levels of the low-lying parts of the site will be raised to 4.55 mOD. This is much higher than the minimum required flood defence level, which is calculated to be 3.8m. The finished floor levels of the buildings on site will be even higher, at above 5 mOD.

These measures will provide a very high standard of flood protection to the site. The Flood Risk Assessment is included in **Appendix 13.4** for reference.

The coastal study found that there would be no risk from coastal erosion 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, but this would be confined only to the amenity walkway and viewing platform and a small section of a diverted gas pipeline outside of the security fence line. However, even allowing for the conservative assumptions used to predict the rate of erosion, the waste-to-energy facility itself will not be impacted by coastal erosion after 40 years.

Based on the study findings and taking into consideration the mitigation measures that will be implemented, it was considered that there is no credible accident scenario at the site resulting from flooding or coastal erosion effects.

16.3.1.3 Power Failure

There are no accident scenarios identified at the site which would be associated with a power failure. There will be no materials at the site which are unstable or which require a power supply to ensure that they are stored or handled safely, e.g. materials requiring a temperature controlled environment.

The site will have a UPS system and emergency diesel generator to provide power in the event of a power cut. This means that Indaver would retain the facility to activate the fire protection systems in the event of a disruption to the electrical supply to the site.

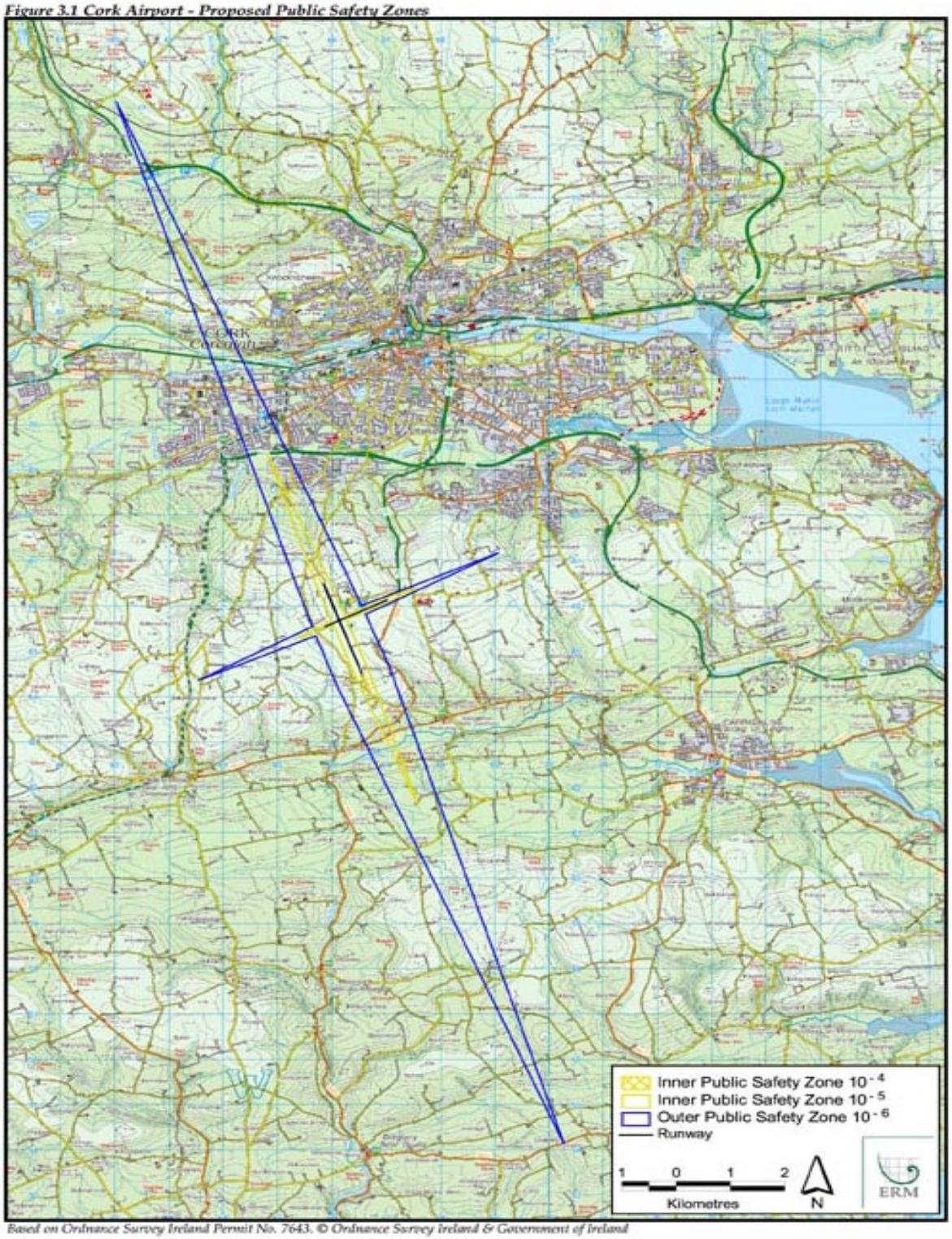
If a power failure occurred to a key item of plant or equipment at the same time as potentially hazardous materials were being delivered to the site (e.g. a delivery of aqueous ammonia to the storage tank), the transfer would be halted for the duration of the loss of power event.

Based on the controls that will be in place it was considered that there was no credible risk of a major accident scenario associated with a power failure to the site.

16.3.1.4 Aircraft Impact

The closest airport to the Ringaskiddy site is Cork Airport, which is located at a distance of c.13 km from the proposed development. **Figure 16.1** shows the plot of the Public Safety Zone (PSZ) for this airport.

Figure 16.1 Public Safety Zones (PSZ) for Cork Airport (ERM)



This is taken from a report[2] by ERM (Environmental Resources Management) Ireland Ltd, which was commissioned by the Department of Transport and the Department of the Environment and Local Government.

The aim of these PSZs was to protect people on the ground from the risk of an aircraft crash by using land use planning controls on developments in the vicinity of airports. Essentially a PSZ is used to prevent inappropriate use of land where the risk to people is the greatest.

The plot shows that the PSZ runs in a north-south direction. The proposed development at Ringaskiddy is located to the east of the airport, just outside the range of the map shown. The development is located more than 10km outside of the PSZ contours. As such the risk of an aircraft impacting the proposed Ringaskiddy development is therefore considered to be extremely remote and therefore was not considered as a credible scenario in the HAZID&RA.

16.3.1.5 Helicopter Impact from Haulbowline Naval Base Activities

As outlined in **Section 15.5.3.1** of **Chapter 15** ***Material Assets***, the potential effects of the stack plume was assessed in relation to helicopter operations at the Naval Base. The assessment, which is provided in **Appendix 8.9** to **Chapter 8** ***Air Quality*** demonstrated that any impact of the plume on the functionality of helicopter engines (and in particular leading to engine failure) from the proposed development, would be confined to less than 14m from the tip of the stack.

This is supported in the assessments provided by two independent aviation experts provided in **Appendices 15.1** and **15.2** which established that general aviation safety rules would demand a 150m clearance from such structures and therefore a helicopter could not safely get close enough to the stack and plume for engine failure to be initiated.

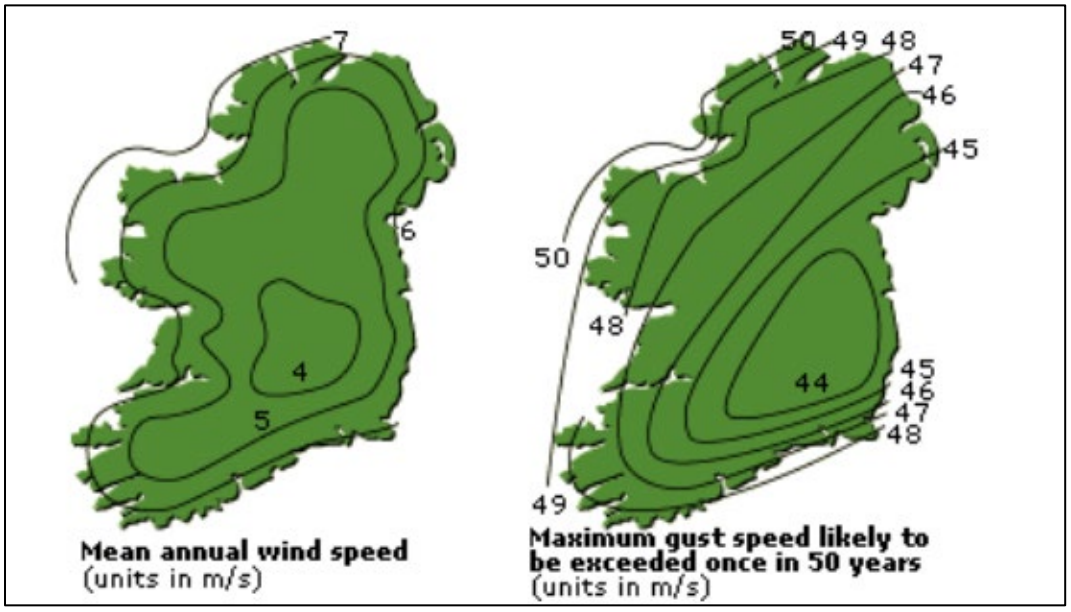
Based on these considerations, the risk from helicopter impact to the site was considered to be negligible.

16.3.1.6 High Wind Speeds

Met Éireann has produced a map showing the estimated maximum gust speeds for a 50-year return period in Ireland. This is reproduced here as **Figure 16.2**.

[2] Public Safety Zones: Cork, Dublin and Shannon Airports, ERM, June 2003 (Draft) on behalf of Department of Transport and Department of Environment & Local Government.

Figure 16.2 Mean and maximum wind speeds (Met Éireann)



Typical maximum gust speeds for Ireland range up to 50 m/s depending on the location of the site. For a development at Ringaskiddy, the estimated speed for this return period is c.48 m/s.

The historic meteorological data from the Cork Airport weather station shows that the highest 10 minute mean wind speed over the period was 56 knots (104 km/h), with a maximum gust of 83 knots (154 km/h). Subsequent to this data period, it is noted that Storm Ophelia occurred exposed Ireland to high wind speeds in October 2017. Referring to Met Éireann's report "*An analysis of Storm Ophelia which struck Ireland on the 16th October 2017*", the highest 10-minute sustained wind speed recorded during Ophelia was at Roches Point, Co Cork. It reached 115 km/h, which is violent storm force, with gusts to 156 km/h.

No credible accident scenario resulting from high wind loading was included as an initiating event by the HAZID&RA Team.

16.3.1.7 Extremes in Ambient Temperature

The highest ambient temperature at the site (based on a 30-year return period) would be of the order of 28.7°C. There are no scenarios envisioned in which high ambient temperatures could give rise to an accident scenario at the site.

The data shows that the lowest temperature recorded during this period was -8.5°C. The only hazards identified which would be presented by extreme low temperatures are the risk of a vehicle collision at the site due to formation of ice on the ground and the risk of freezing in the water main. The potential for a traffic accident exists at all times and is included as an initiating event for relevant scenarios in the HAZID&RA. While there may be an increased risk in the event of heavy icing on site, this would be mitigated by the measures that Indaver will have in place. Indaver will ensure that only operators with appropriate waste collection permits will be allowed to bring vehicles onto the site. Furthermore, all vehicles arriving on site will be checked at Security and Indaver will provide induction training for all drivers operating at the site.

The induction training will be provided to new drivers and will be renewed every year to all drivers. Indaver will maintain records of this training.

There will also be a speed limit on site. Indaver will also monitor ground conditions on site in areas accessed by vehicles during freezing temperatures and will salt/grit areas if required to reduce the risks associated with icy conditions. Indaver will also supervise all deliveries to the tipping hall and a Tipping Hall Operator will guide the driver to ensure that the deliveries are carried out in a safe and controlled manner.

Indaver will mitigate against the risk of water freezing in the water main on site by ensuring that it is designed to meet the necessary standards and the requirements of the Fire Certificate and those of the insurance company. The ring main will be underground and any chambers for hydrants will be insulated and heat traced, the underground ring main will surface inside the building and in areas such as the tipping hall and bunker the internal ring main will be insulated.

As a result, no credible accident scenario resulting from extremes in ambient temperature was included as an initiating event by the HAZID&RA Team.

16.3.1.8 Lightning

Referring to guidance from the UK HSE, it advises that the use of BS 62305 is the expected standard for lightning protection at hazardous industries[3]. The HSE states that the likelihood of a major accident being initiated by a lightning strike at a well-designed and maintained hazardous installation is, therefore, low so Inspectors must act proportionately to focus on those major hazard installations where reasonably foreseeable risk remains.

In other guidance, the UK HSE notes that the probability of an accident arising as a result of lightning strike at a typical facility involved in the storage of flammable liquids is extremely remote, with a probability of 1×10^{-7} per annum[4]. This guidance is for activities involved in the storage and handling of materials which would present a greater fire hazard than the materials at the Indaver facility.

All areas of the site which will be used for the storage and handling of dangerous substances will be assessed under BS EN/IEC 62305 and, where required, will be fitted with lightning protection systems which will be designed and installed in accordance with same.

Based on the measures that will be in place and on the guidance from the UK HSE, it was considered that the risk that a lightning strike could initiate a major accident was found to be negligible.

16.3.2 Major Accident Hazards from Offsite Establishments

The proposed site is located to the east of Ringaskiddy village. The other developments in the vicinity of the Indaver site are described in this section.

[3] http://www.hse.gov.uk/foi/internalops/og/og-00044.htm
[4] http://www.hse.gov.uk/comah/sraghfl/highly-flammable-liquids.pdf

There is a metal reclamation works at Hammond Lane, which is surrounded by the Indaver site. The proposed waste-to-energy facility will be located to the east of Hammond Lane. Due to the proximity of this site to the proposed development, the HAZID&RA gave consideration to the potential risk that an incident at the metal reclamation works could act as an initiator to an accident scenario at the Indaver establishment.

Section 2.4.9 of the HAZID&RA report notes that, in the event of a fire at Hammond Lane, the Emergency Response Team would mobilise at Indaver, to review whether any actions should be taken at the site. However, due to the separation distances between the installations at Indaver and the Hammond Lane site, it was not envisaged that any fire scenario arising at Hammond Lane would present any risk of escalation / domino effects to the Indaver facility.

The DePuy Wind Energy turbine directly to the south of the proposed development was also considered by the HAZID&RA. The impact of collapse of the entire turbine or the catastrophic failure of a turbine blade when rotating at high speed were evaluated.

The assessment for the DePuy site found that the risk presented by the facility to the Indaver site was extremely remote and would make no significant contribution to the risk of a major accident at Indaver.

Apart from the Hammond Lane site, the next nearest building to the Indaver site at which there is industrial/commercial activity is a warehousing operation located immediately opposite the Indaver site, to the north. There is also the National Maritime College of Ireland site as well as the Beaufort Research Building, which are adjacent to this warehousing facility.

As outlined in **Section 1.3.1** of the HAZID&RA Report, there are several COMAH establishments in the broader vicinity of the planned development at Ringaskiddy, as follows:

- Pfizer – Pharma (API) – upper tier;
- Novartis – Pharma (API) – upper tier;
- Carbon Chemicals Group – Chemical suppliers – lower tier;
- SmithKline Beecham t/a GlaxoSmithKline – Pharma – upper tier;
- Hovione – Pharma – lower tier.

The closest of these sites is the Hovione establishment, which is located c.800m from the proposed development. There is no potential for an accident at the Indaver site to present any risk to any of these establishments.

In the event that the Indaver site falls within the Public Information Zones (PIZ) of any of these developments, e.g. as a result of changes at one of these developments, the operators of that site will be required to provide Indaver with an information package on the hazards presented by their establishment. If this happens, then Indaver will review the information and, if necessary, update the HAZID&RA and/or the emergency response arrangements at the site to reflect this.

16.4 Characteristics of Proposed Development

The 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 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 EIAR.

The development of the site will involve the storage and handling of certain materials which have the potential to give rise to accident scenarios which could present risks to human health and/or to the environment. Details of the installations at the site that were considered for the risk assessment are included in the HAZID&RA report in **Appendix 6.1**.

16.5 Likely Significant Effects

16.5.1 'Do Nothing' Effects

In the do-nothing scenario, the potential risk of the proposed development causing, or being affected by a disaster and/or accident would be eliminated as the Ringaskiddy Resource Recovery Centre would not be implemented. Any existing risks of any major accidents or disasters associated with existing developments would remain, should the proposed development not go ahead.

16.5.2 Assessment of Effects during Construction

There are no special or unique hazards associated with the construction of the plant on this particular site that would not be encountered on any typical construction site for an industrial building. As discussed in **Section 5.13** of **Chapter 5** ***Construction Activities***, 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 as required by the Safety, Health and Welfare at Work (Construction) Regulations 2013.

16.5.3 Assessment of Effects during Operation

The risk assessment team examined 95 scenarios at the proposed resource recovery centre, using the methodology described in **Section 16.2.4.2** above. Of these, 91 scenarios were found to present credible accident hazards and they were each assigned a Severity Rating and a Frequency Rating, as described above.

The distributions of risk ratings, based on the risks presented to human health and the risks presented to the environment, are shown in **Table 16.6** and **Table 16.7**.

Table 16.6 Frequency Distribution of Risk Ratings (human health)

	Severity				
Frequency	**1**	**2**	**3**	**4**	**5**
1	0	0	0	0	0
2	10	14	9	0	1
3	22	17	8	0	0
4	4	3	1	0	0
5	0	1	0	0	0
6	0	0	0	0	0

Table 16.7 Frequency Distribution of Risk Ratings (environment)

	Severity				
Frequency	**1**	**2**	**3**	**4**	**5**
1	0	0	0	0	0
2	6	23	5	0	0
3	11	35	1	0	0
4	2	5	1	0	0
5	2	0	0	0	0
6	0	0	0	0	0

The scenarios identified in the HAZID&RA involve accident scenarios such as fires and loss of containment events involving materials that are hazardous to human health and the environment. As such the effects arising from these scenarios would involve direct impacts to human health and/or to the environment. The assessment also considered whether there would be any risk that an accident scenario at Indaver could initiate an accident off site.

Based on the findings of the HAZID&RA exercise, there were no scenarios identified which presented a Priority Risk and there was one scenario which presented a Substantial Risk. This is a scenario involving a fire in the bunker area.

In addition to the bunker fire scenario, several other accident scenarios were also considered for further assessment. These present lower risks, but broaden the assessment of credible worst-case scenarios that could arise at the Ringaskiddy facility. They are a loss of containment of aqueous solution of ammonia or hydrochloric acid and a fire following loss of containment of aqueous solvent waste.

16.5.3.1 Fire in the Bunker

This scenario received a Severity Rating of 3 for both Human Health and for the Environment and a Likelihood Rating of 4. As such the risk mitigation measures to protect against this scenario were examined in more detail to ensure that all necessary measures would be put in place.

Smoke Plume - Human Health

The combined effects of all three phases of a bunker fire on human health have been examined and are described in **Section 2.8.1** of **Appendix 6.1 HAZID Report**. The results show that there is a very large margin of safety between the expected dioxin intake to people at the locations described, 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).

Smoke Plume - Environmental Effects

Based on the results of this assessment, the increase in soil PCDDD/F concentrations over a 30-year period was calculated to be 0.0001337 ng I-TEQ/kg, applying an assumption of one small fire (1-tonne) per annum, and 0.0004445 ng I-TEQ/kg, applying an assumption of two 50-tonne fires over the 30-year period. These were very conservative assumptions when compared with Indaver's operational experience at other plants.

Based on this approach the total contribution to soil concentrations within the zone of influence (a 20 km radius around the site) was calculated to be 0.000577 ng I-TEQ/kg. This was found to be significantly lower (two orders of magnitude) than the lowest background soil concentration measured in the Ringaskiddy area, which was 0.052 ng I-TEQ/kg (measured at the Indaver site in 2015).

Based on this assessment, the calculated values for the PCDD/F contribution made by the Indaver facility were found to be insignificant. There will be no impact of significance to the soils and/or the food chain from dioxins released in the event of accidental fires in the solid waste bunker at Indaver.

Thermal Radiation

Three levels of fire scenario are considered here. In the first two, the structure of the bunker building would remain intact or largely intact and so the impacts to the surrounding area would be minor. In the third scenario, the escalation event, involving a fully developed fire at the bunker, it is assumed that the structure of the building could be damaged by the fire and so this shielding effect would no longer be provided.

Each of the off-site receptors examined are comfortably outside of the hazard distances. As such there is no risk of adverse impacts to any off-site receptors arising from the thermal radiation emitted in all three scenarios. The mitigation measures are described in more detail in **Section 16.6.1.2** and ensure that the risks associated with this scenario are ALARP.

16.5.3.2 Loss of Containment of Aqueous Solution of Ammonia or Hydrochloric Acid

Human Health

The effects of the loss of containment of aqueous ammonia or hydrochloric acid on human health have been examined and are described in **Section 2.8.2** of **Appendix 6.1** HAZID Report. The HAZID identified that the aqueous solutions of ammonia and hydrochloric acid can give rise to the evolution of potentially toxic gas (ammonia or hydrogen chloride).

The closest off-site receptor is at Hammond Lane. At its closest point, the site boundary at Hammond Lane lies within c.100 m of the ammonia tank. As such, there is the potential for the concentration associated with a 1% lethal dose to extend as far as the eastern boundary of Hammond Lane in the absolute worst-case scenario.

This calculation is based on an assumed exposure time of 30 minutes, in accordance with HSA guidance. However, this is likely to be a very conservative assumption in this case as the site's drainage system will collect the spill, thereby reducing the size of the spill as it drains and reducing also the duration for which the pool would be present.

The results indicate that there is no risk of lethal impacts at any of the other off-site receptors (Ringaskiddy, DePuy or the Maritime College), even in the worst-case scenario.

Using the AEGL-2 concentrations rather than the lethality exposure levels results in longer hazard distances, as would be expected. In this case, the results show that for some scenarios the AEGL-2 concentration could extend to several off-site receptors, again depending on the atmospheric conditions and wind direction. In this case, there is no significant risk of lethal effects, but persons downwind following a major release should either remain indoors or evacuate the area in order to protect against exposure effects.

Environmental Effects

The environmental effects of the loss of containment of an aqueous solution of ammonia or hydrochloric acid has been assessed in **Section 2.8.2** of **Appendix 6.1** HAZID Report. No significant environmental risks were identified in the assessment.

Aqueous ammonia, which will be stored on the site, is identified as an environmentally hazardous material. As described in **Section 2.5.4** of **Appendix 6.1**, the probability of loss of aqueous ammonia from the aqueous ammonia tank, is remote given the tank will be double skinned. In the event the tank is damaged, the inventory of the tank could be released into an area of concrete hard standing and graded towards a channel which is routed to the surface water network. Once collected in the surface water network, Indaver can shut down the outfall and divert to a dedicated retention tank. This will be done automatically by fitting a TOC, conductivity and pH meter on the line, which will shut down the outfall when necessary. There will also be a switch which can be activated by Indaver personnel to manually shut down the outfall. As a result, there will be no significant effect on the environment.

Consideration was also given to the impacts from a loss of containment of aqueous HCl. This will be stored in an intermediary bulk container (IBC), which will be fitted with a bund to retain spills. In the event of a release outside of the bund, it would be collected in the site drainage system, as described above. Given the smaller inventory of HCl when compared with aqueous ammonia, and the fact that hydrochloric acid is not classed as environmentally hazardous, the consequences associated with a release of HCl are minor when compared with ammonia. Furthermore, the measures that are in place to protect against a release of ammonia escaping off site would also protect against a HCl release – in particular the pH meter would activate a shut-down of the drainage system in the event of an excessively high or low pH reading.

16.5.3.3 Fire Following Loss of Containment of Aqueous Solvent Waste.

Human Health

As discussed in **Section 2.72** of **Appendix 6.1**, in the event that a pool fire arose following the loss of the containment, none of the fire scenarios would give rise to any adverse impacts at the off-site receptors, refer to **Section 2.8.3** of **Appendix 6.1**.

Environmental Effects

In the event of a fire at the aqueous solvent waste storage, there would be no significant environmental impacts to the surrounding area. In the event of a fire, there is the potential for contaminated fire-fighting water to accumulate on site. The environmental hazard in this case is relatively low but there would be the potential for some contaminants to become entrained in the fire-fighting water. Indaver will provide a dedicated retention tank on site to collect run off in such scenarios. This tank will be sized on the basis of a fire-water retention study. There are no significant risks of a major accident to the environment associated with this scenario.

16.6 Mitigation Measures and Monitoring

16.6.1 Mitigation

16.6.1.1 Mitigation During Construction

As noted in **Section 16.5.1**, none of the hazards identified in this report arise during the construction phase of the development. However, a Construction and Environmental Management Plan (CEMP) will be in place to ensure that the construction is carried out in a safe manner with regard to safeguarding the environment from potential incidents on site. The CEMP also sets out the Construction Traffic Management Plan which will be finalised and implemented by the Contractor. The CEMP is described in **Appendix 5.1** of **Chapter 5** ***Construction Activities***.

Risk assessment is an integral part of the CEMP. Furthermore, the PSCS (Project Supervisor Construction Stage) will ensure that the interaction of different activities at the site is managed safely so as not to present any unacceptable risks. The CEMP will also incorporate the development of an Incident Response Plan (IRP) to ensure that, in the unlikely event of an incident, response efforts are prompt, efficient, and appropriate. The objectives of the IRP will be to:

- Ensure the health and safety of workers and visitors along the site.
- Minimise any impacts to the environment and ensure protection of the water quality and the aquatic species dependent on it.
- Minimise any impacts on properties, services etc.

- Establish procedures that enable personnel to respond to incidents with an integrated multi-departmental effort and in a manner that minimises the possibility of loss and reduces the potential for affecting health, property, and the environment.
- The CEMP also sets out provisions for traffic management during the carrying out of the construction works.

16.6.1.2 Mitigation During Operation

In assessing the risks presented at each installation within the site, the HAZID&RA noted a range of measures that will be in place to mitigate the risks associated with the various accident scenarios identified at each area of the site that was assessed. The areas assessed were as follows:

- Bunker;
- Furnace;
- Boiler;
- Dry Reactor;
- Activated Carbon Silo;
- Bag House;
- Flue Gas Residue Storage;
- Flue Gas Cooling Section (water quench / heat exchanger);
- ID Fan;
- Stack;
- Aqueous HCl IBC;
- Piperacks;
- General storage area (fuel oil, ammonia and aqueous waste tanks).

For those areas identified as presenting a credible risk of a significant accident scenario, the scenarios were documented and assessed in the HAZID&RA worksheets, which are included in **Appendix 3** to the HAZID&RA report (**Appendix 6.1** of this EIAR). The worksheets were also used to document the risk reduction and mitigation measures that will be in place to protect against these scenarios.

Based on the findings of the HAZID&RA exercise, there were no scenarios identified which presented a Priority Risk (see **Table 16.4**) and there was one scenario which presented a Substantial Risk. This scenario involved a fire at the bunker. This scenario received a Severity Rating of 3, for both Human Health and for the Environment, and a Likelihood Rating of 4, giving the scenario a Risk Rating of 12. As such the risk assessment team examined the risk reduction measures planned for this area to ensure that all necessary measures would be in place to protect against this scenario.

Risk Mitigation Measures at Bunker

As noted above, the scenario involving a fire at the bunker was identified as presenting the highest risk rating of the scenarios examined in the HAZID&RA. The following risk reduction and risk mitigation measures will be put in place to protect against this scenario.

- All process activities at the site, including receipt and handling of materials at the bunker, will be carried out by trained operators. Indaver will develop standard operating procedures (SOPs) to governing how these activities are carried out.
- Indaver will conduct a visual inspection of waste as it is unloaded at the bunker. This inspection will be carried out by a trained operator. For new customers, loads will be emptied out in the tipping hall area and examined in more detail prior to admittance to the bunker.
- A fire damper will be fitted, which will close in the event of a fire initiating at the bunker. This measure will ensure that there will be no air supply to the boiler from the bunker area under these circumstances.
- The bunker will be a concrete structure and will be compartmentalised (1-hour fire rating). This measure will help to mitigate against the risk of this scenario by limiting the rate at which a fire can develop in this area.
- Fire wrapping will be installed on cables at the bunker, to ensure continued function in the event of a fire developing.
- Indaver will operate a hot work permitting system at the site, to control ignition sources.
- Where practicable, when maintenance works are required, equipment will be taken outside of the bunker for these works.
- The nature of the activity carried out at the site means that there is a quick throughput of material at the bunker. This means that waste is not left to settle within the bunker for a long period of time (4-5 days).
- Indaver will also implement a Bunker Management Programme. This will be carried out once or twice per year, prior to shutdown periods. Indaver will empty out the bunker to bring the inventory to low level (as far as practicable). This, in conjunction with the quick turnaround of material in the bunker (4- 5 days), will help to avoid a situation where a waste batch is allowed to sit in the bunker for a long period of time.
- Indaver will install UV/IR detectors in the bunker and at the hopper. These detectors will enable early detection in the event of smouldering waste in the bunker. If practicable and safe to do so, Indaver can load this waste directly to the hopper and then add more waste on top to smother it. This is done at other sites in accordance with a documented procedure and this same procedure will be implemented at Ringaskiddy.
- A dedicated deluge system will be installed above the hopper.

- At the time of the HAZID&RA review it was noted that Indaver had implemented a monitoring programme at another of their sites, to study the potential for methane formation due to anaerobic digestion of waste in the bunker at that site. This study has since been completed and has found that the methane levels are very low during operations and rise to levels of up to 400 ppm during shutdowns, when there is no primary air extraction at the bunker. This concentration does not present a fire hazard. Indaver will install LEL detectors at the bunker at the Ringaskiddy site, so that similar monitoring can be carried out there also.
- Indaver will install 4 no. fixed water cannons at the bunker, which will provide the facility to douse spot fires. This measure will allow Indaver to respond to a developing fire scenario, allowing the operator the facility to extinguish the event before it becomes fully developed. This allows the fire to be extinguished rapidly and with relatively low volumes of water when compared with a fully developed fire.
- Indaver will also install a closed dry head sprinkler system in the bunker, as back up to the water cannons. The sprinkler system will be designed to extinguish a fully developed fire. As such, even in the worst case fire scenario the policy is one of extinguishment and not one of controlled burn down.
- A 250 mm high stop block or kerb will be installed at the bunker to protect against the risk of a trailer falling into the bunker when unloading waste.
- The bunker will be designed to act as fire water retention facility, to prevent the risk of fire-fighting water that is applied at the bunker subsequently escaping off site as contaminated run-off.

These measures govern all stages of the potential development of this scenario. The measures will protect against the conditions arising under which a fire could occur, they will enable rapid detection and response at the early stages in the event that a fire scenario developing, they will enable extinguishment of the fire even in the event of escalation to a fully developed fire scenario, and protect against the risk of environmental contamination from fire-fighting run off.

With these measures in place, the HAZID&RA found that Indaver would have all necessary measures to in place at the bunker, throughout all phases of the operation. As such the risks associated with this scenario were considered to be ALARP (as low as reasonably practicable).

During the course of the planning oral hearing in April and May 2016 held by ABP, concerns were raised about the ability of people to safely leave Haulbowline Island during such an event. The analysis in the HAZID&RA Report (**Section 2.8.1**) shows that that the worst case thermal radiation levels at the closest point to the bunker fire on the public road (approximately 43 m to centre of the road) would result in exposure levels of 6.3 kW/m^2 at this point. Only 9 metres away on either side of this point, the worst case thermal radiation levels drop to $4kW/m^2$.

Referring to guidance from the Chemical Industries Association (CIA)[5], a heat flux of 6.3 kW/m^2 is established as the maximum level of thermal radiation for safe escape in the event of a fire. Based on the modelling results for this worst case fire scenario it is possible to travel along the road past the site during a fully developed bunker fire without exceeding this threshold. However, the CIA guidance is for evacuation from an emergency exit from a building and, although it is not stated explicitly as such in the guidance, it is generally understood that this is applied when evacuating away from a fire rather than travelling towards it to pass through a zone, which would result in a longer exposure time. However, for people in vehicles using the road, any exposure would be reduced due to reduced exposure time.

In practice, if this scenario developed the emergency services may decide to impose road blocks to restrict traffic movements. If so, there is an alternative route through the campus of the IMERC and Maritime College which was identified at the planning oral hearing in 2016 that could be utilised. People travelling by this route would be exposed to less than 1 kW/m^2 in the event of a fully developed bunker fire, which is equivalent to the heat generated on a sunny day in summer. As such people could leave safely by this route.

Risk Mitigation Measures at Containment Areas

The following risk reduction and risk mitigation measures will be put in place to protect against accident scenarios involving loss of containment of materials in tanks or IBCs.

- Design of tanks incorporating measures to protect against siphoning of the tank contents (e.g. a hole in pipeline at top point on tank outlet or a check valve) in the event of line failure.
- Impact protection on storage tanks.
- Double skinned tanks, with leak detection between skins to detect a leak in the primary containment layer (fuel oil, ammonia).
- Deliveries to the tanks are manned activities carried out by trained operators.
- Transfer hoses are inspected by trained operators prior to delivery being made.
- Visual inspection of tankers prior to acceptance on site.
- Overfill protection system on storage tanks (level gauging, level switches).
- Personal protective equipment (PPE) for operators involved in carrying out deliveries, where required.
- Contents of aqueous waste tank are diluted (>70% water), thereby reducing the fire hazard.
- UN approved containers / packaging for materials; caged IBCs to protect against loss of containment of aqueous HCl due to impact.
- Bunded IBCs to retain a spill from the primary containment.
- Investigations / follow up if supplier provides faulty or damaged IBC.

[5] "Guidance for the location and design of occupied buildings on chemical manufacturing sites" (Chemical Industries Association)

Other Control Measures (general, site-wide measures)

In addition to identifying area-specific measures, the risk assessment also noted a series of other measures which provide risk reduction or mitigation across multiple site areas.

- All operators will be trained in the tasks they must carry out, with periodic refresher training as required.
- Documented SOPs for carrying out activities on site.
- Trained fitters for carrying out maintenance works.
- Regular site inspection.
- Formalised preventative maintenance program on site (SAP).
- Lock out, tag out procedure when carrying out maintenance works on plant. Permit to work sign off by authorised party.
- Vessels, piping designed to recognised standard/specification.
- Indaver personnel conduct screening / assessing of deliveries to site.
- Speed limit / traffic management controls.
- Oil water separator on drains.
- ATEX zoning.
- Control of ignition sources on site.
- Fire-fighting system - hoses, extinguishers.
- Fire-fighting systems / water main and water cannons.
- Spill kits.
- Emergency response team.

Based on these assessments, and on the controls that will be implemented as risk reduction and risk mitigation measures at the site, the risks associated with accident scenarios at the Indaver facility in Ringaskiddy were found to be ALARP.

16.6.2 Monitoring

16.6.2.1 Monitoring During Construction

The CEMP will include provision for continuous inspections, auditing and monitoring of the construction works. The Site Environmental Manager (SEM) will draw up a schedule of monitoring, which will set out roles and responsibilities for monitoring and reporting the works. In the event that the monitoring results indicate that the works are not being carried out in accordance with the contractual requirements, the SEM is responsible for initiating and reporting on the corrective actions to be implemented.

The SEM and the Construction Manager will also carry out quarterly audits to ensure that the Contractor engaged in carrying out the works is successfully meeting all environmental commitments / requirements under the CEMP.

The effective implementation of the CEMP will help to reduce the risks associated with the construction phase of the project in terms of the environmental effects.

The PSCS (Project Supervisor Construction Stage) will monitor performance against the CEMP to ensure that it is adhered to throughout the process.

16.6.2.2 Monitoring During Operation

Indaver will ensure that there are appropriate controls in place (infrastructural and procedural) to manage the risks associated with the planned operations at the resource recovery centre.

Indaver will also install detection and alarm systems to enable operators to rapidly detect and respond in the event of process deviations or accidents developing at the site. These will include:

- Oxygen monitoring at the furnace, with interlocks on the supply to ensure excess oxygen and protect against incomplete combustion.
- Interlocks will also be installed to prevent oil flow to the furnace when burners are not firing.
- Vibration detection on the fan at the furnace.
- Periodic cleaning of the furnace as part of the preventative maintenance programme, to protect against the risk of slag accumulation on the walls of the furnace.
- UV/IR detection systems.
- Pressure gauge at the burner, with interlocks to bring system to safe shut down.
- Process control system at the boiler system, linked to temperature monitors.
- Monitoring of stack emissions.
- Indaver will implement an automatic purge control sequence before the boiler is fired.
- Process controls to detect pressure drop at the bag house, with alarm.
- Process controls with temperature and weight detection at the bag house.
- Screening assessments of deliveries to the site. Indaver will also conduct investigations where issues arise with waste arriving on site (e.g. waste arriving in a damage container).
- Preventative maintenance programme to ensure that plant and equipment remains fit for purpose.
- Overfill protection systems on storage tanks (level gauging and level switches).

Indaver will also conduct daily visual inspections of the site.

16.7 Cumulative Effects

In the context of a discussion of cumulative effects, consideration was made of the risk that a major accident arising at the Indaver site could act as an initiator of a further accident. Consideration was also made of the risk that a major accident elsewhere could give rise to a major accident at the development.

The consequence modelling results in the HAZID&RA report show the extent of the impacts from accident scenarios arising at Indaver. When considering the potential for cumulative effects, in which a fire or explosion could damage other plant or equipment, the following endpoints have been used:

- Thermal radiation of 8 kW/m^2: This is the threshold value reported in IP19[6] at which protective cooling water may be required to prevent escalation of a fire event to exposed items of plant and equipment.
- Thermal radiation of 25 kW/m^2: This heat flux is reported in the Green Book[7] as being sufficient to cause Damage Level 2 in steel structures (serious discolouration of surface, peeling off of paints and/or appreciable deformations of structural elements).

Referring to the model results in the HAZID&RA report (**Appendix 6.1**), the scenario giving rise to the longest hazard distances to these thermal radiation levels is that of a fire in the waste bunker.

As noted in **Section 16.6.1**, Indaver will have controls in place to fight a fire in this area and prevent it escalating to become fully developed. However, in the worst case scenario if the fire escalated to this level, then the thermal radiation level of 25 kW/m^2 could be experienced at a distance of up to 21m from the bunker, and 8 kW/m^2 could be experienced at a distance of up to 39m. Based on these model results, there is no risk of domino / cumulative effects to any receptors off site from this scenario.

Consideration was also given to the risks that an event occurring off site could initiate an accident at Indaver. This is discussed in more detail in **Section 16.3.2**.

16.8 Residual Effects

16.8.1 Residual Effects During Construction

There are no major accident hazard implications during the construction phase of the proposed development. The accident scenarios discussed in this chapter of the EIAR mainly relate to hazards associated with the storage and handling of dangerous substances or the storage and handling of waste at the site. As such, these hazards will not arise until after the construction phase has been completed and the operational phase has commenced (see **Section 16.8.2**).

16.8.2 Residual Effects During Operation

A discussion of the effects arising from normal operations of the plant is provided in other chapters of this EIAR. There are no residual effects associated with the scenarios discussed in this chapter, except in the case of an accident scenario. In the event of an accident occurring during operations, Indaver will have emergency response measures in place to minimise the impacts to human health and to the environment.

[6] "Model Code of Safe Practice Part 19: Fire precautions at petroleum refineries and bulk storage installations" (Energy Institute)
[7] "Methods for the determination of possible damage to people and objects resulting from releases of hazardous materials (CPR 16E)" (TNO)

As the site will be licensed by the EPA, Indaver has conducted an environmental liabilities risk assessment (ELRA) and prepared a closure restoration and aftercare management plan (CRAMP), in accordance with the EPA's guidance[8] both of which have been included in the licence application to the EPA. Indaver has also prepared ELRA's for their operations at Carranstown and at Dublin Port and a similar approach has been adopted for the assessment at Ringaskiddy. In accordance with the EPA's guidance, Indaver has put the appropriate financial provisions in place at these other sites to cover the liabilities and potential liabilities identified in the ELRA.

Indaver will ensure that appropriate financial provisions are in place, accordance with the EPA guidance, for the Ringaskiddy site also.

16.9 References

"Draft Guidelines on the Information to be contained in Environmental Impact Assessment Reports" (Environmental Protection Agency). 2017

"Environmental Impact Assessment of Projects – Guidance on the preparation of the Environmental Impact Assessment Report" (European Commission). 2017

BS 8800: 1996, Guide to Occupational Health and Safety Management Systems

"Guidance to Inspectors on the Assessment of Safety Reports under the COMAH Regulations 2015" (Health & Safety Authority)

"Model Code of Safe Practice Part 19: Fire precautions at petroleum refineries and bulk storage installations" (Energy Institute)

"Methods for the determination of possible damage to people and objects resulting from releases of hazardous materials (CPR 16E)" (TNO)

"Guidance for the location and design of occupied buildings on chemical manufacturing sites" (Chemical Industries Association)

"Guidance on Environmental Liability Risk Assessment, Residuals Management Plans and Financial Provision" (Environmental Protection Agency)

[8] "Guidance on Environmental Liability Risk Assessment, Residuals Management Plans and Financial Provision"