13 Soils, Geology, Hydrogeology, Hydrology and Coastal Recession

13.1 Introduction

This chapter describes and assesses the potential impacts of the proposed development on soils, geology, hydrogeology, hydrology and coastal recession. The existing environment is also described. Mitigation measures are proposed and the predicted residual impacts are described.

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.

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.

13.2 Methodology

This chapter has been prepared having regard to the following guidelines:

- 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)
- Guidelines on the Information to be contained in Environmental Impact Statements (EPA 2002)
- Advice Notes on Current Practice in the Preparation of Environmental Impact Statements (EPA 2003)
- Geology in Environmental Impact Statements – a Guide (Institute of Geologists of Ireland (IGI) 2002)
- Groundwater Directives (80/68/EEC) and (2006/118/EC)
- Environmental Impact Assessment of National Road Schemes – A Practical Guide (NRA) 2008a)
- Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (NRA 2008b)
- Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements (IGI 2013)
- Good practice guidelines on the control of water pollution from construction sites (Construction Industry Research and Information Association (CIRIA) 2001)

- Guideline on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (NRA 2008c)
- Guidelines for Planning Authorities on 'The Planning System and Flood Risk Management' published in November 2009, jointly by the Office of Public Works (OPW) and the then Department of Environment, Heritage and Local Government (DEHLG);

13.2.1 Desk Study

The information in this section comes from a number of different sources, including:

- Walkover surveys.
- Site Investigations and previous studies
- Public Information Sources (listed below)

13.2.1.1 Site Investigations and previous studies

- Soil and Hydrogeological Investigation undertaken by K.T. Cullen & Co. Ltd 2001 (Appendix 13.1)
- Hydrogeological Assessment for Hammond Lane Metal Company, undertaken by O'Callaghan Moran & Associates in 2011 (Appendix 13.2).
- Coastal erosion study completed by Arup as part of current EIS (Appendix 13.3)
- Flood Risk Assessment completed by Arup as part of current EIS (Appendix 13.4)
- Ground investigation undertaken by Soil Mechanics Ltd in 2012 on the glacial till slope along the eastern boundary of the site.

13.2.1.2 Public Information Sources

The public sources of information used are as follows:

- Historical Maps, Ordnance Survey of Ireland
- National Parks and Wildlife Service online maps of designated conservation areas
- Published geological, soil, groundwater, surface water, aquifer, recharge and aggregate potential maps obtained from the Geological survey of Ireland (GSI)
- *Geological Map of the Cork District* (University College Cork (UCC) 1988)
- Waste and IPPC licensed facility maps (EPA Geoportal).
- EPA online Envision Map Viewer (www.epa.ie)
- Review and analysis of relevant reports from the Lee CFRAM Study, January 2014 (available to download from http://www.leecframs.ie/
- Predicted extreme water levels and flood extent maps from the Irish Coastal Protection Strategy Study (ICPSS), May 2011.

- Flood history of the site from the OPW National Flood Hazard Mapping website (www.floodmaps.ie);
- Preliminary Flood Risk Assessment (PFRA) Mapping produced by the OPW, March 2012 (www.cfram.ie/pfra);
- Aerial photography and mapping from Google Maps (2015);
- Water level data from a number of periods from the gauge maintained at Cobh by the Port of Cork;

13.2.2 Site Description

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 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.

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 Gobby Beach carpark to the north and steepens to the south to a maximum of 10-12m high. There are rock outcrops along the beach to the north east and south east of the site boundary.

The ground levels of the site vary considerably in both the North-South direction and the East-West direction. In the South of the site the levels vary from circa 10m OD to circa 41m OD. In the North of the site the ground levels vary from circa 2.05m OD to circa 4.0m OD. There is a steep escarpment in the centre of the site, aligned in a north-east to south-west direction. Anecdotal evidence suggests that the site was used as a source of material for land reclamation elsewhere in Ringaskiddy, and that this accounts for the escarpment

A detailed description of the proposed development is provided in **Chapter 4** ***Description of the Proposed Development*** of this EIS.

13.3 Receiving Environment

The existing environment is discussed in terms of geomorphology (landscape and topography), superficial and solid geology, groundwater/hydrogeology, hydrology and coastal erosion. The assessment draws on desk study information, related reports, site history, and historic and recent ground investigations.

The regional review of geological and hydrogeological conditions covers a zone of 2 km from the site boundary, as suggested in the IGI guidelines.

13.3.1 Bedrock Geology

13.3.1.1 Regional Bedrock Geology

The geology of Cork Harbour (Figure 13.1) is characterised by east-north-east to west-south-west trending ridges of Upper Devonian sandstone, silt-mudstones and valleys of carboniferous limestone, sandstone, and mud-siltstones. The Devonian lithologies were deposited sediments on a continental landmass in a progressively deepening hollow called the Munster Basin. At the end of the Devonian period, tectonic activity resulted in a marine invasion of the basin and marked the onset of the Carboniferous period. Shallow marine sandstone, mudstone and limestone replaced the former land-based sediments.

At the end of the Carboniferous period, the Devonian and Carboniferous rocks were subjected to intense folding and faulting, which is known as the Variscan Orogeny. This major phase of folding resulted in the creation of the prominent ridge and trough topography that exists in South Cork today. Regionally, the folds are cut by east-west trending strike slip faults parallel to the strike and north-north-west to south-south-east normal faults.

13.3.1.2 Local Bedrock Geology

The site is located on the northern side of one of the east-north-east to west-south-west trending ridges known as the Ringaskiddy anticline. The site is underlain by Lower Carboniferous marine interbedded grey/brown sandstone, siltstone and mudstone referred to as the Cuskinny formation of the Kinsale group (Figure 13.1). As the bedrock geology at this site is not limestone, there is no potential risk of solution features on the site.

Bedrock outcrops along the coastline northeast and southeast of the development site. It was noted during the walkover survey that the bedrock lithology to the southeast graded from interbedded sandstone and siltstone at the northern end to interbedded sandstone/siltstone and mudstone towards the south. The bedrock has a strike of north-east to south-west. Measurements taken on this outcrop recorded the bedrock to be dipping 80° to the South West, and a prominent joint set was noted to be aligned north west-south east. According to the Geology of the Cork District Map (UCC 1988) bedrock dips between 35° to 75 ° to the North West on the site. The rock outcrops show the rock to be moderately strong to strong, grey/brown and very thinly bedded. Beds could thicken with increasing depth.

Site investigations were undertaken within and around the site. Refer to Figure 13.2. These are discussed in more detail in Section 13.3.2. 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 10.1m bgl to the east of the site. Bedrock encountered in the trial pits TP1, TP2, TP3, TP7, TP9 and TP10 and the top 30cm to 90cm of the bedrock at the monitoring boreholes at the Hammond Lane site (see Figure 13.2 and Figure 13.3a-13.3) was described as broken/weathered and fractured.

13.3.1.3 Mineral / Aggregate Resources

There are no pits or quarries at the site or adjacent to the site of the proposed development. The GSI online maps indicate that the nearest active quarry to the proposed development is a crushed rock quarry approximately 2.4km to the south-west of the proposed development. Pre-1946, there were also quarries in operation 3 km from the site and in the centre of Carrigaline. The location of these resources is shown on Figure 13.4.

Since these features are a considerable distance from the site, they will not be considered further in this assessment.

13.3.1.4 Geological Heritage Sites

The Geological Survey of Ireland (GSI) in partnership with the Department of Environment, Heritage and Local Government has designed the Irish Geological Heritage Programme, which aims to identify, document and protect the wealth of geological heritage in Ireland. Certain geologically valuable sites are designated as Geological Heritage Sites (GHSs).

There are no GHSs on the site of the proposed development. There are two GHS sites in the general vicinity of the site. These are listed in the online geological heritage dataset on the GSI web site (Figure 13.5). The closest GHS, which is a county geological site is Ringaskiddy Golden Rock, which is a Lower Carboniferous rock outcrop approximately 400m southeast of the proposed development. The second GHS is approximately 1.4 km southwest of the site of the proposed development and is known as Lough Beg Section, a coastal armour stone. Neither GHS will be affected by the proposed development and therefore will not be considered further in this assessment.

13.3.2 Soils

13.3.2.1 Regional Soils

Cork was covered by ice until approximately 20,000 years ago. The ice sheet originated in the Cork/Kerry mountains and flowed eastwards and southwards into the Celtic Sea. As the ice moved eastwards, it sculpted crushed rock debris, known as boulder clay or till, into streamlined ridges called drumlins or eskers. Glacial till is exposed along the eastern boundary of the site. It ranges from 1.0m to 12.0m in height. Coastal glacial till face slopes vary in this area, to the south some are vertical, with some sections appearing concave due to undercutting from the sea.

The Teagasc Subsoils Map shows that the region is predominately till derived from Devonian sandstones, with some areas of till derived from Namurian shales and sandstones and from Carboniferous limestone, bedrock outcrops and made ground.

The soil data from the EPA classifies the upper soil profile as acid brown earths that are glacial in origin, and are derived from the parent bedrock of Old Red Sandstone and Carboniferous Limestone (Figure 13.5). Research into the soils reveals them to be relatively mature, well-drained mineral soils possessing a rather uniform profile, with little differentiation into horizons. They occur on lime-

deficient parent materials and are therefore acid in nature. They possess medium textures of sandy loam, loam and sandy clay loam.

13.3.2.2 Site Specific Soils

The data from the site investigations undertaken within and around the proposed site development (Figure 13.2) were reviewed to provide information on the ground conditions across the site.

Seventeen trial pits (TP1 to TP17) and five monitoring boreholes (BH1 to BH5) were completed during the 2000 and 2001 investigations (K.T. Cullen & Co. Ltd, 2001). The trial pits reached depths ranging between 1.0m and 5.6m below ground level (bgl) and the boreholes reached depths between 7.6m and 15.0m bgl respectively. A further four trial pits (TP1-2012 to TP4-2012) and four boreholes (BH1-2012 to BH4-2012) were excavated during the 2012 site investigation (Soil Mechanics, 2012). The trial pits reached depths of between 3.6m and 4.0m bgl and the boreholes reached depths between 9.0m and 10.2m bgl respectively.

Information on ground conditions available from the adjacent Hammond Lane Metal Company site was also used in the assessment. A total of four monitoring boreholes (MW1 to MW4) were excavated in 2011 for the Hammond Lane Metal Company site investigation (O'Callaghan Moran & Associates, 2011), reaching depths between 10.0m and 14.0m bgl.

The GSI website was checked for any site investigation data in the area of the Indaver site. The database contained the details of a selection of boreholes and pits investigated during a 1974 site investigation for Irish Steel (R3033). Some of these boreholes and trial pits have been used to enhance the ground model for the site, the locations of which are presented in Figures 13.3a, 13.3b and 13.3c.

A stratigraphic profile of topsoil over orange/orange brown gravelly SILT/CLAY over brown gravelly SILT/CLAY becoming brown sandy gravelly SILT/CLAY was recorded. Interbedded lenses of silty, gravelly SAND were encountered in TP7, TP13, TP16, TP17, BH1-2012, BH2-2012, TP1-2012, TP2-2012, TP3-2012 and TP4-2012 within the sandy gravelly SILT/CLAY stratum. Made ground was noted in BH2 towards the eastern end of the site, and in MW2 and MW3 located in the Hammond Lane Metal Company site. A thin bed of gravel was encountered at the surface of TP13 only. Table 13.1 summarises the site investigation results.

Table 13.1 Summary of Overburden from Previous Site Investigations

Stratum	Depth to top of Stratum (m)	Thickness of Stratum (m)
TOPSOIL	ground level	0.1 – 0.4
MADE GROUND	ground level	0.6 – 2.0
Grey brown silty GRAVEL	ground level	0.2
Orange/orange brown gravelly SILT/CLAY	ground level – 0.3	0.2 – 3.0
Brown gravelly SILT/CLAY with cobbles	ground level – 0.9	0.3 – 5.5
Brown/greyish brown sandy gravelly SILT/CLAY	ground level – 5.7	0.3 – 9.3
Brown clayey/silty fine SAND with occasional cobbles	0.5 – 2.0	0.6 – 3.7

13.3.2.3 Regional and Local Potential for Contaminated Land

A review of the EPA website for both existing and historic licensed and illegal waste activities was carried out to identify any potential contamination sources present in the area, and to identify any potential contaminating activities near the proposed development.

Waste Licences and Permits

The Environmental Protection Agency (EPA) licenses certain waste and industrial activities. The National Waste Collection Permit Office (NWCPO) issues Waste Collection Permits. According to the NWCPO records, only one waste permit has been issued within a 2 km radius of the proposed development (Figure 13.7). Table 13.2 summarises the above mentioned waste permit.

Table 13.2 Waste Licences Issued within a 2 km radius of the Site

Waste Licence No.	Facility Type and Details	Approx. Distance from Site (km)	Licence Status
W0289-01	Landfill The East Tip, Haulbowline Island	1.4	Licensed

Integrated Pollution and Prevention Control (IPPC) and Industrial Emission (IEL) Licences

According to the EPA records, six IPPC licences have been issued within 2 km radius of the proposed development (Figure 13.7) and are summarised in Table 13.3 below. In addition to the six IPPC licences, the adjacent site, Hammond Lane Metal Company, applied in 2014 for an Industrial Emissions Licence, P0997-01.

Table 13.3 Integrated Pollution and Prevention Control (now industrial emission) Licensed sites within a 2 km radius of the Site

IPPC Licence No.	Type of Activity and Details	Approx. Distance from Site (km)	Licence Status
P0010-04	Chemicals Hovione Limited	0.9	Licensed
P0004-04	Chemicals SmithKline Beecham Limited	1.5	Licensed
P0498-01	Metals Irish Ispat Limited	1.5	This licence has been surrendered and the facility demolished
P0778-01	Chemicals Janssen Biologics Limited	1.7	Licensed
P0013-04	Chemicals Pfizer Ireland Pharmaceuticals	1.9	Licensed
P0476-02	Chemicals Recordati Ireland Limited	1.9	Licensed

These licensed activities are not expected to have any implications for the soil, geology, hydrology and hydrogeology at the Indaver site.

Potential Illegal Dumping

According to the EPA publication, *The Nature and Extent of Unauthorised Waste Activities in Ireland* (2005), unauthorised waste activity has not been noted at or within 2 km radius of the Site.

Potential Contamination in Surrounding Sites

Environmental groundwater testing was undertaken in 2011 as part of the development of the adjacent Hammond Lane Metal Company site, (Appendix 13.2). The groundwater results are discussed in Section 13.3.3 below. In the 2011 report, it was noted that an initial assessment of the subsoils was undertaken in 1997 and again in 2010. Neither report identified the presence of any significant impacts on the subsoils due to the operations on site.

The 2011 groundwater samples were analysed for a range of parameters based on the use of the site as a metal processing facility. All results were below the Interim Guideline Values (IGV) published by the EPA.

Environmental Soil Sampling

An environmental soil baseline study was undertaken as part of the 2000 and 2001 site investigations (K.T. Cullen & Co. Ltd, 2001) (Appendix 13.1). At the time of the 2000 and 2001 site investigations, soil laboratory test results were compared to Dutch MAC (maximum admissible concentration) thresholds. Under the Dutch criteria, the degree of contamination was assessed using the following guidelines:

- S-Value Reference for normal uncontaminated soil/groundwater
- I- Value Threshold for intervention

A total of ten trial pits (TP1 to TP10) (Figure 13.2) were sampled for soil contamination at the site in November 2000. Soil samples were analysed for the following:

- Petrol and Diesel Range Organics, Mineral Oils
- Benzene, Toluene, Etylene and Xylene (BTEX) Compounds
- Volatile Organic Compounds (VOCs)
- Polycyclic Aromatic Hydrocarbons (PAHs)
- Metals and Total Phenols
- Pesticides (OPPs, OCPs, ONPs)
- Polychlorinated Biphenyls (PCBS)

An additional five trial pits (TP11 to TP17) (Figure 13.2) were excavated in January 2001 in order to resample the overburden, as soil contamination results were not in line with observations on site. The second round of sampling revealed considerably lower results than detected concentrations from the 2000 site investigation.

Analytical results for the soil samples are presented in the 2001 Soil and Hydrogeological investigation report prepared by K.T. Cullen & Co. Ltd. (refer to Appendix 13.1). The report concluded that there was no significant soil contamination at the site.

13.3.2.4 Landslide Risk and Slope Stability

A review of the landslide information on the GSI Irish Landslides Database indicates that the landslide potential in the vicinity of the site is primarily confined to the shore line. Refer to Figure 13.8 which is an extract from GSI Irish Landslides Database mapping. The proposed placement of sacrificial material on the beach will mitigate this potential hazard.

In the past, the overburden on a section of the eastern part of the site was removed for reclamation works to the north of the site. The resultant slope is steep and is indicated to have some landslide potential in the GSI landslide data base.

13.3.3 Hydrogeology

13.3.3.1 Cork Harbour

The site of the proposed development lies on the Ringaskiddy Peninsula in the lower part of Cork Harbour, and is located on the western side of the West Channel. The harbour has a twice daily tidal cycle, with a range of approximately 4m in spring tides.

The groundwater body of Ringaskiddy is 16.7 km^2 in area and occupies an east west trending valley on the west side of Cork Harbour. Much of the Ringaskiddy groundwater body comprises urban and/or industrial areas.

13.3.3.2 Groundwater Resources

The Geological Survey of Ireland has devised a system for classifying the aquifers in Ireland based on the hydrogeological characteristics, size and productivity of the groundwater resource into the National Draft Bedrock Aquifer Map. The three main classifications are Regionally Important Aquifers, Locally Important Aquifers, and Poor Aquifers. Each of these types of aquifer is further subdivided and has a specific range of criteria associated with it, such as the transmissivity (m^2/day), productivity, yield, and the potential for springs.

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" (Figure 13.9). The site is not underlain by karst. Consequently, LK is not applicable to the aquifer under the site.

The GSI have delineated certain areas nationwide as groundwater Source Protection Areas in order to provide protection for groundwater resources, particularly group water schemes and public water supplies. A Source Protection Area is delineated according to the hydrogeological characteristics of the aquifer, the pumping rate, and the recharge in the area. Activities that may impact on groundwater are tightly controlled within the Source Protection Area. There are no Source Protection Areas located within 2km of the Site.

The GSI databases and maps were consulted to see if any records existed for wells in the area. According to the GSI and the EPA, there are 19 wells within 2 km of the site (Figure 13.10). All of the wells are located to the south of the site. Eighteen of the wells are categorised as for "other use", and were drilled during site investigations undertaken by Pettits in 1997 and 1998. They are located in a cluster together in the current Hovione site. The one other well is located approximately 1.6km south of the site in the vicinity of the current GlaxoSmithKline site in Curraghbinny. It was drilled for industrial use in 2000. Details of groundwater monitoring wells at the Indaver site and at the adjacent Hammond Lane site are provided in Section 13.3.3.7.

Based on the available information, groundwater flow direction in the immediate vicinity of the site is considered to be in a south to north direction. Due to the distance and predicted groundwater flow direction, it is not likely that any of these wells will be impacted by the proposed Indaver development. They will not be considered further in this assessment

13.3.3.3 Groundwater Vulnerability

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 vulnerability of 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.

13.3.3.4 Groundwater Recharge Characteristics

The GSI has published Groundwater Recharge Mapping for almost all of Ireland. The location of the proposed development is categorised in the map as generally having an average recharge of 200mm/yr, with some parts of the surrounding area yielding an average recharge of up to 627mm/yr and 443mm/yr (Figure 13.10).

Potential or effective rainfall is the amount of rainfall that is available to infiltrate the ground and that will not evaporate or be taken up by plants. The effective rainfall for the area is 738mm/yr.

These values influence the amount of recharge the study area receives and will influence the groundwater throughput beneath the study area.

Actual recharge is the measure of how much rainfall can actually be assumed to infiltrate the ground and recharge the water table. It is based on the potential rainfall but also takes into account rainwater that does not enter the ground but becomes overland flow and enters streams. This occurs when the soil is saturated or has reached its field capacity, which is common in Ireland.

13.3.3.5 Groundwater-dependent Terrestrial Eco-systems

The purpose of this section is to assess any impacts on groundwater-dependent terrestrial ecosystems that may be influenced by any potential changes in the groundwater regime as a result of the proposed development. The National Parks and Wildlife Service online database was consulted to establish whether any groundwater-dependent terrestrial ecosystems are located within 2km of the site of the proposed development. No groundwater-dependent ecosystems within 2kms of the proposed development were identified from the database. A full assessment of the ecological features in the vicinity of the site is outlined in **Chapter 12 *Biodiversity***, of the EIS.

13.3.3.6 Potential Groundwater Contamination in Surrounding Sites

Environmental groundwater testing was undertaken in 2011 as part of the development of the adjacent site, the Hammond Lane Metal Company (O'Callaghan Moran & Associates, 2011), refer to Appendix 13.2.

The 2011 groundwater samples were analysed for a range of parameters based on the use of the site as a metal processing facility. All results were below the Interim Guideline Values (IGV) published by the EPA.

13.3.3.7 Site Specific Hydrogeology

Five groundwater monitoring wells (BH1 to BH5) (refer to Figure 13.2) were installed in both the overburden and the bedrock at selected locations across the site as part of the 2000 to 2001 site investigation (Appendix 13.1). Four groundwater monitoring wells (MW1 to MW4) were installed as part of the 2011 Hammond Lane site investigation (refer to Figure 13.2).

Groundwater depths and levels recorded in the trial pits and the boreholes excavated in the previous site investigations across the site are presented in Table 13.4. It should be noted that in the case of the 2000 and 2001 SI, and the 2011 SI performed on behalf of Hammond Lane Metal Company, the groundwater levels to Malin Head Ordnance Datum have been inferred from the topographic survey completed on the site, and therefore the inferred elevations are approximate. Groundwater depths range from 1m to 12m bgl and levels are approximately between 8m OD and -5m OD.

Table 13.4 Water Strike Records from Previous Site Investigations (refer to Figure 13.2)

Exploratory Hole No	Depth (mbgl)	Elevation (mOD)	Water Strike Rose (m)
TP1 (2000)	1.8	1.45	0.8
TP2 (2000)	5	-0.75	0.5
TP4 (2000)	3.4	1.35	
TP5 (2000)	1	1.5	-1.0
TP5 (2000)	2.5	0	0.5
TP7 (2000)	3	1.25	
TP11 (2001)	2.1	4.9	
TP13 (2001)	3.4	-0.3	
TP14 (2001)	3	1.95	
TP16 (2001)	2.5	0.75	1.0
TP17 (2001)	1.5	0.73	0.5
BH1 (2000)	4.5	-1.25	
BH2 (2000)	6	-3	
BH3 (2000)	12	-4.5	
BH4 (2000)	8	-1	
BH5 (2000)	8.5	-3.75	
BH2 (2012)	8.4	0.59	1.3
BH4 (2012)	9.6	2.00	
TP4 (2012)	4.0	8.35	
MW1 (2011)	2.8	0.20	
MW2 (2011)	8.2	-4.20	
MW3 (2011)	6.7	-1.20	
MW4 (2011)	8.6	5.40	

Based on the available information, groundwater flow direction in the immediate vicinity of the site is considered to be in a south to north direction.

13.3.3.8 Environmental Groundwater Sampling

An environmental groundwater contamination baseline study was undertaken as part of the 2000 and 2001 site investigations undertaken by KT Cullen & Co. At the time of the 2000 and 2001 site investigations, groundwater test results were compared to Dutch MAC (maximum admissible concentration) thresholds for soil and groundwater. Groundwater analytical results were also compared to the Irish Water Quality Standard for Drinking Water (S.I. No 81 of 1988).

Under the Dutch criteria, the degree of contamination was assessed using the following guidelines:

- S-Value Reference for normal uncontaminated soil/groundwater
- I- Value Threshold for intervention

A total of five groundwater monitoring wells (BH1 to BH5) (refer to Figure 13.2) were sampled for groundwater contamination at the site in November 2000. Groundwater samples were analysed for the following:

- Petrol and Diesel Range Organics, Mineral Oils
- Benzene, Toluene, Ethylbenzene and Xylene (BTEX) Compounds
- Volatile Organic Compounds (VOCs)
- Polycyclic Aromatic Hydrocarbons (PAHs)
- Metals and Total Phenols
- Pesticides (OPPs, OCPs, ONPs)
- Polychlorinated Biphenyls (PCBS).

Analytical results for the groundwater samples are presented in the Soil and Hydrogeological investigation report prepared by K.T. Cullen & Co. Ltd (refer to Appendix 13.1). The report concluded that there was no significant groundwater contamination at the site and that the slightly elevated levels of ammonia and nitrite were most likely of agricultural origin.

13.3.4 Conceptual Site Model

A conceptual site model (CSM) for the site has been developed, using the site investigation data for the site. It is summarised in Table 13.5 below and presented in Figures 13.3a and Figure 13.3b. Refer to Figure 13.2 for the location of the site cross-sections.

Table 13.5 Conceptual Site Model

Stratum	Depth to top of Stratum (m)	Thickness of Stratum (m)
TOPSOIL/MADE GROUND	0.0	0.1 – 2.0
sandy gravelly SILT/CLAY locally with medium to very thick beds of sand	0.0 – 0.7	0.3 – 9.9
pale green MUDSTONE/green grey fine grained SANDSTONE bedrock	0.3 - 10.1	

The bedrock beneath the site is a ‘Locally Important Aquifer’, with a vulnerability rating of ‘Extreme’, overlain by a thin layer of sandy gravelly CLAY/SILT

interbedded with sand strata. The thickness of overburden across the site was found to range from 0.3m bgl to 10.1m bgl.

Regional flow in the bedrock and subsoil is towards Cork Harbour. This has been confirmed locally as a south to north direction from the groundwater levels recorded in some local site investigations (refer to Appendices 13.2 and 13.3).

13.3.5 Importance of Features

As part of the appraisal of the receiving environment, the importance of the following features has been ranked, based on NRA 2008 criteria.

Table 13.5 Importance of Features

Feature	Importance	
	Ranking	**Justification**
Locally Important Aquifer	Medium	The site is underlain by a Locally Important Aquifer

13.3.6 Environment Type

From the Conceptual Site Model (CSM) presented in Section 13.3.4 above, the proposed development site is categorised as a Type A environment. According to the IGI 2013 Guidelines, the definition of this is:

Type A: Passive geological/hydrogeological environments e.g. areas of thick low permeability subsoil, areas underlain by poor aquifers, recharge areas, historically stable geological environments.

The other categories from the IGI 2013 Guidelines are also presented below

Type A – Passive geological / hydrogeological environments e.g. areas of thick low permeability subsoil, areas underlain by poor aquifers, recharge areas, historically stable geological environments

Type B – Naturally dynamic hydrogeological environments e.g. groundwater discharge areas, areas underlain by regionally important aquifers, nearby spring rises, areas underlain by permeable subsoils;

Type C – Man-Made dynamic hydrogeological environments e.g. nearby groundwater abstractions, nearby quarrying or mining activities below the water table, nearby waste water discharges to ground, nearby geothermal systems;

Type D – Sensitive geological / hydrogeological environments e.g. potentially unstable geological environments, groundwater source protection zones, karst;

Type E – Groundwater dependent eco systems e.g. wetlands, nearby rivers with a high groundwater component of base flow.

13.3.7 Hydrology

13.3.7.1 Existing Hydrological Environment

The main hydrological feature in the vicinity of the site is the West Channel of Cork Harbour, which is adjacent to the eastern boundary of the site. The nearest rivers and streams are the Glounatouig Stream that flows into Monkstown Creek, approximately 3km to the west of the site, and the Owenboy River that flows into Cork Harbour, approximately 2.5km to the south of the site. These surface water features are indicated on the following Figure 13.12. The online EPA envison mapping (consulted 6 July 2015) shows the water quality in Cork Harbour to be 'Unpolluted'.

Surface water within the site boundary appears to drain through naturally occurring channels along the field boundaries following the natural topography of the landscape which falls from 41m OD in the south of the site to 2m – 3m OD at the northern boundary with the road. The relatively flat and low-lying areas in the northern parts of the site adjacent to the road, to the east and west of the Hammond Lane facility, are poorly drained due to the gradient and possibly due to the presence of the thicker glacial deposits. Ponding of water has been noted in these areas during winter months. The potential for flooding of the low-lying parts of the site is further discussed in the following Section 13.3.7.2 below and in **Appendix 13.4 (*Flood Risk Assessment*)**.

13.3.7.2 Flood Risk

The Indaver site was assessed by Arup to determine whether the site was at risk with respect to flooding (Refer to **Appendix 13.4 (*Flood Risk Assessment*)**. Potential sources of flooding considered included:

- Fluvial Flooding
- Tidal/Coastal Flooding
- Groundwater Flooding
- Pluvial/Urban Drainage Flooding

A summary of the findings of the flood risk assessment is as follows:

- Given the absence of any significant watercourse in the vicinity of the site, the risk of fluvial flooding is very low.
- The site is not indicated as being within the design 1000 year tidal floodplain. Consequently the site is classified as lying within Flood Zone C.
- There is a low risk of groundwater flooding of the site.
- Based on a review of all available information, the 1 in 200 year design tidal level at the site has been estimated as 2.73m OD. Sections of the road close to Gobby beach car park are below this level and are therefore at risk of tidal flooding during a 1 in 200 year tidal event.
- Small areas of the site along the northern boundary are also below the predicted 1 in 200 year design tidal level (2.73m OD). The majority of the site is above 2.73m OD.

- There is a risk of pluvial flooding to the L2545 and the low lying areas of the site during periods of heavy rainfall due to an insufficient drainage network and tide locking of the existing drainage outfall. This is described further below.

The existing storm water drainage system along the road consists of a 450mm diameter pipe and is unable to cater for the volume of water falling on the road and consequently the road is subject to flooding. This drainage pipe outfalls into the sea at Gobby Beach. The invert level of the outfall of the road drainage network is set at -0.28mOD. Once 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 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 the road causes it to flood.

In addition, there are a minimal number of gullies along the road to accept water and transfer it the storm water sewer. A number of channels have been cut in the berm on the southern side of the road which allow surface water drain from the road and into the western field area of the Indaver site as a section of this field is lower than the adjacent road level. Therefore, it can be concluded that the existing formal drainage system on the L2545 is inadequate.

13.3.8 Coastal Recession

13.3.8.1 Introduction

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.

A detailed coastal erosion study is provided in **Appendix 13.3** (***Coastal Erosion***) of this EIS. The details provided in this chapter summarise Appendix 13.3.

In November 2008, Arup carried out an assessment of coastal retreat and coastal flooding at the site of the development. The coastline, which forms the eastern boundary of the site, was found to have eroded over the past 100 years at a varying rate, with the most significant erosion occurring along the south eastern boundary of the site. It was also noted that some accretion or increase by natural growth of sediment has occurred along a section of the beach to the north east of the site.

From 2008 to 2015 a series of studies were carried out to get an understanding of coastal erosion patterns in the area with a view to assess if any coastal protection measures were needed.

A site investigation was carried out in 2012 in order to investigate the causes of the coastal recession at the site. The results of the 2012 investigation are summarised in **Appendix 13.3 (*Coastal Erosion***). The 2012 study concluded that the ground conditions and water seepage along the eastern coastal boundary of the site make the slope vulnerable to coastal erosion. This is combined with wave action from the sea, which creates turbulence on the beach and at the base of the coastal slope, leading to recession of the glacial till slope line at the toe. The glacial till slope recedes through a cycle of notching and

fissures forming at the base of the glacial till slope due to the wave action, the subsequent slumping of the overhanging material, and the washing away of the slumped material at the base.

Between 2014 and 2015, further studies were carried out including:

- Topographic survey for the beach and glacial till slope at the eastern boundary of the Indaver site
- Bathymetric survey in the nearshore area adjacent to the eastern boundary of the Indaver site,
- Coastal erosion study which included:
  - Assessment of the retreat rate based on historical information and the new surveys
  - Numerical wave model and beach sediment transport
  - Assessment of expected coastal retreat
- Appraisal of potential impacts of expected coastal retreat on the proposed Ringaskiddy Resource Recovery Centre, and
- Mitigation measures to minimise potential impacts

Refer to **Appendix 13.3** (***Coastal Erosion***) for details.

13.3.8.2 Retreat rates

It was necessary to make an estimate of coastal erosion rate along the eastern side boundary in order to assess whether the proposed development could be impacted by coastal erosion.

An initial estimate of the coastal erosion rate was made using historical data sets collected from various sources including the Geological Survey of Ireland (GSI) and the Ordnance Survey of Ireland (OSI). Rates identified from these historical datasets were extrapolated to give future retreat rates of up to 36 or 55m over 110 years (1897-2008). Refer to Section 2 (Assessment of historical retreat) of **Appendix 13.3** (***Coastal Erosion***) for further details.

The level of uncertainty associated with using historical datasets was high due to a number of factors including the fact that there were large variations in the coastal retreat over the 110 year period, there were large gaps between surveys and the precision and accuracy of historical mapping cannot be quality checked to the same level as modern surveying/monitoring.

Therefore it was necessary to also estimate the coastal erosion rate using recent topographic surveys as it would have a higher level of accuracy than the historical data sets. Periodic topographic surveys were carried out between 2008 and 2014. The information obtained from these topographic surveys was used to assess the coastal retreat since 2008 with a higher level of accuracy than the historical datasets.

As detailed in Section 2.3 of **Appendix 13.3** (***Coastal Erosion***), a conservative approach was used to calculate a maximum retreat line at the site based on the topographic survey data. The approach was based on observations and takes a conservative absolute maximum of any retreat observed within the site boundary over a six year period (2008-2014). Erosion is likely to be the result of episodic

events i.e. a similar event will most likely not occur in the following year and may not occur for a number of years. Therefore for the most accurate estimation of the erosion rate it is necessary to analyse data spanning the largest period available, which in this case is six years. This period of six years is considered to be conservative to extrapolate an erosion rate.

A maximum localised retreat rate was measured at a particular location along the Indaver eastern boundary and based on that an erosion rate of 0.47m per year over the six year period was calculated. However, a conservative rate of 0.5m per year was used in order to calculate the erosion rate into the future.

The topographic surveys carried out between 2008 and 2014 confirm the retreat rates found in the historical maps, surveys and aerial photographs (1897-2008) were within the correct range (36-55m over 110 years).

As discussed elsewhere in the EIS, 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.

The maximum predicted retreat of 0.5m/year was applied to the entire length of the top of the glacial till slope line adjacent to the site in order to calculate how much erosion would occur over the lifetime of the proposed development (30 and 40 years). This approach is conservative as in reality, some areas may experience a lower retreat rate per year and some areas may experience accretion.

Applying the predicted conservative rate of erosion of 0.5m/year gives an expected retreat (of the glacial till face) of 15m in 30 years' time, 20m in 40 years' time and 50m in 100 years' time. Refer to Appendix 13.3 for further details. Refer also to planning drawing No 238129-C-000-060 which shows the estimated retreat lines and the proposed development with and without mitigation. The impact of the predicted erosion retreat on the proposed development is discussed further in Section 13.4.4 below.

13.4 Characteristics of Proposed Development

13.4.1 General

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.

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.

Connection to the national grid within the ESB networks Lough Beg substation is described in Section 4.5.10 of Chapter 4. It is envisaged that the works within the substation lands will be carried out at the same time as the Indaver development.

13.4.2 Soils and Geology

Site preparation will involve the re-grading of the eastern part of the site for the construction of the waste-to-energy facility. Significant earth retaining structures will be required within the proposed development. Where loose/soft soils are encountered in the northern part of the site, excavation and replacement of these soils with more suitable fill will be required to minimise settlement of the ground. The low-lying areas of the site including the western fields will be raised to above 4.55m OD.

It is estimated that up 74,664m^3 of material will be removed from the site and up to 30,261m^3 of material will be imported onto the site during the construction phase. These figures include an allowance for bulking up of material for transportation.

Some works will be carried out below the existing ground level on the site. For the works involved with the proposed resource recovery centre, these will include the following:

- Diversion of existing services including the gas main and overhead power lines.
- Stripping topsoil and vegetation.
- Bulk excavation and general site re-grading.
- Raising the level of the western field to above 4.55mOD.
- Construction of earth retaining structures.
- Construction of foundations, including piling.
- Construction of the bunker, underground tanks, drainage, and underground services.

The road upgrade works will include the following:

- Raising a section of the road to a maximum height of 3.41mOD.
- Upgrading the road drainage by installing additional large diameter pipes under the road and new road gullies in the road.
- Diversion of some existing services in the road.

13.4.3 Surface Water Drainage

13.4.3.1 Standards and Regulations

Surface water will be collected in underground drainage systems. All of the underground drainage systems will be designed and constructed as a minimum to comply with the Building Regulations 2010, BS EN 752-4 Drain and Sewer Systems outside Buildings.

13.4.3.2 Surface Water Drainage from the Waste-to-energy Facility

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.

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 tank will have a Greenfield discharge rate of 18l/s. The attenuation tank will be constructed from reinforced concrete and will be located beneath the car park adjacent to the administration building.

A combined surface water tank (attenuation 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.

A dedicated surface water drainage network will collect and convey all the road and service yard runoff to Surface Water Holding Tank 01 via a Class 1 full retention hydrocarbon interceptor. A second dedicated drainage network will collect and convey all the runoff from all roof areas and discharge them direct to Surface Water Holding Tank 02.

Surface Water Tank 01, which will have a capacity of 1690m^3.

The tanking unloading area, which is located adjacent to the fuel tank, will be provided with cut off drains to collect any minor spillage that may occur during loading of the fuel and ammonia tanks. 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 loading or 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 holding tank.

The fill will be placed in western field to raise the ground level. The area will be finished with stone. Any storm water will infiltrate into the ground. There will be no sources of potential contamination in the area. A new filter drain will be located between the bottom of the raise plateau embankment and the site boundary to aid with the infiltration to ground.

13.4.3.3 Storm Water Monitoring

All runoff from the road and hardstanding areas which drain direct Tank 01 will be monitored by an internal Indaver monitoring and sampling station. In the event of there being an out of specification reading Tank 01 can be isolated from Tank 2 and the water removed in accordance with Indaver operational procedures for dealing with contaminated water. This arrangement allows for the roof runoff to continue to be discharged from the site. Monitoring will also take place at the outfall from the attenuation tank. If the monitoring at either location detects contamination, the outlet valve will be closed and the contaminated water will not be discharged. The contaminated water may be conveyed by tanker to the

aqueous waste tank, for injection into the process, or removed off site for appropriate disposal. It is expected that monitoring will normally show the storm water to be uncontaminated so the holding tank will typically be empty.

13.4.3.4 Fire Water Management

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

A firewater retention tank will be provided. It will be will be located underground beneath the administration building car park to the west of the main entrance.

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 facility, the water used to fight the fire will be captured the recovered water tank or clean water tank which are located below the building floor. The bunker and the recovered water tank will be designed as water retaining structures. The fire-fighting water from any fire in an outdoor area would be captured in the storm water drainage system and will be collected in both the surface water holding tanks, where it can be stored for disposal. The surface water pumps which are located in Tank 02 will be switched if the fire alarm is activated. The combination of both of the surface water tanks will provide sufficient retention capacity in accordance with the EPA guidelines for fire water retention.

13.4.3.5 L2545 Road Drainage Upgrade

The storm water drainage in the L2545 road will be improved as part of the road upgrade works. 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 0.9m 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.

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 during a 200 year tidal event and a 1 in 30 year rainfall event plus an allowance for climate change. The increased storage will be in the form of 2No. 1500mm 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 site and will run 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. The design of the new drainage system will cater for the 7 hours when the storm water outfall is tide locked by a 200 year tidal event combined with a 1 in 30 year rainfall event plus an allowance for climate change.

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.

13.4.3.6 Increase in levels of the Indaver site

The minimum design flood defence level of the proposed development has been calculated as 3.8m OD Malin. Arup however has proposed a far more conservative flood defence level of 4.55m OD Malin for the site.

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. Refer to **Appendix 13.4** (***Flood Risk Assessment***) for further details. This measure will ensure that the risk of flooding to the site is very remote. The finished floor level of the buildings on the site will be set at even more conservative levels, all above 5mOD.

13.4.3.7 Sanitary Drainage

During the operation of the proposed development, sanitary wastewater will be treated as follows:

- All sanitary wastewater will be collected and treated in a standalone wastewater treatment facility that will treat the wastewater to a 20:30 standard, i.e. 20mg/l BOD and 30mg/L SS.
- 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 has been constructed and becomes operational, the pumped untreated sanitary water will go directly to the Irish Water sewer located east of Ringaskiddy Village, which will then be pumped to the Lower Harbour wastewater treatment facility. The site wastewater treatment facility will be removed.

13.4.4 Coastal Recession

As discussed in Section 13.3.8.2 above, a conservative rate of 0.5m per year was used in order to calculate the erosion rate into the future. Applying this predicted rate of erosion gives an expected retreat of the glacial till face of 15m in 30 years' time, 20m in 40 years' time and 50m in 100 years' time. Refer to Appendix 13.3 for further details. Refer also to planning drawing No 238129-C-000-060 which shows the estimated retreat lines and the proposed development with and without mitigation.

The study found that there would be no impact 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 however 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.

The study also found that the proposed development will not increase the current rate of erosion of the glacial till face.

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 in 2008/2009 and given the low risk that the amenity walkway and viewing platform and a section of the diverted gas pipeline could be impacted in 40 years' time, coastal protection measures to reduce the rate of erosion have been included in this planning application as a precautionary measure so as to reduce the rate of erosion of the glacial till face.

Arup investigated a number of coastal protection options that could be applied to the Indaver site. This is detailed further in Appendix 13.3 of this EIS.

In modern coastal engineering practice it is generally thought that the benefits of using 'soft' solutions (where possible) far outweigh the benefits of using 'hard' solutions. Also, 'soft' solutions have a degree of adaptability and dynamism compared to 'hard' solutions. Similarly there is evidence that certain 'hard' solutions can cause wave reflection and can in fact worsen the issue of erosion. For these reasons there is a trend in employing 'soft' solutions wherever possible.

It is proposed that the Indaver coastal boundary is monitored on an annual basis. In addition, approximately 1100m^3 of sacrificial material (shingle) of appropriate size and shape (rounded) will be placed above the foreshore on Gobby beach along the eastern boundary of the Indaver site. This will be a 'soft' solution which will potentially reduce erosion rates by limiting the exposure of the toe of the glacial till face to wave action.

The shingle will be confined to the beach adjacent to the site within Indaver ownership. It will be necessary for tracked machines to access the beach, above the high tide line to spread the shingle.

It is proposed that the sacrificial material (shingle) is placed during the construction period of the Indaver site. Thereafter, it is proposed that the placement of further additional sacrificial material (shingle) is carried out if the glacial till slope erosion rate is more than 0.5m per year measured over a period of six years, which would indicate some acceleration in the current erosion rate, or when the glacial till slope has retreated by approximately 3m, whichever is sooner. For this reason the coastal boundary of the Indaver site will be monitored for erosion on an annual basis.

The proactive monitoring will comprise:

- Annual topographic surveys which will include 0m contour, top and bottom of glacial till face monitoring and specified sections.
- An assessment of the retreat and reporting over the design life of the proposed development including the construction period (40 years).
- Proactive and reactive management of the beach comprising placement of imported shingle to areas of the beach where deemed necessary from beach monitoring data.

The main aim of placing the material is to act as a proactive measure for the coastal area adjacent to the Indaver site only. The solution will have no negative impacts on the adjoining areas. However there will be benefits associated with the works as well as the provision of an environmentally friendly solution. The net coastal sediment transport goes 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 and therefore the sacrificial material will not impact on the SPA. Refer to Appendix 13.3 for further details.

13.5 Potential Impacts

13.5.1 Soils and Geology

The following section details the potential impacts of the construction and operational phases of the proposed development on soils and geology.

13.5.1.1 Construction Phase

Excavation works below the existing ground level will be required during the construction of the proposed facility. In the eastern area of the site, bedrock levels in boreholes range from 1.0m bgl to 9m bgl. Bedrock in trial pits was recorded at depths between 0.30m bgl in trial pit TP9 to 5.5m bgl in trial pit TP2. The proposed foundation levels of the site will be in stepped levels across the site, ranging from circa -1mOD to 10m OD and will require excavations of up to 10m bgl. This will involve the excavation of soil and bedrock.

In the event that soft soils are encountered that will not support the applied loads, or risk settlement over time, additional excavations may be required. This might

be to either bedrock or a sufficient depth within the soil where more competent soils are encountered. Additional fill will then be required to create a competent foundation and reinstate the ground level to that which is required. Piles foundations may also be used.

For bedrock excavation, trial pit and borehole records indicate that the upper 0.5m to 1m of weathered material can be extracted using a large excavator while the remainder will be removed using a chisel or hammer-operated rock breaker. If the removal of the more competent bedrock is required, this has the potential to impact on the environment in terms of creation of additional noise, vibrations and dust.

Existing slopes in the southern part of the waste-to-energy facility will be re-profiled to accommodate the proposed development.

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. Where possible, excavated materials will be reused on site for backfilling purposes, re-grading and landscaping. However, it is expected some of the excavated material may not be suitable for reuse on site. Any excavated materials suitable for re-use may deteriorate due to poor materials handling, storage, and exposure to adverse weather conditions. In particular, where materials consist of high fines content and wet weather is experienced during the excavation activities, such materials may become unusable.

It is estimated that almost 74,664m^3 of surplus material will be removed from the site. This figure includes 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) 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

Almost 30,261m^3 of engineering fill and crushed stone will be imported onto the site. This figure include an allowance for bulking up of material. The material will be transported by road.

Of the 30,261m^3 of imported engineering fill and crushed stone required for the construction works, approximately 1,100m^3 of shingle will be required for the coastal protection works and approximately 4,796m^3 will be required for the road upgrade.

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.

Potential impacts also include the risk that soils could become polluted by accidental spillage of substances including fuels, oil, paints, grout and liquid wastes as a result of the construction activities.

13.5.1.2 Operation Phase

The potential impacts on soils and geology during the operational phase will be limited to accidental spillage of potentially polluting substances including fuel, oils, paints, incoming wastes, raw materials such as lime, hydrochloric acid, caustic soda or ammonia/urea, activated carbon or clay and residues.

13.5.2 Hydrogeology

13.5.2.1 Construction Phase

There is the potential for groundwater to become polluted by accidental spillages during construction e.g. of fuel or hydrocarbon leaks from construction vehicles.

The re-grading of the site has the potential to impact on hydrogeology. Alteration of the topography could result in localised alteration of the groundwater table and ground water flow in the immediate vicinity of the re-graded parts of the site.

13.5.2.2 Operation Phase

There will be no direct discharges to groundwater during the operational phase of the proposed development. Due to the creation of roads, yards, hardstanding areas and buildings, infiltration of surface water will be reduced.

The potential impacts on hydrogeology during the operational phase will be limited to accidental spillage of potentially polluting substances including fuel, oils, paints, incoming wastes, raw materials such as lime, hydrochloric acid, caustic soda or ammonia/urea, activated carbon or clay and residues.

13.5.3 Hydrology

13.5.3.1 Construction Phase

Surface water could potentially become polluted by spillages such as hydrocarbon leaks from construction machinery or by siltation as a result of runoff, during construction.

13.5.3.2 Operation Phase

There will be no discharges of process effluent from the site to surface water.

Potential sources of pollution during the operational phase of the facility would be the accidental spillage or leakage of process materials or wastes, particularly during unloading or loading operations, which could then enter the surface water drainage system.

A fire on site during operations could cause water use for fire-fighting to become contaminated, with the potential for this contaminated water to be discharged to the surface water system.

Other potential sources of pollution that may have an effect on surface water during the operational phase could be oil/fuel leaks from parked cars, trucks and service vehicles.

During operation, all sanitary wastewater will be collected and treated in a standalone wastewater treatment plant that will treat the wastewater to a 20:30 standard, i.e. 20mg/l BOD and 30mg/L SS. The treated domestic process effluent will then be pumped to the Irish Water foul sewer which is located east of Ringaskiddy village. When the Shanbally plant commences operations, the site wastewater treatment plant will be removed, and the untreated sanitary wastewater will be pumped directly to the same Irish Water sewer east of Ringaskiddy village, from which sewage will be pumped to the Lower Harbour wastewater treatment plant.

13.5.4 Potential Impacts on Coastal Erosion

13.5.4.1 Construction Phase

As discussed above, the works associated with the placing of sacrificial beach material, acting as beach nourishment, will consist of the deposition of shingle at the base of the glacial till slope, above the foreshore on Gobby Beach. The shingle will be confined to the beach adjacent to the site within Indaver ownership. It will be necessary for tracked machines to access the beach, above the high tide line to spread the shingle.

Access to the recreational amenity of Gobby Beach shoreline and nearby car park will be a temporarily impacted (for approximately 3 weeks) during the placement of sacrificial beach material. The sacrificial material consists of imported shingle which will be temporarily deposited on the car park. To ensure the safety of the general public, it is envisaged that the area of the beach, in which the construction works will taking 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. However, access to other sections of the beach will be maintained for the duration of the works.

The construction of the proposed development is not expected to have any negative impact on the rate of coastal retreat. It is noted that the construction impacts experienced during the placement of the shingle will be repeated when the shingle is reapplied in the future. See Section 13.5.4.2 below.

13.5.4.2 Operation Phase

As detailed in Section 13.4.4 above, without the mitigation, there will be no impact on the proposed development from coastal erosion after 30 years. The study found that there could be a risk of an impact from coastal erosion (without mitigation) on a small section of the proposed development after 40 years however 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 (without mitigation) will not be impacted by coastal erosion after 40-years.

The study also found that the proposed development will not increase the current rate of erosion of the glacial till face.

As discussed previously, it is proposed that the additional sacrificial material is placed during the construction period of the Indaver site. Thereafter, it is proposed that the placement of further additional sacrificial material is carried out if the erosion rate is more than 0.5m per year measured over a period of six years, which would indicate some acceleration in the current erosion rate, or when the glacial till slope has retreated by approximately 3m, whichever is sooner. For this reason the coastal boundary of the Indaver site will be monitored for erosion on an annual basis.

The proposed placing of sacrificial material on the beach will have a beneficial impact on the glacial till line at site and the adjoining areas of the beach and coastline. The Cork Harbour Special Protection Area (SPA) is located to the south west of the site and therefore the sacrificial material will not impact on the SPA.

The operation of the proposed development is not expected to have any negative impact on the rate of coastal retreat.

It is expected that the sacrificial material placed will remain within the coastal sediment cell, which is delimited by the rock headlands to the north and south of the glacial till slope at the site, since these offer a partial barrier to sediment movement.

The extent to which the deposited shingle remains in place will depend on the severity and frequency of storm events which occur at the site. The south and south east wind directions will created the greatest wave action at the beach. Consequently, the likely direction for any movement of the sacrificial beach material due to extreme storm events is from south to north. Any movement of the sacrificial material would have the effect of protecting the shoreline north of the site.

The proposed size of the shingle has been chosen to ensure that it can remain in place within the beach. Potential seasonal movements of the material are expected. However, this effect will be positive for the beach, since the material will offer an additional protection for the emerged beach in storm conditions.

It is noted that the construction impacts experienced during the placement of the shingle will be repeated when the shingle is reapplied in the future.

Based on an assessment of existing topographic and site investigation information, as detailed in Section 5 of Appendix 13.3, it can be concluded that the sacrificial material will reduce the existing erosion rate. Refer to planning drawing No 238129-C-000-060 which shows the estimated retreat lines and the proposed development with and without mitigation.

The results show that with the application of the sacrificial material, there will continue to be no coastal erosion impact on the entire proposed development after 30 years. With the application of the sacrificial material, the diverted gas pipeline will not be impacted after 40 years. However, there is still low a risk of an

impact on a very small section of the amenity walkway and viewing platform after 40 years.

The waste-to-energy section of the proposed development will not be impacted by coastal erosion for the entire duration of the planning permission.

13.6 Landslide Risk and Slope Stability

The proposed placement of sacrificial beach nourishment material will mitigate the potential landslide hazard, which is primarily confined to the shore line at the site.

Works on the eastern part of the site will alter the site gradients and earth/rock retaining structures will be constructed as required to ensure the continued stability of this part of the site.

13.7 'Do Nothing' Impacts

In the scenario where the proposed Indaver facility and road upgrade were not to be developed, there would be no resulting impacts on the soils, geology or hydrogeology of the area. The impact would therefore be neutral.

If the proposed development did not go ahead, there would be no impact on hydrology. The L2545 road would continue to flood following heavy rainfall because the road drainage is inadequate. Excess surface water from the road would be diverted to the western field. There is a risk that a 1 in 200 year tidal flood event, combined with sea level rise as a result of climate change, would cause flooding to a small area of the site adjacent to the road.

In the scenario where the proposed sacrificial beach material was not to be undertaken, coastal recession would continue as it is at present.

13.8 Mitigation Measures

13.8.1 General

Excavated material will be reused onsite where feasible. Material not suitable for reuse will be transported off site for disposal or recovery at appropriately licensed or permitted sites.

Material derived from excavations that could be re-used as engineering fill will be assessed for its suitability for such use, and will be subject to appropriate control and testing in accordance with the NRA Specifications for Road Works. Excavated soil materials will be stockpiled appropriately to minimise the effects of weathering. Care will be undertaken in re-working this material to minimise dust generation, groundwater infiltration, and generation of run-off.

Earthworks operations will be carried out such that surfaces shall be designed with adequate falls, profiling and drainage to promote safe run-off and prevent ponding and flooding. Run-off will be controlled through erosion and sediments control structures appropriate to minimise the silt in the run-off. Care will be taken to ensure that the bank surfaces are stable to minimise erosion.

Groundwater pollution will be minimised by the implementation of good construction practices. Refer to **Chapter 5 *Construction Activities***, Section 5.8.5., of this EIS.

13.8.2 Soils and Geology Mitigation Measures

13.8.2.1 Construction Phase

Mitigation measures to prevent impacts on soils and geology during the construction phase are described in Section 5.11 in Chapter 5 *Construction Activities* of this EIS.

13.8.2.2 Operation Phase

All substances that would have the potential to cause a negative impact on the soils and geology will be stored in appropriate containers and, if required, placed within bunded areas in the proposed development. All storage tanks for chemicals will be fully bunded or double skinned. Raw materials for the process will be stored in containers or silos within the process building. Residues will be stored in the bottom ash hall and silos within the process building.

All waste entering the facility will be stored in fully contained structures. All waste storage facilities will be rendered impervious to the materials stored therein. All concrete underground storage structures whether for waste or liquid (as there is a possibility that firewater run-off may enter any of the tanks) will be constructed as watertight structures in accordance with the requirements of relevant Codes of practice such as EN 1992-3:2006 Eurocode 2 – Design of Concrete Structures – Part 3: Liquid retaining and containment structures.

Typically these structures will be reinforced concrete with minimum wall and base thicknesses of 250 mm or greater depending on the structural requirements. The construction of these tanks will comply with the requirements of the Eurocode. The structures will be integrity tested to confirm that they are watertight. This will be demonstrated to the satisfaction of the EPA following installation and prior to use for storage.

Similarly, the storm water attenuation tank (which could also contain fire-water run-off) will be a watertight unit, which will be tested and demonstrated to be watertight to the satisfaction of the EPA.

The waste bunker will be constructed in accordance with the requirements of relevant Codes of practice such as EN 1992-3:2006 Eurocode 2 – Design of Concrete Structures – Part 3: Liquid retaining and containment structures. This will prevent any potential leakage of leachate from the waste to soil or groundwater.

All underground process piping or process drains, which will contain liquids which could cause contamination, will be double contained and regularly maintained and inspected for integrity.

Rainwater run-off from fire-fighting in external areas, which could be contaminated, will drain to the surface water drainage system and will be collected in the storm water holding tank. Run-off from fire-fighting in the bunker

area will be collected in the bunker. Run-off from fire-fighting in other parts of the waste-to-energy building will be collected by the floor drains and held in the recovered water tank. Refer to Section 4.5.9 of **Chapter 4** ***Description of the Proposed Development*** of this EIS, for a description of the firewater containment systems.

Roads, hard standings and yard areas will be paved to prevent any contamination of groundwater or soil. Storm water run-off from these areas will drain via hydrocarbon interceptors and will be collected in the storm water holding tank where it will be sampled to ensure that contaminated surface water will not be discharged from the site**.** Refer to Section 4.16.3 of **Chapter 4** ***Description of the Proposed Development*** of this EIS for a description of drainage systems.

Tanker loading and unloading operations in the waste-to-energy facility will be undertaking in a dedicated tanker loading/unloading bay which will have a local collection system and holding tank to contain any spillage. Refer to Section 4.16.3 for a description of the measures which will be in place to control any spillage from tanker unloading operations.

13.8.3 Landslide Risk Mitigation Measures

The proposed placement of sacrificial beach nourishment material will mitigate the potential landslide hazard, which is primarily confined to the shore line at the site.

Earth/rock retaining structures will be constructed in the eastern part of the site as required to ensure the continued stability of this part of the site.

13.8.4 Hydrogeology Mitigation Measures

13.8.4.1 Construction Phase

Mitigation measures to prevent impact on groundwater during the construction phase are described in Section 5.13.4 in Chapter 5, *Construction Activities*, of this EIS. The measures described above, to prevent a negative impact on soils and geology during the construction stage will also prevent a negative impact on hydrogeology.

It is expected that the EPA will impose a condition, in the industrial emissions licence, requiring the monitoring of soil on site at regular intervals.

13.8.4.2 Operational Phase

Roads, hard standings and yard areas in the eastern part of the site will be paved. Surface water run-off from such areas and from the roofs of the buildings will be collected in the surface water drainage system. This will reduce the infiltration of surface water into the groundwater, in the eastern part of the site, and have a minor impact on the groundwater flow regime under this part of the site. The levels of the western field will be raised but the area will not be paved. This will allow the infiltration of surface water into the groundwater. There will be negligible impact on the groundwater flow regime under the western part of the site. Raising the road levels will have a negligible impact on the groundwater flow

regime under the road. Similarly, the placing of sacrificial beach material will have a negligible impact on the groundwater flow regime of the beach.

The measures described above, to prevent contamination of soils which would have a negative impact on soils and geology during operations, will also prevent contamination of groundwater and a negative impact on hydrogeology during operations.

A network of groundwater monitoring wells will be installed on the eastern part of the site. Regular monitoring of groundwater will be a requirement of the industrial emissions licence. The monitoring will detect any changes in groundwater quality during the operational phase of the facility.

13.8.5 Hydrology mitigation measures

13.8.5.1 Construction Phase

There are no existing 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. In general, storm water will be infiltrated to ground via managed soakaways. The laydown areas will be suitably drained and any areas which will involve the storage of fuel and refuelling will have paved areas with bunding and hydrocarbon interceptors to ensure that no spillages will get into the surface water or groundwater systems. Refer also to mitigation measures described in Section 5.13.4 *Soil, Surface Water and Groundwater* of Chapter 5 *Construction Activities* of this EIS.

The proposed placement of sacrificial material on the beach will be undertaken above the foreshore on Gobby Beach. Clean material will be used and there is not expected to be a significant impact on water quality. Refuelling of equipment will not be allowed on the beach.

13.8.5.2 Operation Phase

During operation, as described above, surface water will be contained within the site. The surface water discharge will be monitored prior to discharge and if an out of specification reading is detected the pumps will be shut off and all contaminated runoff will be contained within the retention tank system i.e. both surface water tanks..

In the event of a fire on site, the water used for fire-fighting will be retained.

As discussed above, 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. Refer to **Appendix 13.4** (***Flood Risk Assessment***) for further details. This measure will ensure that the risk of flooding to the site is very remote. The finished floor level of the buildings on the site will be set at even more conservative levels, all above 5mOD.

It is proposed to upgrade the L2545 to address the risk of flooding of the road. The upgrade works will include raising a 185m section of the road to a maximum height of 3.45m OD between the car park adjacent to Gobby Beach and the

eastern end of the Hammond Lane Metal Company site. 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 and ensure that access and egress routes are maintained during extreme flood events.

A new dedicated surface water drainage system will also be installed as part of the upgrade works to collect, convey and attenuate the runoff from the road before connecting back into the existing drainage to discharge to the foreshore.

These measures are sufficient to ensure that the risk of flooding of the site and the L2545 is extremely low.

With the mitigation measures in place, there will be no impact on surface water as a result of the operation of the proposed development.

13.8.6 Coastal Recession mitigation measures

13.8.6.1 Construction Phase

Access to the recreational amenity of Gobby Beach shoreline and nearby car park will be a temporarily impacted (for approximately 3 weeks) during the placement of sacrificial beach material. The sacrificial material consists of imported shingle which will be temporarily deposited on the car park. To ensure the safety of the general public, it is envisaged that the area of the beach, in which the construction works will taking 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. However, access to other sections of the beach will be maintained for the duration of the works.

It is noted that the construction impacts experienced during the placement of the shingle will be repeated when the shingle is reapplied in the future. The same mitigation measures as described above will be applied for repeat applications.

13.8.6.2 Operational Phase

Refer to Section 13.5.4.2 above. No other mitigation measures are proposed.

13.9 Cumulative Impacts

The potential for cumulative impacts as a result of the construction and operation of the proposed development and the following projects has been evaluated:

Proposed Projects

- M28 Cork to Ringaskiddy Motorway Scheme
- Haulbowline East Tip and steelworks remediation projects and Spike Island Master Plan
- Port of Cork expansion
- Possible district heating system from Indaver to local users
- Municipal Sewage Treatment Plan at Shanbally

- Novartis Wind Turbine

Existing Projects

- Wind turbines at DePuy, GSK and Janssen
- Hammond Lane extension
- Irish National Maritime College
- Beaufort Laboratory

It is expected that the construction phases of the new M28, the Haulbowline remediation works and Spike Island Master plan, the Port of Cork Expansion, the Cork Lower Harbour Main Drainage Scheme, the Novartis turbine and the possible district heating system, from Indaver to local users, would each have potential impacts on soils, geology and hydrogeology, which will be similar to the potential impact of the construction phase of the Ringaskiddy Resource Recovery Centre. However, due to the distances involved and/or the likely timing of these projects, is not expected that these projects and the Ringaskiddy resource recovery centre will have a significant cumulative impact on soils, geology and hydrogeology.

Construction of the Hammond Lane extension has been completed. No cumulative construction impacts on soils, geology, hydrogeology or hydrology are likely with the Hammond Lane extension. During operation of the Hammond Lane and Indaver facilities, is considered that there will be no significant negative cumulative impacts on soils, geology, hydrogeology or hydrology. The operations of both facilities will be subject to strict licence conditions, which will be audited by the EPA. The EPA is precluded from issuing a licence to a facility which would cause significant environmental pollution. Consequently, it is unlikely that the operations of the two facilities would result in significant cumulative impacts on soils, geology, hydrology and hydrogeology.

Connection to the national grid within the ESB networks Lough Beg substation is described in Section 4.5.10 of Chapter 4. It is envisaged that the works within the substation lands will be carried out at the same time as the Indaver development. Given the minor nature of the works required, the potential impacts on soils, geology, hydrogeology and hydrology are considered to be negligible.

13.10 Residual Impacts

It is expected that, with the implementation of the mitigation measures described above, the construction and operation of the proposed development will not result in significant negative impacts on soils, geology, hydrology or hydrogeology and coastal recession. There will be a positive impact on the L2545 due to the improvement in drainage.

The placing of the sacrificial material, acting as beach nourishment on Gobby Beach above the foreshore, will reduce the rate of recession of the glacial till slope along the eastern site boundary. It is noted that the construction impacts experienced during the placement of the shingle will be repeated when the shingle is reapplied in the future.

With the application of the sacrificial material, there will continue to be no impact from coastal erosion on the entire proposed development after 30 years. With the

application of the sacrificial material, the diverted gas pipeline will not be impacted after 40 years. However, there is still low a risk of an impact on small section of the amenity walkway and viewing platform after 40 years.

The waste-to-energy section of the proposed development will not be impacted by coastal erosion for the entire duration of the planning permission.

The coastal protection measures will have no negative impacts on the adjoining areas. However, there will be benefits associated with the works as well as the provision of an environmentally friendly solution. The net coastal sediment transport goes 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.

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