15 LAND AND SOILS

15.1 Introduction

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

Chapter 3 provides a full description of the proposed development and Chapter 4 describes the construction strategy.

This chapter has been prepared by Eoin Wyse of Arup. Eoin is a Senior Engineer in the Applied Geology sub-group of the Ground Engineering group at Arup. Eoin has experience in a number of contaminated land projects and has particular skills in ground investigation, risk assessment, waste categorisation and Environmental Risk Assessment.

Please refer to Chapter 1 for further details of his relevant qualifications and experience.

15.2 Assessment Methodology

15.2.1 General

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

The potential impacts of the proposed development on the land and soil has been assessed by classifying the importance of the relevant attributes and quantifying the likely magnitude of any impact on these attributes.

15.2.2 Guidance and Legislation

This assessment has been undertaken with due regard to the overarching EIA guidance[1,2,3,4] (see Section 1.3. of Chapter 1) and Institute of Geologists Ireland (IGI) guidance[5].

- The following legislation is particularly relevant to the management of impacts to land and soil:
- Environmental Protection Agency (2017) Draft Guidelines on the Information to be contained in Environmental Impact Assessment Reports (Draft August 2017)[6]; and
- European Commission (2017) Environmental Impact Assessment of Projects: Guidance on the preparation of the Environmental Impact Assessment Report[7].

This chapter has been prepared using the following guidelines:

[1] Department of Housing, Planning and Local Government (2018) Circular PL 05/2018 -Transposition into Planning Law of Directive 2014/52/EU amending Directive 2011/92/EU on the effects of certain public and private projects on the environment (the EIA Directive)
[2] Department of Housing, Planning, Community and Local Government (2017) Key Issues Consultation Paper on the Transposition of 2014 EIA Directive (2014/52/EU) in the Land Use Planning and EPA Licencing Systems;
[3]Department of Housing, Planning, Community and Local Government (2017) Circular PL 1/2017 - Implementation of Directive 2014/52/EU on the effects of certain public and private projects on the environment (EIA Directive): Advice on the Administrative Provisions in Advance of Transposition
[4] Government of Ireland (2018) Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (August 2018);
[5] Institute of Geologists of Ireland (IGI 2013). Guidelines for the Preparation of Soil, Geology and Hydrogeology Chapters of Environmental Impact Statements. Available at: http://igi.ie/publications/guidelines/.
[6] EPA, 2017. Draft Guidelines on the Information to be contained in Environmental Impact Assessment Reports. Available at: http://www.epa.ie/pubs/advice/ea/drafteiarguidelines.html.
[7] European Commission (2017) Environmental Impact Assessment of Projects: Guidance on the preparation of the Environmental Impact Assessment Report. Directive 2011/92/EU as amended by 2014/52/EU. Available at: http://ec.europa.eu/environment/eia/eia-support.htm.

- Institute of Geologists of Ireland (IGI, 2013). Guidelines for the Preparation of Soil, Geology and Hydrogeology Chapters of Environmental Impact Statements[5];
- National Roads Authority (NRA, 2008). Environmental Impact Assessment of National Road Schemes – A Practical Guide[8];
- National Roads Authority (NRA, 2008). Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes[9];
- Environmental risks have been assessed by comparing testing against Generic Assessment Criteria (Arup GACs) based on Contaminated Land Exposure Assessment (CLEA) v1.07 software to determine the appropriate assessment of risks to human health from contaminated land. Using the input parameters including soil organic matter content and health criteria values, soil guideline values are produced for different land uses.

15.2.3 Study Area

The proposed development and study area for the land and soils assessment are shown on Figure 15.1 in Appendix 15.1. These lands include the site of the development and also the location of upgrade works to services required on Parkgate Street. The main focus of this chapter is on the construction of Block A, however the baseline environment for the development includes information gathered for the development of Blocks B and C.

In accordance with IGI's Guidelines for the preparation of soils, geology and hydrogeology chapters of environmental impact statements, 2013, baseline information within a distance of 2 km from the proposed development has been reviewed. This 2 km buffer area is also shown on Figure 15.1 in Appendix 15.1.

15.2.4 Site Visits

Numerous site visits and site walkovers have been conducted by Arup geotechnical and other Arup personnel in late 2018 and early 2019 as part of the desk study phase, ground investigation scoping and pre-mobilisation meetings.

15.2.5 Consultation

Discussions were held with the Waste Enforcement division of Dublin City Council (on 10th October 2019) in relation to the retention of materials on site where appropriate and also the potential for reuse of suitable materials on site.

15.2.6 Categorisation of the Baseline Environment

As part of the desk study that was undertaken to establish the baseline conditions (i.e. soils, and geological environment), the following sources of information were reviewed:

Desk Study Information

- Bing Maps (2018). Aerial photography[10];
- Department of Communications, Energy and Natural Resources (2011). State Mining and Prospecting Facilities[11];

[8] National Roads Authority (2008). *Environmental Impact Assessment of National Road Schemes - A Practical Guide.* NRA
[9] National Roads Authority (2008). *Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes.* NRA
[10] Available at: https://www.bing.com/maps, Accessed 18-07-2018
[11] Available at: http://www.mineralsireland.ie/files/Competition_Booklet_May2011_web.pdf, Accessed 18-07-18

- Environment Protection Agency (EPA) (2018). EPA Maps, Corine Land Cover 2012[12;]
- EPA (2018). Office of Licencing and Permitting[13].
- Google Maps (2018). Aerial photography[14]
- Geological Survey of Ireland (GSI) (2018). Geological maps of the site area produced by the Geological Survey of Ireland[15] including;
- Quaternary Maps (GSI);
- Bedrock Mapping;
- National Landslide Database (GSI);
- Karst Database (GSI);
- Historic Mine Sites - Inventory and Risk Classification;
- GSI (2014). Directory of Active Quarries, Pits and Mines in Ireland. 4th Ed;
- National Parks and Wildlife Service (2018). Proposed / Designated NHA, SPA, SAC Sites[16;]
- Ordnance Survey of Ireland (OSI) (2017). Current and historical Ordnance Survey (OS) maps (1837-1842 and 1888-1913) available for the study area at 1:2,500 and 1: 10,560 scales[17];
- OSI (2017). Aerial photography (1995, 2000, 2005)17;
- Teagasc and the Environmental Protection Agency (EPA) (2017). Irish Soil Information System[18]
- Dublin City Development Plan 2016-2022 (2016) Dublin City Council[19].

Historic Ground Investigations

The following historic reports have been used to inform this report:

- Arup Consulting Engineers (2003) Site Investigation Report, Parkgate Street Development for Hickeys Fabrics & Co. Ltd., refer to Appendix 15.2.
- Arup Consulting Engineers (2006) Geotechnical and Environmental Assessment Report for Hickeys Fabrics & Co. Ltd., refer to Appendix 15.3.

The original 2003 report is attached as an appendix (Appendix 15.2) to this report. Reference will be made to the relevant sections of the 2003 report. The 2006 report was prepared as part of a planning report submitted for Hickey's of Parkgate Street Planning Application (Planning Ref. 3613-06) and included the ground investigation results from the 2003 report.

Project Specific Ground Investigations

A detailed geotechnical and geo-environmental site investigation was carried out and completed in early May 2019, see Appendix 15.4.

[12] Available at: https://gis.epa.ie/EPAMaps, Accessed 18-07-18
[13] Available at: http://www.epa.ie/licensing/, Accessed 18-07-18
[14] Available at: https://www.google.ie/maps, Accessed 18-07-2018
[15] Available at: http://map.geohive.ie/mapviewer.html, Accessed 18-07-2018
[16] Available at: http://webgis.npws.ie/npwsviewer/, Accessed October 2019
[17] Available at: http://map.geohive.ie/mapviewer.html, Accessed October 2019
[18] Available at: http://gis.teagasc.ie/soils/index.php, Accessed October 2019
[19] Available at: http://www.dublincity.ie/main-menu-services-planning-city-development-plan/dublin-city-development-plan-2016-2022, accessed October 2019

15.2.7 Impact Assessment

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 *EC Commission Guidance on the preparation of a EIAR*[1,2,3,4,7] and the *draft EPA guidelines on the preparation of an EIAR*[6], along with the IGI guidance[5] 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 and Geological 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 within the planning boundary based on existing literature as well as site specific and neighbouring site investigation data.

Direct and Indirect Site Investigation

Sections 15.3.2 to 15.3.3 and Section 15.3.5 provide discussion on the data available from the site-specific ground investigations (GI) carried out in relation to the proposed development. This, along with other sections from within Section 15.3.4 look at the regional setting. 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 conditions beneath the proposed development that considers the likely significant effects of the proposed development.

A 'Feature Importance ranking' is then assigned to each feature likely to be affected by the proposed development based on guidance from the IGI Guidance document which in turn references the National Roads Authority (NRA) guidance[9]. This facilitates the assessment of likely significant effects which has been undertaken in accordance with the guidance outlined in Section 15.2.2.

Section 15.5 outlines the "Mitigation Measures and Monitoring" associated with the works in accordance with the above methodology.

Completion of the Land and Soils Sections of the EIAR

This section has been prepared iteratively whilst undertaking the first three elements. Upon finalisation of the preceding steps, this information has been documented accordingly (i.e. as part of this chapter) which corresponds to the final element of the methodology 'Completion of the Soils and Geological Sections of the EIAR'.

In parallel with the EIAR process, the site has been assessed following the Environmental Protection Agency's Guidance on the Management of Contaminated Land and Groundwater at EPA licensed Sites[20]. While this document outlines the approach which should be adopted in order to assess contamination

[20] EPA (2013) "Guidance on the Management of Contaminated Land and Groundwater at EPA licensed Sites", https://www.epa.ie/pubs/advice/waste/contaminatedland/contaminatedland, accessed 22/10/2019

present on a licensed site, it is widely accepted as best practice for the assessment of contaminated sites in advance of redevelopment. The Preliminary Site Assessment (PSA) and Detailed Site Assessment (DSA) required under this methodology are all included in Appendix 15.5 and 15.6.

15.3 Baseline Conditions

15.3.1 Introduction

As noted in Section 15.2.6, the existing soils and geology in the study area have been interpreted from both desk study information and from project-specific site investigations.

15.3.2 Non-Intrusive Investigations

Geophysical surveys were carried out to examine the nature of the foundations beneath the site. The results of these surveys are included in Appendix 15.4.

15.3.3 Intrusive Investigations

15.3.3.1 IGSL 2002 Ground Investigation

A site investigation (SI), consisting of 8 No. shell and auger boreholes (Nos. 1 to 7 and 8B) and 16 No. window samples (Nos. 1 to 8, 9B and 10 to 16), was undertaken by Irish Geotechnical Services Limited (IGSL) in December 2002, under the direction of representatives from Arup Consulting Engineers, Dublin.

During the SI works (presented in the 2003 Arup Consulting Engineers Report), environmental soil testing was carried out. It should be noted that the analyses were carried out for the purposes of soil disposal. The soils testing was completed before the finalising of the Landfill Directive[21] and therefore do not follow the outlined methodology from that document. However, the results may still be used to indicate chemicals of concern on the site.

The following organic contaminants present in the soils:

- Mineral Oil – Associated with diesel, turpentine, and fuel oil; and
- PAH's (Polynuclear Aromatic Hydrocarbons) – Formed through the incomplete combustion of fossil fuels, typically found in ash and clinker, also, a component of petrol.

The following metals were noted to be present in the made ground:

- Lead;
- Copper;
- Arsenic;
- Mercury; and
- Chromium.

Concentrations of these metals were elevated when screened against the Dutch Intervention values[22]. These values were used in The Netherlands as Generic Assessment Criteria for sites and represent concentrations above which there would be an unacceptable risk to human health and the environment, assuming a final use of residential and including for potential plant uptake. Arsenic, chromium and mercury were isolated to one sample. Copper was noted in 3 no. samples while lead was noted in 6 no. samples. These exceedances were located within the top 2-3m.

[21] OJEC (2002), COUNCIL DECISION of 19 December 2002 establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 of and Annex II to Directive 1999/31/EC

[22] Dutch Standards (2000) Circular on Target Values and Intervention Values for Remediation. Dutch Ministry of Housing, Spatial Planning and Environment, Netherlands Government Gazette

Ground gas was detected during the ground investigation in 2002 at concentrations of 2.3% (CO2) and 3.9% (Methane). The historic reports (Appendix 15.2 and 15.3) assessed the concentrations against CIRIA 149[23], however this methodology is now obsolete.

15.3.3.2 Ground Investigations Ireland Ground Investigation 2019

Ground Investigations Ireland Ltd. (GII), under the instruction of Arup, carried out the GI between March and May 2019. The GII Ground Investigation Report (2019) is presented in Appendix 15.4.

The following intrusive works were carried out:

- 18 No. window sample boreholes to recover soil samples;
- 4 No. cable percussion boreholes to a maximum depth of 7.6mbgl;
- 4 No. rotary core follow-on boreholes to a maximum of 15.60mbl;
- 4 No. rotary core follow-on boreholes to a maximum depth of 17.0mbgl;
- Installation of 10 No. groundwater monitoring wells;
- Installation of 3 no. gas monitoring caps;
- Geophysical survey; and
- Geotechnical and environmental laboratory testing.

To give a robust understanding of the nature of contamination within the made ground and natural soils in vertical and lateral extent, environmental samples were taken from both boreholes and window samples. At boreholes, bulk distributed samples were taken from made ground and granular soil at 1m intervals to 8mbgl. In window samples, a small distributed sample was taken from the made ground and natural material at 1m intervals commencing at 0.5mbgl to 4mbgl or until practical refusal.

Samples were collected in dedicated soil pots and jars as specified and supplied by the analytical laboratory. Samples were taken in accordance with methods specified and referenced in the Investigation of potentially contaminated sites - Code of practice (BS 10175:2011+A2:2017[24]).

Representative geotechnical samples of the soils were also collected in dedicated sample pots and bulk bags.

The site geology consists generally of made ground overlying a layer of clay with occasional shell fragments, which overlies sand and gravel. Limestone bedrock is present underneath the natural soils. A summary of the strata proven at the site is summarised in **Error! Reference source not found.**.

This information is compiled from the borehole and window sample logs from the site investigation as presented in Appendix 15.3 and the site investigation report produced by Ground Investigations Ireland (Appendix 15.4). The strata proven is consistent with the regional geology and generally consistent with findings from previous site investigations for the site.

Lithology	Description	Depth (mbgl)	Thickness (m)
Made ground	Hardcore Concrete and Tarmacadam	0 – 1.3	0.04 – 1.3
	Clay/ Gravel Brown to dark brown slightly sandy clay and gravel with cobbles and anthropogenic materials (including, but not	0 – 5.0	1.4 – 5.0

[23] CIRIA (1995), CIRIA Report 149 - Protecting Development from Methane, CIRIA
[24] British Standards Institution (2017), BS10175:2011+A2:2017; Investigation of potentially contaminated sites – Code of practice, BSI

Lithology	Description	Depth (mbgl)	Thickness (m)
	limited to slag, redbrick, mortar, charcoal). Gravel is angular to subrounded, fine to coarse.		
Clay	Soft, light brown to brown, slightly sandy silty clay with occasional shell fragments	1.9 – 6.20	0.3 – 1.40
Sand and gravel	Loose to very dense grey to brown slightly clayey gravelly fine to coarse sand and gravel with occasional cobbles. Gravel is subangular to subrounded.	2.6 – 8.50	1.2 - 3.8
Weathered Bedrock	Angular cobbles of weak, thinly laminated dark grey to black Mudstone and Limestone	6.4 – 8.6	0.2 - 1.5
Limestone Bedrock	Weak to very strong dark grey fine grained limestone with bands of mudstone (?) and calcite veining	6.7 – 17.0 (proven)	8.7 (proven

Table 15.1: Site geology

15.3.4 Regional Overview

The site is located on the original floodplain of the River Liffey. The site is approximately 7km east of the River Liffey discharge point to the Irish Sea.

15.3.4.1 Regional Geomorphology and Topography

The site is located within the original flood plain of the River Liffey.

With reference to the GSI online mapping, the subsoils comprise primarily of made ground, with alluvium shown to the west of the site. This has been interpreted as a potential glacial meltwater channel which potentially extends beneath the site.

The topography of the site falls to the south towards the River Liffey. Levels on Parkgate Street to the north of the site vary from 5.3 to 5.5mOD, falling to approximately 3.4mOD at the southernmost point of the site adjacent to the River Liffey.

15.3.4.2 Regional Soils and Subsoils

The soils within the study area are described in the GSI Subsoils Map. The Quaternary map of Ireland published by the GSI shows the study area to be underlain by urban soils or made ground.

River alluvium deposited from historic flooding events is mapped by the GSI along the banks of the River Liffey and along the River Liffey paleochannel. Another paleochannel is visible approaching the site from the northwest, passing beneath the Criminal Courts of Justice. It is unknown where this paleochannel terminates.

The till within the study area principally reflects the depositional process of the last glaciation. Typically, during the ice advance, boulder clays were deposited subglacially as lodgement till over the eroded bedrock surface, whilst moraine granular deposits were laid down at the glacier margins. Subsequently, with the progressive retreat of the ice sheet from the region, granular fluvio-glacial deposits were laid down in places by melt waters discharging from the front of the glacier.

The EPA Subsoils map of the study area is shown in Figure 15.3 in Appendix 15.1.

15.3.4.3 Regional Bedrock Geology

The 1:100,000 GSI bedrock geology map indicates that the site is underlain by the Lucan Formation consisting of dark limestones and interbedded shales known colloquially as Calp Limestone.

No bedrock structures were noted on the 1:100,00 GSI bedrock geology map (Figure 15.4 in Appendix 15.1).

15.3.5 Site Specific Environmental Setting

15.3.5.1 Introduction

This section outlines the site-specific information available for the proposed development. This section describes the findings of the site-specific surveys commissioned for the proposed development.

15.3.5.2 Site Description

There is one main access point to the site on Parkgate Street. The public do not have access to the site.

Access to the Block A site would be through the areas previously granted permission, Block B and C of the original submission.

The River Liffey forms the southern boundary of the site and Parkgate Street runs parallel to the northern site boundary. Sean Heuston Bridge (Luas crossing and pedestrian only) is located to the east of the site (refer to Figure 15.1 in Appendix 15.1).

The site is located in a built-up urban environment. West of the site is an apartment complex, Parkgate Complex, and commercial office buildings at Parkgate Place, presently occupied by Transport Infrastructure Ireland (TII). Parkgate street is lined with two and three storey buildings used for retail and potentially some residential apartments over the ground floor retail units.

15.3.5.3 Topography

The topography of the site for Block A is within the footprint of the warehouse structure on site. The slab level in the warehouse was recorded as 4.28mOD. Levels on Parkgate Street to the north of the site vary from 5.3 to 5.4mOD.

15.3.5.4 Site History/Man Made Features

The previous site operations have been established based on publicly available information.

A history of the site was prepared by in the Arup Consulting Engineers (2003) and is summarised in **Error! Reference source not found.** below.

Date	Site History
Early 1800s	2-5m of fill was used to raise the levels across the site above the River Liffey floodplains.
1800s – 1890 (approximate)	Phoenix and Royal Iron Works. As shown on the Historic Map 6 Inch Colour (1837-1842)
c.1820	Construction of the Phoenix Iron Works manager's house located the in the north-west of the site. Listed under the National Inventory of Architectural Heritage (NIAH), Reg. No. 500060347.
c. 1895	Construction of the electricity sub-station east of the site. Listed under the National Inventory of Architectural Heritage (NIAH), Reg. No. 500060350
1900 – 1910	Woollen worsted manufacturing by The Knightsbridge Mills
1916 – 1919	Ireland National Shell Factory, Dublin, manufacturing 9.2 inch shells and fuses.
1920-1930	Government Stores

Date	Site History
1930 -1970s	Printing works As shown in OSi Cassini 6 inch (1830s – 1930s)
Mid 1970s – Present	Hickey's Fabrics warehouse.

Table 15.2: Summary of Site History at 43 Parkgate Street.

Directly to the west of the site currently lie No.'s 41 and 42 Parkgate. Historic maps show that this site was also part of the Phoenix Iron Works and later the Lucan Dairy Depot.

Further west of the site along Conyngham Road, was the location of a chemical works around the early 1800s; no further information was found. A chemical factory was also noted on the northern side of Parkgate Street, the use of which was recorded as chemical manufacturing and chemical importing at various times.

The iron works were in operation from approximately the 1880s to 1890. Following the iron works the site was used as a mill under Knightsbridge Mills from approximately 1900-1910. The site was briefly used as the Irish National Shell factory, from March 1916 to March 1919. The site was then left vacant until the 1920s when it was used as a government store until the 1930s when the printing works began.

Hickey's Fabrics took ownership of the site in the 1970s and it has since been used as a warehouse.

Several other garages and depots (bus and electric railway) were recorded, both on Conyngham Road and on the northern side of Parkgate street. A petrol spill is known to have occurred at the Maxol Garage in the mid-1990s located to the west of the site.

15.3.5.5 Potential Contamination due to Site History

Based on a review of the historic site investigation data, the following parameters were noted as potential contaminants of concern:

- Hydrocarbons (Diesel Range Organics (DRO) from 99 – 7090mg/kg);
- Heavy Metal Concentrations (Arsenic, Copper, Chromium, Lead);
- Poly-Aromatic Hydrocarbons (PAHs) from 0.13mg/kg to 18.9mg/kg (Sum of 17 PAHs); and
- Asbestos Containing Materials (ACM) in soils and in the building fabric.

15.3.5.6 Soils

The made ground is present in all boreholes and window samples on the site. A generally thin layer of concrete or tarmacadam overlies the clay and gravel made ground layers.

The thickness of the made ground varies between 1.4m in WS113 to 5.0m in BH104 and typically contains slag, red brick fragments, mortar and charcoal.

A clay layer with occasional shell fragments is present across the site and is likely to be alluvium deposits from the River Liffey floodplain before the site was reclaimed in the early 1800's.

Layers of sand and gravel underlying the clay layer were also present throughout the site and are likely to be river or estuarine deposits in the area of the River Liffey channel.

A layer of angular cobbles of limestone were then encountered, described by the drillers as weathered bedrock followed by weak to very strong dark grey fine-grained limestone with bands of mudstone and calcite veining, proven to 17.0mBGL.

15.3.5.7 Bedrock Geology

Bedrock described as Weak to very strong dark grey fine grained limestone with bands of possible mudstone and calcite veining. Bedrock was encountered approximately 6.7 to 17m Below Ground Level.

15.3.5.8 Karst Features

The karst feature database available on the GSI Groundwater Data Viewer was consulted. No recorded karst features were identified within 1km of the study area. As such, this assessment does not consider this feature any further.

15.3.5.9 Soft and /or Unstable Ground

Soft deposits consist of peat, alluvium or very soft cohesive material. Construction on these soils may undergo settlement or other undesirable ground movements. Where identified, special measures may be required such as excavation and replacement or other ground improvement measures. Various sources of information were consulted in establishing these areas along the study area and include:

- EPA subsoil map, produced by EPA and GSI;
- GSI database of historical landslides;
- Ground Investigation data; and
- Site Walkover.

The EPA subsoil map outlined no locations of soft soil within the study area, and the GSI database shows no recorded landslide events within the study area. As such, this assessment does not consider this feature any further.

15.3.5.10 Mineral / Aggregate Resources

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

- GSI: Aggregate Potential Mapping;
- GSI: mineral localities; and
- EPA: active mine sites.

A detailed description of how the Aggregate Potential Mapping was developed is available on the GSI Website[25].

The site was noted to have a low to moderate aggregate potential, however given the current location and planning context of the site, it is unlikely to ever be utilised.

No active metallic mines exist today in the study area. There is no record of underground mining in the area. Therefore, there would be a low risk of underground structure collapse due to underground excavations.

As such, this assessment does not consider these features any further.

15.3.5.11 Geological Heritage Areas

The Irish Geological Heritage Programme is a partnership between the GSI and the National Parks and Wildlife Services (NPWS). The programme was developed to identify and document the geological heritage and protect and conserve it. Consultation was conducted with the GSI in order to identify all

[25] Accessed at https://dcenr.maps.arcgis.com/apps/webappviewer/index.html?id=ee8c4c285a49413aa6f1344416dc9956, accessed October 2019.

geological heritage sites within the study area through checking of the GSI GHA / County Geological Sites (CGS) webveiwer [26].

No Geological Heritage Areas were noted.

Two County Geological Sites were identified. One consists of two boreholes located in the Diageo Brewery at St James Gate and the other was identified as the Phoenix Park. Both sites are suitably remote, and will not be affected by the proposed development.

As such, this assessment does not consider these features any further.

15.3.5.12 Chemical Test Results

The site investigations that have been undertaken (Refer to Appendix 15.4) are described in detail in the Detailed Site Assessment that has been produced by Arup (Refer to Appendix 15.6).

The soil samples recovered during the Ground Investigation were tested against a suite of parameters which included the contaminants highlighted as potential contaminants of concern.

These results were screened with a view to assessing the possibility of retaining these materials on site.

In terms of assessing the level of contamination within the soils, the soil results were screened against Generic Assessment Criteria (GACs). The GACs are values which have been calculated for typical soils in certain proposed end uses to determine the concentration above which there would be an unacceptable risk to human health or the environment.

The samples recovered during the ground investigation were screened against the GACs for a residential end use without plant uptake.

In addition, the samples were screened for the presence of asbestos fibres.

Based on the screening carried out on the soils, a number of locations were identified where the soils contained parameters which exceeded the GACs for Residential Land Use (without Plant Uptake). These were as presented below.

Contaminant	GAC Threshold	No. Exceedances	Sample ID and Depth (mbgl)	Sample Result
Arsenic	2 mg/kg	1	BH01 at 1.0 mbgl	43.1 mg/kg
Lead	310 mg/kg	8	WS106 at 0.5 mbgl	366 mg/kg
			WS106 at 1.0 mbgl	414 mg/kg
			WS114 at 1.5 mbgl	385 mg/kg
			WS103 at 2.6 mbgl	521 mg/kg
			WS101 at 1.0 mbgl	312 mg/kg
			WS105A at 0.5 mbgl	4755 mg/kg
			TP102 at 1.0 mbgl	692 mg/kg
			WS110 at 0.9 mbgl	2229 mg/kg
Benzo[a] anthracene	14 mg/kg	1	WS106 at 0.5 mbgl	19.01 mg/kg
Benzo[a] pyrene	3 mg/kg	2	WS106 at 0. 5 mbgl	17.27 mg/kg
			WS105A at 1.3 mbgl	8.97 mg/kg
	0.32 mg/kg	3	WS106 at 0.5 mbgl	4.81 mg/kg

[26] Accessed at https://dcenr.maps.arcgis.com/apps/webappviewer/index.html?id=b245c2bd11a64162a1632ad6bccf8e34&scale=0, accessed October 2019.

Contaminant	GAC Threshold	No. Exceedances	Sample ID and Depth (mbgl)	Sample Result
Dibenzo[ah] anthracene			WS106 at 1.0 mbgl	0.64 mg/kg
			WS105A at 1.3 mbgl	1.46 mg/kg
Total No. of Exceedances		15		

Table 15.3: GAC Exceedances

Based on this table, the majority of the exceedances (13 of 15) occur between 3.5mOD and 2.5mOD. Only one of these exceedances occur within the footprint of Block A (WS110 at 0.9mbgl).

8 no. soil samples were noted to contain low levels of asbestos (<0.1%). Four of the asbestos detects all occurred in close proximity, at TP102, BH101, WS101 and WS103, all between 3.5-2.5mOD.

3 no. asbestos detects occurred just between ground level and 3.5mOD with the remaining asbestos detect occurring between 2.5-1.5mOD.

15.3.6 Technical Limitations

The baseline data described and considered in this assessment includes existing data from earlier investigations within the study area and surrounds as well as dedicated field surveys commissioned specifically for the proposed development. The data collected provides a comprehensive dataset in relation to the soils, and geology 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. While soils and geology can vary, the exploratory locations have been selected following the completion of the comprehensive baseline data collection. This review was completed by studying local geological maps, aerial photography, historic ground investigation and completing site walkovers to provide an understanding of the study area. The location and the spacing of the exploratory locations used as part of the intrusive investigation was chosen in order to gain an understanding of the soils and geology beneath the site. The findings from the investigations for the majority of cases compared favourably with the desk study of existing information on the baseline conditions.

15.3.7 Conceptual Site Model

15.3.7.1 Introduction

A CSM was developed based on the data obtained during the intrusive investigations i.e. borehole and trial pit logs, geophysical surveys and groundwater monitoring data. The CSM (as presented in Figure 15.6 in Appendix 15.1) summarises the important geological and hydrogeological features in the study area.

15.3.7.2 Importance of Features

A summary of the geological and hydrogeological features of relevance within the study area is presented in Table 15.4. In addition, the importance ranking of the highlighted feature is established based on the IGI guidance.

ID	Feature	Description/ Location	Feature Importance Ranking	Criteria
Overburden soils	Made ground, estuarine deposits, glacial tills	Widespread	Low	Volume of soil has a low significance on a local scale
Contaminated Land	Made ground	Historical site for heavy industry	High	Contaminated Soil on site with previous heavy industrial usage.
Soft ground	Estuarine deposits	Widespread	Low	Volume of soil has a low significance on a local scale
Bedrock/Aggregate Resources	Crushed rock aggregate potential	Excavation of material	Low	Uneconomically extractable resource

Table 15.4: Summary of the geological features of importance

15.3.7.3 Environment Type

The geological environment at and in the vicinity of the study area can be described as a historically stable geological environment and underlain by a poor aquifer. Consequently, the geological environment is considered to be Passive (type A) as per the IGI guidelines.

15.3.7.4 Activities/Environment Matrix

Table 15.5 outlines the required activities that would be undertaken during construction and operation, and the investigations, assessments and surveys that have been carried out to consider those activities.

Work Required under Activity and Type Class (based on IGI Guidelines)	Details of works completed to date
Earthworks	
Invasive site works to characterise nature, thickness, and stratification of soils and subsoils	Site specific site investigation carried out across the study area.
Storage/ transmission of leachable and/or hazardous materials	
Establish nature and quantity of leachable materials.	Collection of soil samples. Analysis for quality, including WAC and waste classification screening.

Work Required under Activity and Type Class (based on IGI Guidelines)	Details of works completed to date
Site works to characterise nature, thickness, permeability and stratification of soils, subsoils, bedrock geology.	Site specific site investigation carried out across the study area.
Excavation of materials above the water table	
Site works to characterise nature, thickness, permeability and stratification of soils, subsoils, bedrock geology.	Site specific site investigation carried out across the study area.
Excavation of materials below the water table	
Site works to characterise nature, thickness, permeability and stratification of soils, subsoils, bedrock geology.	Site specific site investigation carried out across the study area.

Table 15.5: Details of proposed works as per the IGI Guidelines and how they were undertaken to support this EIAR

15.4 Likely Significant Effects

15.4.1 Introduction

The activities on site during the construction phase will involve the demolition of some of the existing structures and the excavation of parts of the site to facilitate the construction of the foundations, with a finished slab level of approximately 5.0mOD. Local excavation may be carried out to deeper depths.

15.4.2 Assessment of effects during the "Do Nothing" Situation

In accordance with EC Guidance notes and after reviewing the baseline data, this section considers the effects of the 'do nothing' scenario. If nothing is done there is no impact on the land and soils and the site condition remains as outlined in the baseline.

However, it is not practicable to complete the consented scheme (ABP-306569-20, Blocks B & C) without a further grant of permission for development that resolves the eastern elevation of Block B2, at the site of proposed Block A.

A 'do nothing' scenario in respect of proposed Block A would be an undesirable planning and environmental outcome, in particular from an optimum site regeneration and a landscape and visual impact perspective, at this pivotal, gateway site.

15.4.3 Assessment of Effects during Construction

The likely potential effects of the construction of the proposed development on land and soils are listed below and described in the following sections:

- Pollution from construction activities;
- Compression of substrata;
- Loss of Overburden
- Earthworks haulage;
- Excavation of Soft Soils; and
- Ground Movements.

Pollution from Construction Activities

The construction of the proposed development will require the use of fuels and materials which will have the potential to pollute the site, and adjacent, environment. Pollution from construction activities is considered to be a small adverse effect and the significance of this effect is moderate/slight.

Compression of Substrata

During earthworks heavily loaded HGVs would travel through the site potentially generating ground vibration, unwanted compaction and disturbance of natural ground on unfinished surfaces. Construction traffic may therefore result in increased loading on underlying soils which may affect the current characteristics of the ground by compressing substrata.

Given the nature of the soils and the site history of industrial use, the effect is deemed to be imperceptible and thus not significant during construction.

Loss of Overburden

Some of the overburden material may be suitable for re-use as an engineered fill for use within the development subject to appropriate approvals/notifications. Materials which are not suitable for reuse, through their properties or the absence of opportunity for reuse, will need to be removed off-site to a suitable disposal facility.

Given the nature of the soils and the site history of industrial use, the effect is deemed to be imperceptible and thus not significant during construction.

Earthworks Haulage

The excavation of soils to facilitate construction of the foundations will result in increased traffic on the roads to and from the proposed site. Increased noise, dust and vibration will also be generated.

Details in relation to the management of these soils is discussed in Chapter 17: Material Assets - Waste Management of this EIAR.

These works are expected to have a low importance given that the volume of the material for removal is low on a local scale. The magnitude of the impact of this activity would be small adverse. The significance of the potential impact is Imperceptible.

Excavation of Soft Soils

Limited soft soils may require excavation and replacement when encountered at the base of excavations for the proposed development. These are expected to be localised and minor in extent.

Given the relatively small quantity of soils which will be removed, it is considered to be a small adverse impact that does not have any regional significance. The significance of the potential impact is Imperceptible.

Removal of Contaminated Soils

The excavation on the site and removal of soils unsuitable for reuse or retention on site would be of low importance given the volume of the material that would be removed is low on a local scale. Further, where possible, suitable material would be retained within the proposed development.

The removal of soils unsuitable for reuse or retention on site would be a small adverse effect, therefore this effect is deemed to be imperceptible during construction. However, the removal of these soils off-site would also result in a beneficial small positive effect on site.

Ground Movements

The excavation activities generate the potential to induce ground movements and potentially settlement adjacent to excavations and dewatering operations across the study area. However, this would be typical of a development of this scale and would be considered as standard for these types of works.

The potential to induce movement and settlement would be of low importance given the limited area to be excavated and the provision of appropriate temporary support measures, including but not limited to trench boxes and/or sheet piling. The potential to induce movement and settlement would be small adverse and this effect is deemed to be Slight.

Summary of Construction Effects

summarises the predicted impacts during the Construction Phase.

Feature	Importance		Magnitude of Effects		Significance of Effects
	Ranking	Justification	Ranking	Justification	
Contaminated Land	High	Historic site for heavy industry	Small adverse	Limited construction traffic and construction activities	Moderate / Slight
Overburden Soils	Low	Subsoils are likely to be removed. Increased loading on underlying deposits	Small adverse	Removal of soils and replacement with structure will not impact on the characteristics of the soils and rock.	Imperceptible
Loss of Overburden	Low	Made Ground / estuarine deposits / Glacial Till	Small adverse	Loss of a small proportion of soils	Imperceptible
Earthworks Haulage	Low	Volume of material for removal is low on a local scale	Small adverse	Limited excavation and disposal	Imperceptible
Excavation of soft soils	Low	Volume of soft alluvial soil is small	Small adverse	Only a small proportion/if any of soft soils beneath the foundations will require excavation	Imperceptible
Effect on the surrounding ground	Low	Minor on a local scale	Small Adverse	Results in minor impact on the integrity of the attribute	Imperceptible

Table 15.6: Summary of Effects due to construction

15.4.3.1 Indirect Effects

The main identified indirect effects relate to removal and disposal of contaminated soils off site, and damage to nearby sites and infrastructure due to ground movements during excavation.

Both of these are directly addressed in Sections 15.5.1 Mitigation and Monitoring measures from Section 15.5.2 are provided to minimise the residual indirect risk.

15.4.3.2 Cumulative Effects

In preparing this chapter, consideration was given to the developments listed in Appendix 21.1 of this EIAR in relation to relevant cumulative and in combination effects, along with the development of Blocks B and C as per ABP-306569-20.

The main impacts from the proposed development arise during construction with negligible effects with respect to land and soils occurring during operation. It is unknown at this stage if the construction works associated with other developments would be occurring at the same time as the construction of the proposed development.

Notwithstanding, given the nature and scale of the developments identified, no cumulative effects on land and soils are predicted to occur if any, or all of these developments occur concurrent to the construction of the proposed development.

It is our opinion that there are no significant cumulative effects on Land and Soils associated with the proposed development.

15.4.4 Assessment of Effects During Operation

The operational phase of the proposed development will have an overall neutral long-term impact on land and soils.

The potential impacts on land and soils during the operational phase will be limited to accidental spillage of potentially polluting substances including fuel, oils, paints and wastes.

All potential impacts on land and soils from the operational phase of the proposed development will be of imperceptible significance.

15.4.4.1 Indirect Effects

There are no identified indirect impacts at the operational stage relation to Soils and Geology.

15.4.4.2 Cumulative Effects

In preparing this chapter, consideration was given to the developments listed in Appendix 21.1 in relation to relevant cumulative and in combination effects. It is our opinion that there are no significant cumulative effects on Land and Soils associated with the proposed development in the operational phase.

15.5 Mitigation Measures and Monitoring

15.5.1 Mitigation

15.5.1.1 Mitigation During Construction

General

A Construction Environmental Management Plan (CEMP) is contained in Appendix 4.1.

Precautionary measures will be taken to contain any areas within the planning boundary at risk of contaminated run-off.

- Potential pollutants shall be adequately secured against vandalism and will be provided with proper containment according to the relevant codes of practice. Any spillages will be immediately contained, and contaminated soil shall be removed from the proposed development and properly disposed of in an appropriately licensed facility;
- Dust generation shall be kept to a minimum through the wetting down of haul roads as required and other dust suppression measures;

- Any stockpiles of earthworks and site clearance material shall be stored on impermeable surfaces and covered with appropriate materials;
- Silt traps shall be placed in gullies to capture any excess silt in the run-off from working areas;
- Soil and water pollution will be minimised by the implementation of good housekeeping (daily site clean-ups, use of disposal bins, etc.) and the proper use, storage and disposal of these substances and their containers as well as good construction practices; and
- A contingency plan for pollution emergencies will also be developed by the contractor prior to the commencement of the works and regularly updated during construction. This contingency plan will identify the actions to be taken in the event of a pollution incident in accordance with the CIRIA guidance37 which requires the following to be addressed:
    - Containment measures;
    - Emergency discharge routes;
    - List of appropriate equipment and clean-up materials;
    - Maintenance schedule for equipment;
    - Details of trained staff, location and provision for 24-hour cover;
    - Details of staff responsibilities;
    - Notification procedures to inform the EPA or Environmental Department of the Wicklow County Council;
    - Audit and review schedule;
    - Telephone numbers of statutory water consultees; and
    - List of specialist pollution clean-up companies and their telephone numbers.

Compression of Substrata

- Excavations shall be kept to a minimum, using shoring or trench boxes where appropriate. For more extensive excavations, a temporary works designer shall be appointed to design excavation support measures in accordance with all relevant guidelines and standards.

Loss of Overburden

- All excavated material will, where possible, be reused as construction fill. The appointed contractor will ensure acceptability of the material for reuse for the proposed development with appropriate handling, processing and segregation of the material. This material would have to be shown to be suitable for such use and subject to appropriate control and testing according to the Earthworks Specification(s);
- These excavated soil materials will be stockpiled using an appropriate method to minimise the impacts of weathering. Care will be taken in reworking this material to minimise dust generation, groundwater infiltration and generation of runoff; and
- Any surplus suitable material excavated that is not required elsewhere for the proposed development, shall be used for other projects where possible, subject to appropriate approvals/notifications.

Earthworks Haulage

- Earthworks haulage will be agreed on predetermined routes along existing national, regional and local routes. Where compaction occurs due to truck movements and other construction activities on unfinished surfaces, remediation works will be undertaken to reinstate the ground to an

acceptable condition. Where practicable, compaction of any soil or subsoil which is to remain in situ will be avoided; and

- Earthworks operations shall be carried out such that surfaces shall be designed with adequate falls, profiling and drainage to promote safe runoff and prevent ponding and flooding. Runoff will be controlled through erosion and sediment control structures appropriate to minimise the possible impacts.

Impact on surrounding ground:

- Ground settlement, horizontal movement and vibration monitoring will be implemented during construction activities to ensure that the construction does not exceed the design limitations; and
- Ground settlements will be controlled through the selection of a foundation type and construction methods which are suitable for the particular ground conditions.

15.5.1.2 Mitigation During Operation

No mitigation has been proposed with respect to effects from operation of the proposed development in relation to soils and geology.

There are no residual issues relating to soils and geology. No specific operational phase mitigation measures relating to soils and geology are required.

15.5.2 Monitoring

15.5.2.1 Monitoring During Construction

Excavations in made ground will be monitored by an appropriately qualified person to ensure that any contaminated material is identified, segregated and disposed of appropriately. Any identified hotspots shall be segregated and stored in an area where there is no possibility of runoff generation or infiltration to ground or surface water drainage. Care will be taken to ensure that the hotspot does not cross-contaminate clean soils elsewhere.

Any excavation shall be monitored during earthworks to ensure the stability of side slopes and to ensure that the soils excavated for disposal are consistent with the descriptions and classifications according to the waste acceptance criteria testing carried out as part of the site investigations.

Ground settlement, horizontal movement and vibration monitoring will be implemented during construction activities to ensure that the construction does not exceed the design limitations. Monitoring will be more rigorous in the proximity of any protected structures. This will include more frequent monitoring and additional monitoring points. Monitoring points will be located on the face of the structures and centred every 1m. Horizontal, vertical and rotational displacement in all directions will be monitored.

Movement monitoring shall be carried out during any activities which may result in ground movements or movements of any nearby structures.

15.5.2.2 Monitoring During Operation

No monitoring is specified as no impacts were identified for the operational phase of the works.

15.6 Residual Effects

Before the implementation of any mitigation measures, all but one effect was noted to have an imperceptible effect. The only feature which was identified to have a moderate to slight effect related to the excavation and management of contaminated soils on the site.

With the implementation of the proposed mitigation measures outlined in Section 15.5.1 and monitoring during construction, the effect of the proposed development on land and soils is considered to be of negligible magnitude and imperceptible significance during construction and operation. Table 15.7 summarises the residual effects; however, no residual effects of significance on land and soils were identified.

16.0 Difficulties Encountered

There were no difficulties encountered during the compilation of this chapter.

Feature	Importance		Magnitude of Effects		Significance of Effects	Mitigation Measures	Residual effect	Residual Significance of Effect
	Ranking	Justification	Ranking	Justification				
Contaminated Land	High	Historic site for heavy industry	Small adverse	Limited construction traffic and construction activities	Moderate / Slight	Implementation of CEMP, Good management of site and excavated soils.	Negligible	Imperceptible
Overburden Soils	Low	Subsoils are likely to be removed. Increased loading on underlying deposits	Small adverse	Removal of soils and replacement with structure will not impact on the characteristics of the soils and rock.	Imperceptible	N/A	Negligible	Imperceptible
Loss of Overburden	Low	Made Ground / estuarine deposits / Glacial Till	Small adverse	Loss of a small proportion of soils	Imperceptible	N/A	Negligible	Imperceptible
Earthworks Haulage	Low	Volume of material for removal is low on a local scale	Small adverse	Limited excavation and disposal	Imperceptible	N/A	Negligible	Imperceptible
Excavation of soft soils	Low	Volume of soft alluvial soil is small	Small adverse	Only a small proportion/if any of soft soils beneath the foundations will require excavation	Imperceptible	N/A	Negligible	Imperceptible
Effect on the surrounding ground	Low	Minor on a local scale	Small Adverse	Results in minor impact on the integrity of the attribute	Imperceptible	N/A	Negligible	Imperceptible

Table 15.7: Residual Effects