14 Land and Soils

14.1 Introduction

This chapter of the Environmental Impact Assessment Report (EIAR) considers and assesses the likely significant effects with regards to soils, geology and hydrogeology associated with both the construction phase and operational phase of the proposed development. Measures to mitigate any likely significant adverse impacts of the proposed development on the soil, geology and hydrogeology in the vicinity of the proposed development are proposed within this chapter.

An assessment is made of the likely significant effects associated with the construction and operation of the proposed development on these resources. Measures are presented to mitigate or eliminate the effects of the soils, subsoils, bedrock, geological resources and heritage and hydrogeology.

Chapter 4 ***Description of the Proposed Development*** provides a full description of the proposed development.

Note: **Figures 14.1** to **14.9** of this chapter are presented in **Appendix 14.1** of **Volume 3** of this EIAR.

14.2 Assessment Methodology

14.2.1 General

The following section outlines the legislation and guidelines considered, and the adopted methodology for preparing this chapter and undertaking the soils, geology and hydrogeology assessment.

The potential effects of the proposed development on soils, geology and hydrogeology has been assessed by classifying the importance of the relevant attributes and quantifying the likely magnitude of any effect on these attributes.

14.2.2 Guidelines and Legislation

This chapter has been prepared using the following guidelines:

- European Communities Environmental Objectives (Groundwater) Regulations 2010 (S.I. No. 9 of 2010), as amended by the European Communities Environmental Objectives (Groundwater) (Amendment) Regulations 2011 (S.I. No. 389 of 2011), the European Communities Environmental Objectives (Groundwater) (Amendment) Regulations 2012 (S.I. No. 149 of 2012) and the European Union Environmental Objectives (Groundwater) (Amendment) Regulations 2016 (S.I. No. 366 of 2016)
- European Communities Environmental Objectives (Surface Waters) Regulations 2009 (S.I. No. 272 of 2009), as amended by the European Communities Environmental Objectives (Surface Waters) (Amendment)

Regulations 2012 (S.I. No. 327 of 2012), as amended by the European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2015 (SI No. 386 of 2015) and the European Union Environmental Objectives (Surface Water) (Amendment) Regulation 2019 (S.I. No. 77 of 2019)

- European Communities (Water Policy) Regulations 2003 (S.I. No. 722 of 2003) as amended by the European Communities (Water Policy) (Amendment) Regulations, 2005 (S.I. No. 413 of 2005) and by the European Communities (Water Policy) (Amendment) Regulations, 2008 (S.I. No. 219 of 2008), as amended by the European Communities (Water Policy) (Amendment) Regulations, 2010 (S.I. No. 93 of 2010)
- European Union (Water Policy) Regulations 2014 (S.I. No. 350 of 2014)
- European Communities (Drinking Water) Regulations 2014 (S.I. No 122 of 2014), as amended by the European Union (Drinking Water) (Amendment) Regulations 2017 (S.I. No. 464 of 2017)
- European Communities (Quality of Salmonid Waters) Regulations 1988 (S.I. No. 293 of 1988)
- Institute of Geologists of Ireland (IGI, 2013). Guidelines for the Preparation of Soil, Geology and Hydrogeology Chapters of Environmental Impact Statements
- The EU Water Framework Directive (WFD), 2000/60/EC
- The Groundwater Directive, 2006/118/EC
- Water Services Acts (2007 – 2017)

14.2.3 Impact Assessment Methodology

The likely significant effects have been assessed by classifying the importance of the relevant attributes and quantifying the magnitude of any likely significant effects on these attributes. This has been undertaken in accordance with the IGI guidance (2013) which outlines a 13-step methodology that is divided across four distinct elements:

- Initial Assessment;
- Direct and Indirect Site Investigation;
- Mitigation Measures, Residual Impacts and Final Impact Assessment; and
- Completion of the Soils, Geological and Hydrogeological Sections of the EIAR.

Initial Assessment

The ‘Initial Assessment’ presents a description of the past and present uses of the land across the study area which may have a bearing on the proposed development. This includes a detailed description of the nature of the ground conditions beneath the site based on existing literature as well as site specific and neighbouring site investigation data.

Direct and Indirect Site Investigation

Section 14.2.6 provides information on the data available from the site-specific investigations carried within study area. **Section 14.3.2** describes ground conditions in the regional context. The information gathered on the baseline environment during ground investigations corresponds to the second element of the methodology, 'Direct and Indirect Site Investigation and Studies'.

Mitigation Measures, Residual Impacts and Final Impact Assessment

The outcome from examining this available data is a Conceptual Site Model (CSM). The CSM is a summary of geological and hydrogeological conditions beneath the proposed development that considers the likely significant effects of the proposed development.

Section 14.6 describes the likely significant effects associated with the proposed development based on the CSM in accordance with the guidance. Following the assessment, specific mitigation (**Section 14.8**) and monitoring measures (**Section 14.9**) have been developed to avoid, reduce and, if possible, remedy any predicted negative effects on the land and soils. Residual significant effects are described in **Section 14.10**. The magnitude and significance of these residual effects have also been classified based on the IGI Guidelines.

14.2.4 Study Area

The soils, geology and hydrogeology study area for the proposed development is shown on **Figure 14.1.** The study area is defined in this chapter as 2km from the existing Indaver site boundary.

14.2.5 Categorisation of Baseline Environment

In order to identify and quantify the potential impact of the construction phase and operational phase of the proposed development, it is necessary to undertake a detailed study of the (baseline) geological and hydrogeological environment of the study area. The existing soils, geology and hydrogeology conditions in the area have been interpreted from desk study information, previous studies and site investigations.

A site walkover was carried out on the 11th of October 2019.

14.2.6 Desk Study Information

A desk study was undertaken to establish the baseline conditions (i.e. soils, geological and hydrogeological environment) within the study area. The following sources of information have been used:

Site specific study:

- A soil and groundwater quality study completed by AWN Consulting Ltd in 2014, as part of Indaver Ireland Industrial Emissions (IE) licence W0167-03[1];
- Historic site investigation:
  - Site investigation (2000)[2]
  - Geotechnical investigation (2007)[3]
  - Geophysical and geotechnical field works[4];
- EIA Report for Development for Further Replacement of Fossil Fuels with Alternative Fuels and Alternative Raw Materials, prepared for Irish Cement Limited (ICL) by Brady Shipman Martin (2017)[5].

Public sources of information:

- Environmental Protection Agency (EPA) maps including[6]:
  - Registered protected areas
  - Water Features, Rivers and Streams
  - Historic Mine Sites - Inventory and Risk Classification
  - Ground Waterbodies Risk (WFD)
  - EPA Hydronet;
- Historic groundwater data - Annual Environmental Reports[7] for Indaver IE Licence W0167-03;
- Google Maps (2019) Aerial photography[8];
- Geological maps of the study area produced by Geological Survey Ireland (GSI) including[9]:
  - Groundwater Wells and Springs
  - Geological Heritage Areas
  - Groundwater Vulnerability
  - Groundwater Recharge
  - Groundwater Resources (Aquifers)

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[1] AWN Consulting Limited (2014), Indaver IRL Ltd – Soil and Groundwater Baseline Report (IED). Available from EPA IE Licence database, Indaver Reg. No. W0167-03: http://www.epa.ie/licences/lic_eDMS/090151b280502a7f.pdf

[2] Alpha Engineering Services, Consulting Engineers, Land Surveyors (2000), Geotechnical Report for Green Field Site at Platin, Co. Meath for Project Management

[3] Byrne Looby (2007), Indaver, Carranstown Geotechnical Assessment Report (B580)

[4] IGSL Ltd (2009), Meath Waste Management Facility Carranstown, Co. Meath, Geotechnical Interpretative Report (Report No. 14039)

[5] Available from EPA IE Licence database, Irish Cement Reg. No. P0030-05: https://www.epa.ie/licensing/

[6] Available at: https://gis.epa.ie/EPAMaps/ [Accessed 2October 2019]

[7] Available from EPA IE Licence database, Indaver Reg. No. W0167-03: https://www.epa.ie/licensing/

[8] Available at: https://www.google.com/maps/ [Accessed 1 October 2019]

[9] Available at: https://dcenr.maps.arcgis.com/apps/MapSeries/index.html?appid=a30af518e87a4c0ab2fbde2aaac3c228 [Accessed 1 October 2019]

- Teagasc Soils
- Quaternary Sediments
- Bedrock Geology 100k
- Karst Features
- Physiographic Units
- Historic Mine Sites - Inventory and Risk Classification
- Bettystown GWB: Summary of Initial Characterisation (GSI);

- National Parks and Wildlife Service (NPWS)[10] – Designated ecological sites;
- National Monuments Service[11];
- Water Framework Directive[12].

14.2.7 Technical Limitation

The baseline data described and considered in this assessment includes existing data from available desk study and site walkover information. The data collected provides comprehensive information on soils, geology and hydrogeology within the study area.

The baseline data provides valuable information on the existing soils, geology and hydrogeological environment at point locations within the study area. Between each point the baseline data has been assessed by conservative interpretation.

This review was completed by studying local geological maps, aerial photography and completing a site walkover to provide an understanding of the study area.

Based on the comparability of the results from the investigations commissioned specifically for the proposed development and the desk study of existing information on the baseline conditions, the information on the baseline conditions (as described in **Section 14.3**) is deemed sufficient.

14.3 The Existing Receiving Environment (Baseline)

14.3.1 Introduction

This section describes the existing soils, geology and hydrogeology within the study area. A regional overview is provided in terms of topography, soils, subsoils, solid geology and hydrogeology of the local area. This is followed by sub-sections identifying the feature importance ranking of the agricultural soils, superficial deposits, bedrock geology, soft and unstable ground, contaminated land, karst solution features, mineral and aggregate resource, hydrogeological features and geological heritage sites in accordance with the IGI guidelines.

Chapter 4 ***Description of Proposed Development*** of the EIAR outlines the proposed development.

[10] Available at: http://webgis.npws.ie/npwsviewer/ [Accessed 1 October 2019]
[11] Available at: http://webgis.archaeology.ie/historicenvironment/, [Accessed 1 October 2019]
[12] Available at: https://wfd.edenireland.ie/

The receiving soils, subsoils, geology and hydrogeology environment is presented on **Figures 14.1-14.7** in **Volume 3** of this EIAR.

14.3.2 Regional Overview

The proposed development is located at the existing waste to energy plant at Carranstown, Duleek, County Meath. The existing waste to energy plant is located beside the R152 approximately 4.5km south-west of Drogheda and 2.7km north-east of the village of Duleek. The M1 motorway runs north-south approximately 2km of the site (**Figure 14.1**).

The general land use of the area is agricultural, however there are significant areas of industrial and extractive uses (Platin Cement Works) immediately to the north of the site. There are scattered residential houses located primarily along the existing road network.

14.3.2.1 Regional Geomorphology and Topography

The region is mainly a low-lying terrain with river channels incised into wide tracks of sand and gravel terraces. Elevated areas comprise relatively high, streamlined ridges of bedrock.

The site is located at the edge of the Nanny River Valley and in proximity to major excavation activities associated with Platin quarry located 200m to the north. Ground elevations of the study area vary from 34m to 44mOD (Ordnance Datum) in the south to 30m to 37mOD in the north of the study area. The physiography is classified by GSI as rolling ice-moulded topography with megascale lineations.

14.3.2.2 Regional Soils and Subsoils

The Teagasc soil mapping identifies the soils underlying the study area as deep well drained mineral soils derived from mainly non-calcareous parent material with pockets of mineral poorly drained soils and alluvium mapped along the north-west boundary of study area.

The quaternary mapping of the region based on the GSI indicate the study area is dominated by till derived from Namurian sandstones and shales as presented on **Figure 14.2**.

14.3.2.3 Regional Bedrock Geology

The GSI 1:100,000 bedrock map indicates the study area is underlain by Carboniferous limestones of the Platin formation as presented on **Figure 14.3**. The limestone is described as pale grey, thickly bedded, fine to coarse-grained. It is comprised of crinoidal and peloidal grainstone, locally conglomeratic.

There is no evidence of geological faults in the immediate vicinity of the study area. The closest series of faults are mapped approximately 1km north-west of the study area.

14.3.2.4 Regional Hydrogeology

The GSI Bedrock Aquifer map indicates the Platin Formation is classified as a Regionally Important karstified aquifer dominated by diffuse flow (Rk_d) as presented on **Figure 14.4**.

Under the Water Framework Directive (WFD), the GSI have delineated a number of groundwater bodies (GWB) in Ireland. The Bettystown GWB (IE_EA_G_016) underlies the study area and the Quantitative Status of the GWB is poor (WFD Status 2010-2015) due to the over abstraction and falling groundwater level. The GWB is also at risk of deteriorating or being at less than good status due to phosphate contributing to the surface water[12].

The GSI groundwater vulnerability mapping shows the vulnerability of the region is highly variable and ranges from low (L) in the east to extreme (X, E) to the north of the study area. The groundwater vulnerability within the study area is mapped as moderate (M) as presented on **Figure 14.5**.

14.3.2.5 Groundwater Resources

Groundwater resources describe any large spring, well or boreholes which are used as a groundwater abstraction source by domestic, agricultural, commercial, industrial, local authority or group water scheme users. Several boreholes used for supply have been identified in the area including two public water supply (PWS) wells (PWK1 and PWK2) in Kiltrough and two production wells located within the Indaver site. The GSI wells located in the vicinity of the study area are listed in **Table 14.2**.

Kiltrough (PWS) wells are approximately 1.5km north-east of the study area. Both wells are pumping constantly and combine daily abstraction rate is on average 2,600m^3/d.

Two production wells installed within the existing Indaver site in June 2011 have a sustainable yield of 600m^3/d and currently supply the water demand for the Indaver site. Current abstraction rate is approximately 216m^3/d, refer to **Section 4.7.1**. There are three monitoring boreholes within the Indaver site; one up-gradient (AGW1-1) and two down-gradient (AGW1-2 and AGW1-3) in relation to the site activities. The locations of both the monitoring boreholes and production wells are presented on **Figure 14.6.**

Groundwater Source Protection Zone (SPZ) reports have been produced by the GSI and the EPA. The reports aim to guide development planning and regulation to provide protection to groundwater sources. The closest SPZ report has been produced for Kiltrough PWS and does not overlap with the site.

The GSI wells and SPZ located within the study area are presented on **Figure 14.6** as well as the site groundwater boreholes (AGW1-1, AGW1-2 and AGW1-3).

A significant dewatering operation is carried out at the nearby Platin Quarry. The quarry is abstracting from the aquifer on average 17,500m^3/d to maintain dry working conditions at the quarry floor.

The hydrograph for Kiltrough EPA Monitoring borehole[6] shows a downward trend of groundwater level in the aquifer. The annual groundwater level variation in 2009 was 1.9m and in 2018 was 6.7m.

Table 14.1 GSI wells list located within 2km of the study area (Indaver site).

GSI Name	Well Type	Depth of hole (m)	Depth to bedrock (m)	Yield (m^3/d)	GSI Yield Class	Source Use
2927SEW035	Borehole	n/a	n/a	n/a	n/a	n/a
2927SEW036	Borehole	42.7	9.1	54.5	Moderate	Public Supply
2927SEW037	Borehole	61.0	0	n/a	n/a	Industrial use
2927SEW038	Borehole	47.2	15.2	872.7	Excellent	Industrial use
2927SEW039	Borehole	34.1	11.3	164	Good	Industrial use
2927SEW047[13]	Borehole	61	0	3600	Excellent	Industrial use
2927SEW048[2]	Borehole	30	n/a	3600	Excellent	Industrial use
2927SEW001	Dug well	6.7	n/a	n/a	n/a	n/a
2927SEW003	Dug well	n/a	n/a	n/a	n/a	n/a
2827SEW111	Borehole	42.7	0	1091	Excellent	Agriculture and domestic use
2927SEW110	Borehole	76.2	0	21.8	Poor	Agriculture and domestic use
2927SEW041	Borehole	21.9	n/a	28	Poor	Agriculture and domestic use
2925NEW058	Dug well	4.6	n/a	3.3	Poor	Public supply (Co Co)
2923NWW070	Borehole	22.9	8.2	109	Good	n/a

[13] Abstraction wells at the Platin Quarry used to dewater the site.

GSI Name	Well Type	Depth of hole (m)	Depth to bedrock (m)	Yield (m^3/d)	GSI Yield Class	Source Use
2925NWW071	Borehole	48.2	7.6	101	Good	Agriculture and domestic use
2925NEW070	Borehole	18.9	n/a	49	Moderate	n/a

14.3.2.6 Karst

Karst describes landforms which form in areas where the rock is readily dissolved by water. Distinctive karstic landforms include sink holes, turloughs, springs and enclosed depressions. Often these feature form along preferential groundwater flow paths such as fractures, fissures or joints. There is potential for high yields and long flow paths where these preferential pathways are present.

The GSI Karst database was consulted and no karst features are indicated as being present within the study area. The closest karst feature is an enclosed depression in Donore located approximately 2.4km north-west as presented on **Figure 14.5**.

14.3.2.7 Designated Areas

There are no European designated ecological areas i.e. Special Areas of Conservation (SAC) or Special Protection Areas (SPA), within the study it (i.e. within 2km of the Indaver site boundary).

The closest groundwater dependant ecological area is River Boyne and River Blackwater SAC/SPA (002299) located approximately 3.2km north-west of the proposed development. However, there is no direct pathway as all the groundwater is captured by the Platin Quarry.

The closest proposed Natural Heritage Area (pNHA) is Duleek Commons (001578) approximately 2km south-west of the proposed development, as presented on **Figure 14.6**. Duleek Commons is a drained marsh surrounded by wet woodlands and grassland. This ecological area is not designated for groundwater dependant habitat.

14.3.2.8 Mineral / Aggregate Resources

Various datasets were consulted in establishing the economic geology within the study area including:

- GSI: aggregate potential mapping;
- GSI: mineral localities; and
- EPA: active mine sites.

There are active quarries within the immediate vicinity of the existing Indaver facility. These include Platin Quarry approximately 200m north of the Indaver

site, Duleek Quarry approximately 2km south-west, Annagor Quarry approximately 1.9km east, Mullaghcrone Quarry 1.3km north, as presented on **Figure 14.7.** Bellewstown Quarry is also 3.4 km south-east of the Indaver site boundary**.**

The GSI mineral localities database show no active metallic mines in the study area. There is no record of underground mining in the area therefore this assessment does not consider this feature any further.

According to the aggregate potential mapping data obtained from the GSI the area of the proposed development is described as having a high crushed rock aggregate potential and no granular aggregate potential. There is no aggregate potential for the overburden.

14.3.3 Site Specific Environment

14.3.3.1 Soils and Subsoils

According to the site-specific ground investigation[2] the quaternary deposit within the study area generally comprises low permeability boulder clay with occasional gravel lenses.

A summary of the subsoil deposits is presented in **Table 14.2**.

Table 14.2 Soils and subsoil deposits within study area.

Strata[14]	Depth to Top of Strata (mbgl)	Thickness Range (m)	Notes/Description
Topsoil	0.0	0.4	Well drained to poorly drained mineral soil.
Subsoils	0.4	1.0	Soft to firm silty CLAY with cobbles.
	0.4	4.0	Firm to hard silty CLAY with cobbles/boulders.
	0.4	5.0	Medium dense to dense sandy GRAVEL with local sand lenses.
	2.5	4.0	Hard silty BOULDER CLAY with cobbles/boulders.

14.3.3.2 Soil Quality

Soil samples collected during a previous investigation[1] were tested for a broad range of parameters. This included analysis for metals, total phenols, volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), polychorinated biphenyls (PCBs), pesticides (OPPs, OCPs, ONPs).

There have been no exceedances noted to suggest that soil contamination has occurred on site in the past.

[14] Strata indicated may not be present at all locations along the proposed development.

14.3.3.3 Bedrock

The local limestone is described as strong to very strong (where intact) and predominantly slightly weathered to fresh, though zones of moderately weathered and heavily fractured (non-intact) limestone based on the site-specific information[4]. The depth to competent limestone ranges from approximately 10m below ground level (bgl) to 15mbgl from the west to the east of the study area respectively.

14.3.3.4 Groundwater Flow and Water Level

Three monitoring boreholes installed within Indaver site indicate the groundwater flow direction is towards the north-west. Originally the groundwater flow in the area was towards the River Nanny in south-east direction. However, groundwater flow has reversed due to dewatering at Platin Quarry.

Current water levels are in excess of 30mbgl based on these monitoring boreholes Water level measured in August 2019 in AWG1-1, AGW1-2 and AGW1-3 was 35.4mbgl, 32.7mbgl and 34.6mbgl, respectively.

14.3.3.5 Groundwater Quality

Regular groundwater sampling and analysis for the Indaver site is required as part of the EPA licence (W0167-03). The analysis includes chloride, metals, ammonia, TOC and nitrates. The recent monitoring results are presented in **Appendix 14.1**.

There are three monitoring boreholes within the Indaver site; one up-gradient (AGW1-1) and two down-gradient (AGW1-2 and AGW1-3) in relation to the site activities.

Results have been compared to the threshold values from the European Communities Environmental Objectives (Groundwater) (Amendment) Regulations 2016 (S.I. No. 366 of 2016).

Total coliforms and faecal coliforms were present in majority of the samples in all monitoring boreholes.

A review was undertaken of available groundwater quality results (2011-2019). The groundwater monitoring data review shows there have been exceedances of the ammonia, nickel and lead concentrations recorded in all monitoring boreholes, refer to **Table 14.3** below. The ground water quality at the site reflects poor water quality status of the Bettystown groundwater body which is driven by high chloride values (WFD Status 2010-2015).

There appears to be an overall incline trend in the chloride concentration in both down-gradient monitoring boreholes and decline trend in the up-gradient borehole.

However, there was no chloride exceedances recorded in any of the three monitoring boreholes, refer to **Table 14.3**. Chloride trends graph is presented in **Appendix 14.2**.

Table 14.3 Exceedances recorded in monitoring boreholes.

Parameter	Threshold Value (TV)[15]	Date	AWG1-1 (up-gradient)	AWG1-2 (down-gradient)	AWG1-3 (down-gradient)
Ammonia (NH4) µg/L as N	175	01/09/2015 01/04/2018 01/10/2018 11/03/2019	27 40 **870** 20	61 60 30 130[16]	167[1616] 120[1616] 20 100
Lead (ug/l)	7.5	11/09/2015 24/05/2017 12/03/2018 10/09/2018 06/03/2019	**10.43** **13.41** **19** **26** **25**	1.251 3.42 3 6 **12**	1.57 1.91 5 **8** **19**
Nickel (ug/l)	15	10/09/2018 06/03/2019	10 **30**	**25** **52**	**17** **52**
Chloride[16] (mg/l)	187.5	10/07/2017 09/10/2017 07/01/2019 06/03/2019 02/08/2019 05/09/2019	25.7 120 38 50 52 44	121.9 29.6 76 74 126 90	49.3 3.9 139 123 98 100

14.3.4 Conceptual Site Model

A Conceptual Sit Model (CSM) was developed based on the available site investigation information as outlined in **Sections 14.3.2 and 14.3.3.**The information is presented on **Figure 14.8** and **14.9** in profile format with the profile illustrating the current geological and hydrogeological environment at the Indaver site.

The proposed development is underlain by silty sandy gravelly clay with cobbles and boulders underlain by dense sandy gravel. The overburden overlays the Carboniferous limestone. Depth to bedrock varies from 10 to 15mbgl across the site. The depth of soil excavation for proposed levelling and foundations varies from 0.6m to 2m. Current water levels are in excess of 30mbgl based on the monitoring boreholes.

The groundwater flow direction in the area is to the north-west, towards Platin Quarry located approximately 200m north of the Indaver site. Originally the groundwater flow was to the south-east, towards River Nanny however, due to dewatering at Platin Quarry it was reversed.

There are no sensitive receptors immediately adjacent to the facility. The closest SAC and SPA is River Boyne and River Blackwater located approximately 3.2km north-west of the proposed development. However, there is no direct pathway as the groundwater under the site is captured by Platin Quarry. The closest proposed Natural Heritage Area (pNHA) is Duleek Commons approximately 2km south-west of the proposed development, which is not a groundwater dependant habitat.

[15] Based on the European Union Environmental Objectives (Groundwater) (Amendment) Regulations 2016 (S.I. No. 366 of 2016), Threshold Values for Chemical Status Test 1 Column 4
[16] The highest recorded levels.

14.4 Summary of Features of Geological Importance

14.4.1 Environment

The environment of the proposed site falls under Type C category outlined in IGI Guidelines. The proposed site is categorised as a Type C environment which is described as man-made dynamic hydrogeological environment with nearby quarrying activities below the water table.

14.4.2 Feature Importance Classification

A summary of the geological and hydrogeological features of importance within the study area is presented in **Table 14.4**. The importance ranking of the feature is established based on the IGI guidance (2013).

Table 14.4 Features of importance.

Feature	Importance	Criteria / Justification
Bedrock	Very High	Aggregate Potential comprising large existing quarry: Platin Quarry is approximately 200m and Duleek Quarry approximately 2km from the study area.
Regional Important Aquifer (RK_d)	Very High	A regionally important aquifer with multiple well fields (Kiltrough WS).

14.5 Characteristics of the Proposed Development

A description of the proposed development and construction activities are provided in **Chapters 4** and **5**, respectively.

This section of the EIAR outlines the key design features and the characteristics and activities of the proposed development of relevance to soils, geology and hydrogeology. The potential impacts related to such construction activities are provided in **Section 14.6**.

Works proposed relevant to land and soils are summarised below:

- Strip topsoil and vegetation;
- Bulk excavation and general site re-grading, including placing of fill;
- Construction of earth retaining structures (i.e. berms);
- Development of:
    - a tank farm and tanker unloading area for the storage and processing of aqueous liquid wastes;
    - a $10MW_e$ hydrogen generation unit;
    - a bottom ash storage building;
    - a concrete yard and parking area for up to 10 trucks, tankers or containers on the site;

- additional car-parking spaces;
- a warehouse, workshop and ERT/office building;
- demolition and re-building of an existing modular office building;
- other miscellaneous site upgrades.

All proposed development elements are presented in drawing **29043-CD-003** in **Appendix 5.2** of **Volume 3**.

- Increase in the amount of hazardous waste accepted in the facility for treatment (in WtE facility) from 10,000 tonnes per annum (tpa) up to 25,000 tpa (to include the associated increase in the total waste accepted for treatment in WtE facility from 235,000 tpa to 250,000 tpa);
- Additional acceptance capacity for up to 30,000 tpa of boiler ash and flue gas cleaning residues for treatment in the currently permitted ash pre-treatment facility on site (bringing the site total to 280,000 tonnes per annum);
- There will be no change to the type or nature of the waste processed the waste to energy plant and the pre-treatment facility only the volume of waste.

14.5.1 Activities/Environment Matrix

Assessments are required by the Activities/Environments Matrix in the IGI guidelines relating to the proposed project conditions.

Table 14.5 outlines the required activities, considering the environment type and different activities which will be undertaken on site during construction and operation, and the works assessments and surveys which have been carried out to consider those activities.

Table 14.5 Details of works required under the IGI guidelines and how they were undertaken on the site.

Work required under Activity and Type Class (base on IGI guidelines)	Details of works completed to date
Earthworks	
Invasive site works to characterise nature, thickness, permeability and stratification of soil, subsoil and bedrock.	Specific ground investigation carried out across the site as presented in Section 14.3.3.1 (Soils and Subsoils) and 14.3.3.3 (Bedrock).
Works to determine groundwater level, flow direction and gradient.	As presented in Section 14.3.3.4 (Groundwater Flow and Water Level).
Identify location and abstraction rate of nearby groundwater abstraction.	As presented in Section 14.3.2.5 (Groundwater Resources).
Storage/transmission of leachable and/or hazardous material	
Establish nature and quantity of leachable material.	2000 SI, 2007 SI and 2014 SI – collection of soil samples. Analysis for quality (as presented in Section 14.3.3.2). There will be no change to the type or nature of the waste processed the waste to energy plant and the pre-treatment facility, only the volume of waste.
Site works to characterise nature, thickness, permeability and stratification of soils, subsoils and bedrock geology.	Specific ground investigation carried out across the site as presented in Section 14.3.3.1 (Soils and Subsoils) and 14.3.3.3 (Bedrock).
Works to determine groundwater level, flow direction and gradient.	As presented in Section 14.3.3.4 (Groundwater Flow and Water Level).

14.6 Likely Significant Effects of the Proposed Development

14.6.1 "Do Nothing" Scenario

Under the do-nothing scenario, Indaver Waste to Energy Facility will continue to:

- Accept the hazardous waste for treatment in the waste energy plant in an amount of 10,000 tpa;
- Accept total waste in an amount of 235,000 tpa; and
- There will be no additional acceptance capacity of boiler ash and flue gas cleaning residues for treatment.

If the proposed development will not be carried out, there would be no direct or indirect significant effects on soils, geology and hydrogeology.

14.6.2 Construction Phase

The potential impacts on soils, geology and hydrogeology during the construction phase are presented in this section. Construction methodologies for the various elements of the proposed development are presented in **Chapter 5** ***Construction Activities***.

The potential construction impacts of the proposed works on the geological attributes identified in the area are outlined below:

- Loss of overburden;
- Loss of solid geology;
- Effect of local dewatering;
- Potential pollution from construction activities;
- Impacts on Duleek Commons (pNHA).

Loss of overburden

Ground works associated with the construction of the proposed development will require bulk excavation works. These excavation works include the existing berm in the northeast corner of the site. This area contains material previously excavated from the site during the construction of the existing facility, which was then used for landscaping. Overall excavations where required will be from 0.6 to 2.0mbgl. These excavation works can potentially cause minor local permanent change in aquifer vulnerability due to the loss of overburden.

The IGI guidance matrix table has been used to establish overall 'likely significant effect' on groundwater. This matrix combines the 'importance of attribute' (in this case 'very high' see **Table 14.4**) with the 'magnitude of impact' classification (for groundwater vulnerability in this area 'small adverse') to provide the overall rating. The overall rating of a 'likely significant environmental impact' on the aquifer vulnerability is 'significant/moderate'.

Loss of Solid Geology (Bedrock)

Excavation of bedrock is not expected to be required as the base of excavation (varies from 0.6 to 2mbgl) is above the depth to bedrock (10-15mbgl). As such, the 'magnitude of impact' on the bedrock is determined to be 'negligible'.

Using the IGI guidance matrix, the 'magnitude of impact' is combined with the 'importance of attribute' (the importance of bedrock in this area is defined as 'very high' see **Table 14.4**) provides a 'likely significant environmental impact' which is 'imperceptible' for bedrock.

Effect of local dewatering

There is no requirement for dewatering on-site during the construction of the proposed development. The effects of dewatering at the Irish Cement site in Platin is discussed in **Section 14.3.4**.

Potential pollution from construction activities

There is a potential risk of localised contamination of the groundwater due to accidental spillages and leaks during construction which could result in a 'permanent negative' effect on the groundwater. There are numerous substances likely to be used during the construction phase that have the potential to contaminate groundwater including fuel and hydrocarbons, lubricants and cement. The washing of construction vehicles also poses a risk due to potential release of contaminated runoff into groundwater.

The groundwater table is approximately 30mbgl and the depth to bedrock is between 10 to 15mbgl. The natural protection from the thick subsoil deposits underlying the site will limit the potential for contamination to infiltrate into the underlying aquifer.

The 'magnitude of impact' on the groundwater is determined to be 'small adverse'. Using the IGI guidance matrix, the 'magnitude of impact' is combined with the 'importance of attribute' (the importance of aquifer in this area is defined as 'very high' see **Table 14.4**) provides a 'likely significant environmental impact' which is 'significant/moderate' for aquifer.

Summary of Construction Impacts

The following **Table 14.6** summarises the predicted impacts during the construction stage of the works.

Table 14.6 Summary of Impacts on Geological and Hydrogeological Attributes at the proposed site.

Feature	Importance		Pressure	Magnitude of Impact		Significance of Impact
	Ranking	Justification		Ranking	Justification	
Bedrock	Very High	Aggregate Potential comprising large existing quarry: Platin Quarry is approximately 200m and Duleek Quarry approximately 2km from the study area.	Bulk excavation works of the topsoil, overburden and previously stored excavated material.	Negligible	Excavation of bedrock is not expected to be required.	Imperceptible
Regional Important Aquifer (RK_d)	Very High	A regionally important aquifer with multiple well fields (Kiltrough WS)	Bulk excavation works of the topsoil, overburden and existing berms.	Small Adverse	Thickness of the subsoil deposit overlying bedrock will be reduced. This can cause minor local permanent change in aquifer vulnerability.	Significant/Moderate
			Accidental localised contamination due to construction activities i.e. spillages or leaks.	Small Adverse	There is a potential risk of localised contamination of the groundwater due to construction activities. However, this would only be accidental cases.	Significant/Moderate

14.6.3 Operational Phase

The proposed development will be operating in accordance with the current Indaver EPA licence (W0167-03) requirements. There are currently, and will not in the future, be any discharges to ground other than approved percolation from the existing wastewater treatment system on site, which treats all effluent generated from toilets, showers and utility areas. Therefore, a potential impact on land, soil and groundwater quality in the operational phase of the proposed development is unchanged from the existing risk of accidental spillage of potentially polluting substances (raw materials or waste) handled at the facility today. The existing risks are discussed in further detail in **Section 17.5.3.2** of **Chapter 17** ***Major Accidents and Disasters***.

As is currently the case, good control measures in terms of containment, controlled drainage, emergency measures and training will ensure that the risk of an accidental release to soil and groundwater is low.

Additionally, the proposed tanks for aqueous waste liquid storage will be located in concrete containment bunds and designed to the required standards for water-tightness and retention capacity. Containment for the full contents of a tanker will also be provided (as is currently the case) at the upgraded tanker unloading area in the event of a spillage.

Any liquid falling on tanker unloading area, paved areas serving the hydrogen generation building and the bottom ash storage building will have a contained drainage system and will only be released into the main drainage network upon confirmation that there is no contamination present. The introduction of paving and hardstand areas with associated surface drainage where soil is removed will limit the potential for any accidental spillages to contaminate groundwater.

The increase in hardstanding will reduce local recharge to ground. However, the soils present on the site are of low permeability as such the reduction of the groundwater recharge will be insignificant. Hence, the 'magnitude of impact' on the groundwater is determined to be 'negligible'. Using the IGI guidance matrix, the 'magnitude of impact' is combined with the 'importance of attribute' (the importance of aquifer in this area is defined as 'very high' see **Table 14.4**) provides a 'likely significant environmental impact' which will be 'imperceptible'.

The existing Site Emergency Plan will be followed in case of any spillages on site, refer to **Section 4.9.2** of **Chapter 4** ***Description of the Proposed Development***.

The hydrogen generation unit will require water which will be supplied from existing groundwater production wells. Approximately 53m^3/d is required to feed the unit when running at full capacity. The current abstraction rate is approximately 216m^3/d with a potential yield of 600m^3/d.

The additional water abstraction is negligible in comparison to other major abstractions from the water body (Platin Quarry 17,500m^3/d and Kiltrough PWS 2,600m^3/d).

The 'magnitude of impact' from operation of the proposed development on land, soil and groundwater quality is determined to be 'negligible'. Using the IGI guidance matrix, the 'magnitude of impact' is combined with the 'importance of attribute' for bedrock and groundwater in the study area (defined as very high see **Table 14.4**) provides the overall rating that during operation the 'likely significant environmental impact' is 'imperceptible'.

14.7 Mitigation Measures and Monitoring

This section describes the mitigation measures to reduce or avoid potential impacts where possible, for both the construction phase (Section 14.6.2) and operational phase (Section 14.6.3) of the proposed development. The mitigation measures detailed below are also relevant for the protection of surface water and are hence cross referred to in **Section 15.6.1** of **Chapter 15** ***Water***. Also, **Section 15.6.1** of **Chapter 15** ***Water***, outlines additional measures which will be implemented when working adjacent to or in the vicinity of ditches or streams to prevent uncontrolled runoff from the site into watercourses. Refer to **Section 15.6.1** for further details.

14.7.1 Construction Phase

As outlined in **Appendix 5.1** ***Construction Environmental Management Plan*** (CEMP) of **Volume 3**, the adopted construction techniques will be completed in accordance with industry best practice guidance:

- TII's Guidelines for the Creation, Implementation and Maintenance of an Environmental Operating Plan and Construction Industry Research; and
- Information Association (CIRIA) in the UK, Environmental Good Practice on Site Guide, 4th Edition (CIRIA 2015).

Mitigation measures regarding land and soils will be implemented to minimise the impact on land and soils (including groundwater). These mitigation measures are designed to contain any areas within the site boundary at risk to contaminated run-off.

Excavation Works

- Where possible, excavated materials will be reused on site for backfilling purposes, re-grading and landscaping.
- All earthworks will be monitored by suitably qualified and experienced geotechnical personnel.
- Earthworks will be programmed so as not to be carried out during extreme weather events.
- There is no evidence that contaminated soil should be encountered during the site works, however if any is encountered it will be disposed of as required to a suitable authorised waste facility.

Storm water and foul water management

- In general, storm water generated on site (e.g. from excavations) will be channelled away from the watercourse and infiltrated to ground via silt traps and managed soakaways.
- Drainage from the bunded and designated storage areas will be diverted for collection and safe disposal.
- All construction foul effluent will be stored in the temporary holding tank and will be regularly disposed of off-site.
- Laydown areas will be suitably drained.
- Temporary interceptors (soak pits lined with geotextile) will be constructed as necessary during the early stages of construction mitigating against silt laden run off to the existing drainage network.

Material Storage

- Storage tanks/drums of fuel, oil, chemicals and all other materials that pose a risk to waters if spilled, will be stored in designated storage areas which will be locked when not in use.
- Bunded pallets will be used for storage of drums.
- Storage areas will be bunded to a volume of 110% of the capacity of the largest tank/container within the bunded areas.
- Secure valves will be provided on oil and fuel storage facilities.
- Filling and draw-off points will be located entirely within the bunded areas.
- Any areas which will involve the storage of fuel and refuelling will be paved and bunded and hydrocarbon interceptors will be installed to ensure that no spillages will get into the surface water or groundwater.
- Appropriate staff will be trained in environmental issues and spill response procedures.
- The contractor will maintain an incident and emergency response action plan which will cover all foreseeable risks, i.e. fire, flood, collapse etc. An Incident Response Plan (IRP) is located in Section 8 of the CEMP in **Appendix 5.1** of **Volume 3.**

Site Hygiene

- Vehicles exiting the site from excavation areas will be required to pass through wheel wash facilities to remove mud and organic material before entering main site or public roads. The discharge from the wheel wash (equipped with a filtering system) will be directed to a temporary storage tank on site and will be collected periodically for off-site treatment.

Waste Management

- All waste produced on site will be transported to licensed waste disposal facilities to avoid potential soil contamination. Refer to the Construction

Waste Management Plan in Section 7 of the CEMP in **Appendix 5.1** of **Volume 3.**

Monitoring

- Visual monitoring will be undertaken as part of the regular site audits during the construction of the proposed development to ensure existing surface water runoff is draining from the site and is not exposed to any contaminants.
- The contractor will be required to monitor the weather forecasts to inform the programming of earthworks and stockpiling of materials.
- Any excavation shall be monitored during earthworks to ensure the stability of side slopes and to ensure that the material excavated for disposal or re-use is consistent with the descriptions and classifications according to the waste acceptance criteria testing carried out as part of the site investigations.
- Movement monitoring shall be carried out during any activities which may result in ground movements. It is anticipated that the works will be monitored by a Resident Engineer.
- In relation to potential contamination, a suitably experienced environmental consultant will be required to oversee the excavation works for the proposed development so that potential contamination can be segregated, classified and suitably disposed.

Refer also to **Section 15.6.1** ***Water*** for specific monitoring measures required for the protection of (surface) water quality.

14.7.2 Operational Phase

As the significance of the 'likely significant environmental impact' on the site during operation of the proposed development is 'imperceptible' no mitigation measures have been proposed with respect to effects from operation of the proposed development.

Regular on-going monitoring of groundwater quality is already carried out at the existing Indaver facility as part of the EPA licence (W0167-03) requirement and this monitoring will continue, refer to **Section 14.3.3.5**.

No additional monitoring is necessary during the operational phase.

14.8 Cumulative Effects

Chapter 18 ***Cumulative Effects, Other Effects and Interactions***, lists a number of planned projects that may potentially have a cumulative impact on the environment. Each project has been reviewed in turn below for the potential cumulative impacts on land, soils and hydrogeology.

14.8.1 Irish Cement Ltd (Ref. LB150375) - Cement silo

The Planner's Report[17] (2015), prepared by Meath County Council, states that '*no soils, geology or habitats will be affected'* and '*the proposed development will not result in any additional water discharges'.*

Therefore, there is no potential for significant negative direct not indirect cumulative impacts on land, soils and hydrogeology.

14.8.2 Irish Cement Ltd (PL17.PA0050) - Alternative fuels and raw materials

Based on the EIA Report[18] (2017), Section 6.5 states that there is no potential for cumulative impact on land, soils and hydrogeology. The report states '*The proposed works will have no impact on the dewatering operations within the quarry'.*

Therefore, there is no potential for significant negative direct not indirect cumulative impacts on land, soils and hydrogeology as a result of the proposed and planned development.

14.8.3 SSE Generation Ireland Ltd (PL17.303678) - 110kV transmission substation

Section 6.4.1 of the EIAR[19] (2019) prepared for the SID application stated that '*There will be no discharges to ground or groundwater during the operational phase of the Substation as none of the substation infrastructure will pose a risk to land and soils during the operational phase*.'

As such, there is no potential for significant negative direct nor indirect cumulative impacts on land, soils and hydrogeology as a result of the proposed and planned development (Ref. PL17.303678).

14.8.4 Highfield Solar Ltd. (PL17.248146) - Solar Farm

Section 7.8.4 of the Inspector's Report[20] (2017) reported that '… *the construction process outlined for the solar farm to be relatively low impact from a geotechnical perspective, with significant earthworks only occurring for the access tracks, substations and cable routes*'.

As such, there is no potential for significant negative direct nor indirect cumulative impacts on land, soils and hydrogeology as a result of the proposed and planned development.

[17] Available for inspection from Meath County Council Planning database, http://www.eplanning.ie/MeathCC/AppFileRefDetails/LB150375/0
[18] Available for inspection under EPA IE Licence application P0030-06, https://www.epa.ie/licensing/
[19] Available from: http://caulstown-platin-substation.com/downloads/environmental/substation-environmental-report.pdf
[20] Available for inspection from An Bord Pleanála: http://www.pleanala.ie/casenum/248146.htm

14.8.5 Highfield Solar Ltd. (PL17.303568) - Electrical substation (110kV)

Section 6.6.1 of the Inspector's Report[21] (2019) referred to the Chief Executive's Report from Meath County Council which stated they were satisfied that '*the underlying geology of the area will not be unduly impacted upon by the proposed development'*. As such, there is no potential for significant negative direct nor indirect cumulative impacts on land, soils and hydrogeology as a result of the proposed and planned development.

14.8.6 Conclusion

A review of these projects has shown there are no planned projects which could contribute to any potential significant negative direct nor indirect cumulative effects on the land, soils or hydrogeology during operation of the proposed development.

When the predicted effects of the proposed development at Indaver are considered cumulatively with each planned project and cumulatively with all planned projects as a whole, it is concluded that there are no significant negative cumulative effects predicted on soils, geology or hydrogeology.

14.9 Residual Impacts

The residual impacts are those that would occur after the mitigation measures have taken effect.

14.9.1 Construction Phase

Upon application of the mitigation measures outlined in **Section 14.8** the residual impact is considered to be 'neutral' in terms of quality. The magnitude of any impact in the construction phase is 'negligible' as detailed in **Table 14.7**. As a result, the significance of all the effects is 'imperceptible'.

[21] Inspector's Report (2019) Available from An Bord Pleanála : http://www.pleanala.ie/documents/reports/303/R303568.pdf

Table 14.7 Residual impacts during construction phase on the soils, geology and hydrogeology within the site after mitigation measures have been carried out.

Feature	Importance		Magnitude of Impact		Significance of Impact	Mitigation Measures	Residual Impact	Residual Significance of Impact
	Ranking	Justification	Ranking	Justification				
Bedrock	Very High	Aggregate Potential comprising large existing quarry: Platin Quarry is approximately 200m and Duleek Quarry approximately 2km from the study area.	Negligible	Excavation of bedrock is not expected to be required.	Imperceptible	Excavation of bedrock is not expected to be required.	Negligible	Imperceptible
Aquifer	Very High	A regionally important aquifer with multiple well fields (Kiltrough WS)	Small Adverse	Much of the topsoil, overburden and berm material will be excavated reducing thickness of the subsoil deposit overlying bedrock.	Significant/Moderate	Slight impact on the surrounding ground and such shall be monitored and mitigated against discharge to ground.	Negligible	Imperceptible
			Small Adverse	There is a potential risk of localised contamination of the groundwater due to construction activities.	Significant/Moderate			

14.9.2 Operational Phase

There are no planned discharges to ground or likely changes to the current groundwater regime. As such, for the proposed development the residual impact is considered to be 'neutral' in terms of quality, 'negligible' in terms of magnitude and of 'imperceptible' significance as a result of this proposed development on the surrounding soils, geology and hydrogeology.

14.10 References

AWN Consulting Limited (2017) Chapter 12 – Land, Soils and Geology of Indaver Carranstown EIAR. Available from IE Licence W0167-03 from www.epa.ie/licensing

AWN Consulting Limited (2014), Indaver IRL Ltd – Soil and Groundwater Baseline Report (IED). Available from IE Licence W0167-03 from www.epa.ie/licensing

Alpha Engineering Services, Consulting Engineers, Land Surveyors (2000), Geotechnical Report for Green Field Site at Platin, Co. Meath for Project Management.

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

IGSL Ltd (2009), Meath Waste Management Facility Carranstown, Co. Meath, Geotechnical Interpretative Report (Report No. 14039).

Geological Survey Ireland (GSI) (2019) Groundwater Viewer. Available from: https://www.gsi.ie/en-ie/data-and-maps/Pages/Groundwater.aspx.

Geological Survey Ireland (GSI) Bettystown GWB: Summary of Initial Characterisation.

Institute of Geologists of Ireland (IGI) (2013) Guidelines for the Preparation of Soil, Geology and Hydrogeology Chapters of Environmental Impact Statements.