Chapter 9
Land and Soils

CONTENTS

9. LAND AND SOILS

9.1 Introduction

This chapter of the Environmental Impact Assessment Report (EIAR) presents the land and soils assessment of the proposed Construction, Operational, and Decommissioning Phases of the DART+ Coastal North project ('the Proposed Development').

The Land and Soils assessment has been carried out according to best practice and guidelines relating to land, soils, and geology, and in the context of similar large-scale infrastructural projects.

'Land' in the context of this chapter refers to the existing soil and geological characteristics of the receiving environment. Land use changes are addressed in Volume 2, Chapter 7 (Population), and property impacts are dealt with in Volume 2: Chapter 16 (Material Assets: Agricultural) and Volume 2: Chapter 17 (Material Assets: Non- Agricultural). This chapter sets out the methodology used to undertake the assessment (Section 9.3), describes the existing environment (Section 9.4), presents a tabulated conceptual site model for zones along the Proposed Development (Section 9.5), summarises the main characteristics of the Proposed Development (Section 9.6), examines the predicted impacts of the Proposed Development (Section 9.7), proposes mitigation measures (Section 9.8), and identifies residual and cumulative impacts (Sections 9.9 and Section 9.10 respectively). This chapter should be read in conjunction with the following Chapters of Volume 2 of this EIAR, and their appendices, which present related impacts arising from the Proposed Development and proposed mitigation measures to ameliorate the predicted impacts:

- Chapter 4 Description of the Proposed Development;
- Chapter 5 Construction Strategy;
- Chapter 11 Hydrogeology;
- Chapter 19 Material Assets: Resource and Waste Management;
- Chapter 20 Archaeology and Cultural Heritage;
- Chapter 21 Architectural Heritage; and
- Chapter 26 Cumulative Effects.

9.2 Legislation, Policy, and Guidance

9.2.1 Legislation

Córas Iompair Éireann is applying to An Bord Pleanála for a Railway Order for the DART+ Coastal North project under the Transport (Railway Infrastructure) Act 2001 (as amended and substituted) ("the 2001 Act") and as recently further amended by the European Union (Railway Orders) (Environmental Impact Assessment) (Amendment) Regulations 2021 (S.I. No. 743/2021) ("the 2021 Regulations"). The purpose of the 2021 Regulations was to give further effect to the transposition of Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment as amended by Directive 2014/52/EU "the EIA Directive" on the assessment of the effects of certain public private projects on the environment by amending the 2001 Act. This land and soils impact assessment has been undertaken in accordance with these requirements and in relation to conditions relevant to land and soils.

9.2.2 Policy

Relevant policy documents that have informed this chapter include:

- Dublin City Development Plan 2022-2028;
- Fingal Development Plan 2023-2029;
- Meath County Development Plan 2021-2027; and
- Louth County Development Plan 2021-2027.

9.2.3 Guidance

This chapter has been prepared following the guidance documents below:

- Environmental Protection Agency (EPA) (2022), Guidelines on the Information to be contained in Environmental Impact Assessment Reports;
- Guidelines for the Preparation of Soil, Geology and Hydrogeology Chapters of Environmental Impacts Statements (IGI, 2013); and
- National Roads Authority (NRA) Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (hereafter referred to as the NRA Guidelines) (NRA, 2008).

Though the NRA is now known as Transport Infrastructure Ireland (TII), for the purpose of this chapter the guidelines mentioned above are referred to as the NRA Guidelines.

In addition, the following have been referenced:

- CL:AIRE, 2010, Soil Generic Assessment Criteria for Human Health Risk Assessment;
- CL:AIRE/SuRF, 2010, A Framework for Assessing the Sustainability of Soil and Groundwater Remediation;
- European Communities (Assessment and Management of Flood Risks) Regulations 2010 (S.I. No. 122/2010); and
- Regulation 15 of S.I. No. 323/2020 – European Union (Waste Directive) Regulations 2020.

9.3 Methodology

9.3.1 Study Area

The Proposed Development extends for approximately 50km along the existing Northern Line railway corridor, including the Howth Branch line, which runs through county Dublin (Dublin City and Fingal) into counties Meath and Louth, and which comprises mostly urban, suburban and agricultural areas.

The southern part of the Proposed Development is in a more densely populated, commercial and urbanised area, starting from north of Connolly Station in Dublin City Centre. Further out along the route, land use transitions more frequently to agriculture with farmland pastures either side of the existing transport corridor, with several towns located along the route. The end of the Proposed Development is located in the large urban centre of Drogheda in County Louth.

The study area is also affected by the historic development of the original railway line which masks the original context of the natural ground conditions. As the Proposed Development relates to upgrade and expansion of existing rail infrastructure, the study area is taken as no more than a 100m wide corridor along most of the existing railway lands.

As outlined in Chapter 4 (Description of the Proposed Development) in Volume 2 of this EIAR, the Proposed Development has been divided into five zones (Zones A to E), which are summarised below.

- Zone A – North of Connolly Station to south of Howth Junction & Donaghmede Station (including Fairview depot);
- Zone B – South of Howth Junction & Donaghmede Station (including Howth Branch) to north of Malahide Viaduct;
- Zone C – North of Malahide Viaduct to south of Gormanston Station (Fingal boundary);
- Zone D – South of Gormanston Station (Fingal border) to County Meath/County Louth border; and
- Zone E – Drogheda MacBride Station and surrounds.

9.3.2 Data Collection and Collation

Data were compiled from publicly available datasets, the findings of ground investigations, design information, a scheme walkover survey, and other sources, as outlined further herein.

9.3.2.1 Publicly Available Datasets

The publicly available datasets listed in Table 9.1 have been acquired and consulted in the assessment of the baseline conditions.

Table 9.1 Publicly available datasets.

Source	Name	Description
Ordnance Survey Ireland Geohive (OSI)	Current and historical ordnance survey maps	Current and historical survey maps produced by the OSI
	Aerial photography	Current and historical aerial imagery produced by the OSI
Google	Aerial Photography	Current aerial imagery produced by Google
Bing	Aerial Photography	Current aerial imagery produced by Bing
Teagasc	Teagasc Soil Data	Surface soils classification and description
Environmental Protection Agency (EPA)	CORINE Land Cover 2018	These datasets are based on interpretation of satellite imagery and national in situ vector data
	Historic Mine Sites – Inventory and Risk Classification	
	River Network Map	
	Waste Boundaries	Boundaries of all waste facilities within Ireland that are or are going to be licensed by the EPA.

Source	Name	Description
National Monuments Service (2018) (Archaeological Survey of Ireland)	Archaeological Monuments	This dataset provides all recorded archaeological monuments
Department of Communications, Energy, and Natural Resources	State Mining and Prospecting Facilities	A booklet contains a list of all current and prospecting mining facilities
	Historical Mine Sites – Inventory and Risk Classification	Inventory of Ireland's Historic Mine Sites with investigation and potential risk posed by these sites.
Geological Survey Ireland (GSI)	Quaternary Mapping	Geological maps of the site area produced by the GSI and available on the GSI online map viewer
	Bedrock Mapping	
	Aggregate Potential Mapping	
	Mineral Localities	
	Geotechnical Sites	
	National Landslide Database	
	Karst Database	
	Historic Mine Sites – Inventory and Risk	
	Active Quarries and pits	
	County Geological Heritage Sites and Geological Heritage Areas	
	GSI, Memoirs	

The desk study involved collecting all relevant geological data for the study area, particularly those within the railway corridor or in the vicinity of the proposed substation locations where feasible design options were required.

Existing information such as mapping and aerial photographs were used during initial desktop studies to plan the ground investigations. Sources of historical information, geological maps and/or features had been established during the geotechnical desktop study of the area including a review of information from various previous projects and site developments.

The sources of information reviewed include:

- Geological mapping from the Geological Survey of Ireland (GSI);
- Historic Borehole Logs, Geotechnical, GeoUrban, Aquifer Viewers and GOLDMINE digital report depository (www.gsi.ie/mapping);
- Historical ordnance survey mapping information from OSI website, including historical maps available, OSI Historic 6" black & white and colour, OSI 6" Cassini and OSI Historic 25" (map.geohive.ie);
- Information on the hydrology and hydrogeology has been obtained from the interactive maps on the GSI website;
- Corine Land Cover, River Network and EPA Licensed Facilities obtained from the Environmental Protection Agency (EPA) online maps;
- Topographical information from Ordnance Survey Ireland published on the GSI website.
- Dublin Soil Urban Geochemistry (SURGE) project data and reporting as published on the GSI website; and

- Google Earth and Bing Maps.

9.3.2.2 Ground Investigations

The details of the existing and historical Ground Investigation (GI) reports located along the Proposed Development which have been used in the assessment of the baseline conditions are presented in Table 9.2. These reports are publicly available from the 'EXT GSI Geotechnical Sites' layer of the Geological Survey Ireland (GSI) Spatial Resources Map Viewer. Additional existing ground investigation reports were provided by Iarnród Éireann and are presented in Table 9.3.

Table 9.2 Existing Ground Investigations.

Title	Contractor	Year	Location	Scope
Baldoyle Industrial Estate	IGSL	September, 1991	Zone B; north-east of Howth Junction and Donaghmede Station	7 no. trial pits
DART Enhancement Howth Junction	IGSL	January, 2004	Zone B; Howth Junction and Donaghmede Station	3 no. boreholes
Reports on a Site Investigation at Clontarf, Dublin	IGSL	June, 1993	Zone A; Clontarf Station	6 no. boreholes 8 no. trial pits
Report on Trial Pit Investigation at Gairdíní Léin. Raheny	Irish Soil Laboratories Ltd.	January, 1976	Zone A; east of Raheny Station	5 no. trial pits
Report on Site Investigation at Raheny, Co. Dublin	SIL	January, 1973	Zone A; south of Raheny Station	Unknown
Report on Site Investigation for Gerard Laboratories at Baldoyle Industrial Estate	IGSL	August, 1993	Zone B; north of Howth Junction and Donaghmede Station	5 no. trial pits
Report on a Site Investigation at Grange Road Site C	IGSL	July, 2005	Zone B; between Howth Junction and Donaghmede and Clongriffin Stations	7 no. trial pits 20 no. dynamic probes
Ground Investigation for Proposed Residential Development – Phase 3	IGSL	October, 2005	Zone B; Clongriffin Station	25 no. boreholes 13 no. trial pits
Mayne Road Railway Bridge	IGSL	March, 2008	Zone B; railway bridge crossing north of Clongriffin Station	4 no. boreholes
Report on a Site Investigation for a Development at Portmarnock, Co. Dublin	IGSL	January, 2005	Zone B; Portmarnock Station	4 no. boreholes 8 no. trial pits
New Malahide Marina Development	IGSL	June, 1992	Zone B; south of Malahide viaduct	9 no. trial pits
Ground Investigation Rogerstown, Co. Dublin	IGSL	January, 2008	Zone C; Rogerstown viaduct	6 no. boreholes
Site Investigation at Balbriggan Road, Skerries, Dublin	IGSL	July, 1998	Zone C; north of Skerries Station	21 no. trial pits 21 no. dynamic probes

Table 9.3 Existing Ground Investigations (provided by Iarnród Éireann).

Title	Contractor	Year	Location	Scope
Civil Engineering Works for the Down Side Loop at Clongriffin Station, Baldoyle Dublin	IGSL	June, 2007	Zone B; Clongriffin Station	10 no. boreholes 4 no. rotary core boreholes 3 no. trial pits
Proposed Maintenance Depot McBride Railway Station, Drogheda	IGSL	July, 2000	Zone E; around Drogheda MacBride Station	8 no. boreholes 10 no. trial pits 2 no. rotary core boreholes
Malahide Estuary Bridge Estuary Model, Drawing 091059_3DEST1_5_R1, Rev 1, 08.01.10	Murphy	January, 2010	Zone B; Malahide Estuary	Bathymetric survey

The project specific ground investigation carried out to inform the Proposed Development design and EIAR is listed in Table 9.4 and included investigation works within and adjacent to the rail corridor. These provide useful verification for the data already collected relating to the baseline environment. Graphical Conceptual Sites Models (CSMs) as Geological Plan and Profile drawings are presented in Appendix A9.1 of Volume 4 of this EIAR.

Table 9.4 Project-specific Ground Investigation.

Title	Contractor	Report no., Year, and Revision	Location	Scope
DART+ Coastal North & BEMU Stage A Ground Investigation	Causeway Geotech Ltd.	Report no. 21-1711 November 2023 Revision A01	-	Cover report of Volumes 1,2 and 3 listed below
Volume 1 – Drogheda Station, Depot & BEMU	Causeway Geotech Ltd.	Report no. 21-1711A October 2023 Revision A10	Zone E; around Drogheda MacBride Station	7 no. boreholes 5 no. boreholes with rotary follow-on drilling 2 no. rotary core boreholes 9 no. dynamic (windowless) samples 12 no. dynamic probes 13 no. trial pits 5 no. foundation inspection pits 2 no. slit trenches 7 no. standpipe installations in boreholes Laboratory testing on collected samples for material properties determination
Volume 2 – Drogheda to Malahide Electrification	Causeway Geotech Ltd.	Report no. 21-1711B October 2023 Revision A05	Northern portion of Zone B around Malahide Viaduct and Causeway, Zone C, Zone D and Zone E	24 no. boreholes 30 no. boreholes with rotary follow-on drilling 14 no. rotary core boreholes 125 no. dynamic (windowless) samples 13 no. trial pits 4 no. observation pits 32 no. foundation inspection pits 11 no. dynamic probes 30 no. standpipe installations in boreholes Geophysical survey consisting of 7 no. 2D Electrical Resistivity Tomography, 7 no. Seismic Refraction, and 38 no. Soil Resistivity readings Laboratory testing on collected samples for material properties determination

Title	Contractor	Report no., Year, and Revision	Location	Scope
Volume 3 – Malahide, Clongriffin & Howth Junction	Causeway Geotech Ltd.	Report no. 21-1711C October 2023 Revision A06	Zone B; Howth Junction and Donaghmede, Clongriffin, and Malahide Stations	4 no. boreholes 3 no. boreholes with rotary follow-on drilling 12 no. dynamic (windowless) samples 3 no. trial pits 2 no. foundation inspection pits 3 no. dynamic probes 4 no. standpipe installations in boreholes

9.3.2.3 Site Walkover

Site walkovers and inspections were carried out by Arup along the Proposed Development in both trackside and off-track locations including during the site-specific ground investigations.

9.3.3 Assessment Methodology

The potential impact of the Proposed Development on the land and soils environment has been assessed by classifying the importance of the relevant attributes and quantifying the likely magnitude of impact on these attributes. The rating criteria for assessing the importance of geological features within the study area are detailed in Table 9.5 whilst the rating criteria for quantifying the magnitude of impacts are detailed in Table 9.6. The significance rating of potential impacts on the land and soils environment are based on the assessment criteria presented in Table 9.7. This will take account of both the importance of an attribute and magnitude of the potential impacts on the attribute as a result of the Proposed Development.

The impact assessment for this chapter has been carried out in accordance with the NRA Guidelines (NRA, 2008a) and the IGI Guidelines (IGI, 2013). This IGI guidance outlines a 13-step methodology that is divided across four distinct elements:

- Initial assessment;
- Direct and indirect site investigation;
- Mitigation measures, residual effects, and final impact assessment; and
- Completion of the Lands, Soils, Geological and Hydrogeological sections of the EIAR.

9.3.3.1 Initial Assessment

The ‘initial assessment’ presents a description of the past and present uses of the land across the relevant site and route which may have a bearing on the Proposed Development. This includes a detailed description of the nature of the ground conditions beneath the relevant sites and route based on existing literature as well as site specific and neighbouring site investigation data.

9.3.3.2 Direct and Indirect Site Investigation

Section 9.3.2.2 provides a summary of the data available from the historic and site-specific investigations carried out in relation to the Proposed Development. The information gathered on the receiving environment during ground investigations corresponds to the second element of the methodology, ‘Direct and Indirect Site Investigation and Studies’.

9.3.3.3 Mitigation Measures, Residual Effects, and Final Impact Assessment

The outcome from examining this available data is a Conceptual Site Model (CSM). The CSM is a summary of the 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 which has the potential to be affected by the Proposed Development based on the guidance from the NRA and IGI. This facilitates the assessment of likely significant impacts which has been undertaken in accordance with the guidance outlined in Section 9.2.

Section 9.8 outlines the 'Mitigation Measures' associated with the works in accordance with the above methodology. The final impact assessment includes a description of any residual impacts. The significance of any residual impact is determined based on the same methodology and reported.

Table 9.5 Criteria for Rating Importance.

Importance	Criteria	Typical Example
Very High	Attribute has a high quality, significance or value on a national or regional scale. Degree or extent of soil contamination is significant on a national or regional scale. Volume of peat and/or soft organic soil underlying route is significant on a national or regional scale*	Geological feature rare on a regional or national scale (NHA). Large existing quarry or pit. Proven economically extractable mineral resource.
High	Attribute has a high quality, significance or value on a local scale. Degree or extent of soil contamination is significant on a local scale. Volume of peat and/or soft organic soil underlying route is significant on a local scale*	Contaminated soil on site with previous heavy industrial usage. Large recent landfill site for mixed wastes. Geological feature of high value on a local scale (County Geological Site). Well drained and/or high fertility soils. Moderately sized existing quarry or pit. Marginally economic extractable mineral resource.
Medium	Attribute has a medium quality, significance or value on a local scale. Degree or extent of soil contamination is moderate on a local scale. Volume of peat and/or soft organic soil underlying route is moderate on a local scale*	Contaminated soil on site with previous light industrial usage. Small recent landfill site for mixed wastes. Moderately drained and/or moderate fertility soils. Small existing quarry or pit. Sub-economic extractable mineral resource.
Low	Attribute has a low quality, significance, or value on a local scale. Degree or extent of soil contamination is minor on a local scale. Volume of peat and/or soft organic soil underlying route is small on a local scale*	Large historical and/or recent site for construction and demolition wastes. Small historical and/or recent landfill site for construction and demolition wastes. Poorly drained and/or low fertility soils. Uneconomically extractable mineral resource
*relative to the total volume of inert soil disposed of and/or recovered		

Table 9.6 Criteria for rating the impact significance at EIAR Stage – Estimation of magnitude of impact on Soil/Geology Attribute.

Magnitude of Impact	Criteria	Typical Example
Large Adverse	Results in loss of attribute.	Loss of high proportion of future quarry or pit reserves. Irreversible loss of high proportion of local high fertility soils. Removal of entirety of geological heritage feature. Requirement to excavate / remediate entire waste site. Requirement to excavate and replace high proportion of peat, organic soils and/or soft mineral soils beneath alignment.
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute.	Loss of moderate proportion of future quarry or pit reserves. Removal of part of geological heritage feature. Irreversible loss of moderate proportion of local high fertility soils. Requirement to excavate / remediate significant proportion of waste site. Requirement to excavate and replace moderate proportion of peat, organic soils and/or soft mineral soils beneath alignment.

Magnitude of Impact	Criteria	Typical Example
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute.	Loss of small proportion of future quarry or pit reserves. Removal of small part of geological heritage feature. Irreversible loss of small proportion of local high fertility soils and/or high proportion of local low fertility soils. Requirement to excavate / remediate small proportion of waste site. Requirement to excavate and replace small proportion of peat, organic soils and/or soft mineral soils beneath alignment.
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity.	No measurable changes in attributes.
Minor Beneficial	Results in minor improvement of attribute quality.	Minor enhancement of geological heritage feature.
Moderate Beneficial	Results in moderate improvement of attribute quality.	Moderate enhancement of geological heritage feature.
Major Beneficial	Results in major improvement of attribute quality.	Major enhancement of geological heritage feature.

Table 9.7 Significance of Impacts.

Significance	Description
Imperceptible	An effect capable of measurement but without significant consequences.
Not Significant	An effect which causes noticeable changes in the character of the environment but without significant consequences.
Slight Effects	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.
Moderate Effects	An effect that alters the character of the environment in a manner that is consistent with existing or emerging baseline trends.
Significant	An effect which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
Very Significant	An effect which by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment.
Profound Effect	An effect which obliterates sensitive characteristics.

9.3.4 Consultation

Consultation was carried out with the Geological Survey Ireland (GSI) in relation to the relevant datasets used during the land and soils assessment. For further information regarding the overall consultation for the DART+ Coastal North project refer to Volume 2: Chapter 1 (Introduction) of this EIAR.

9.3.5 Difficulties Encountered/Limitations

The baseline data described and considered in this assessment of land and soils includes existing data from desk study information available at the time of writing and project-specific ground investigation information for the Proposed Development.

The baseline data from the project-specific ground investigation provides valuable information of the existing land and soils at point locations within the study area. Between each point the baseline data from the intrusive investigation has been assessed by conservative interpretation. While land and soils can vary, the exploratory locations have been selected following the completion and comprehensive review of all existing information available at the time.

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 locations and the spacing of the exploratory locations used as part of the intrusive investigation were chosen in order to gain an understanding of the land and soils. The findings from the investigation for most cases compared favourably with the desk study of existing information on the baseline conditions.

As is common in most construction projects, ground models for Proposed Developments are based on numerous information sources such as, but not limited to, geological maps, historic investigations in the area, and overburden mapping. By examining the existing landforms and understanding the geological history of the geomorphology of a site, these can all be used to assist in constructing a robust ground model. This ground model should then be assessed and confirmed through project specific ground investigation.

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 9.4), is deemed sufficient.

The ground conditions presented in this assessment are based on the factual ground investigation information from the Causeway Geotech Ltd. (2023) DART+ North & BEMU Stage A Ground Investigation as noted in Table 9.4 above. Historical ground investigation information has also been considered.

This assessment of the impact on land and soils has been carried out based on the preliminary design of the Proposed Development, with particular reference to the draft Railway Order, Chapter 4 (Description of the Proposed Development) and Chapter 5 (Construction Strategy).

9.4 Receiving Environment

9.4.1 Current and Historic Land Use

The current and historic land use is discussed to give context to any potential changes to land and soils that could influence the importance of a feature and the magnitude of any impacts. The current land use is based on current aerial imagery and mapping available from Ordnance Survey Ireland (OSI) (OSI, 2023), Google (Google, 2023), and Bing (Bing 2023), and the CORINE Land Cover maps (EPA, 2018). The historic land use is based on the following OSI (OSI, 2023) historical aerial imagery and historic maps:

- OSI 6-inch mapping produced between 1837 and 1842;
- OSI 25-inch mapping produced between 1888 and 1913;
- OSI 6-inch Cassini mapping produced between 1830 and 1930s; and
- OSI 1995, 1999–2003, 2004–2006, and 2005–2012 aerial photography.

9.4.1.1 Zone A (North of Connolly Station to south of Howth Junction & Donaghmede Station)

Historical OSI 6-inch mapping indicates that construction of the Dublin to Drogheda Railway was in progress in the period 1837–1842, with a viaduct crossing a tidal marsh zone in Clontarf. North of Clontarf, the railway construction passed through agricultural land and private estates. A quarry was located where the Clontarf Golf Club is currently located.

The historical OSI 25-inch mapping shows that by the period 1888–1913, the railway line had been constructed as well as an expansion of Dublin City suburbs north of Connolly Station (formerly Amiens Street Station) to Killester.

By the 1930s the land west of the railway line at Fairview had been reclaimed to create Fairview Park (OSI 6-inch Cassini mapping) and further urban development occurred around Killester and Raheny.

Recent aerial imagery shows widespread urban development within Zone A during the 20th Century with large scale residential, industrial, and commercial developments along the railway line. Further reclamation of the estuarine area at Fairview is evident where the land has been extended east of the railway line. The Dublin Port Tunnel was constructed in the early 2000's and crosses beneath the railway line to the south of Fairview depot buildings.

The CORINE 2018 database classifies the land use in Zone A as primarily discontinuous urban fabric, with green urban areas noted at Fairview Park and sports and leisure facilities at Clontarf Golf Club.

9.4.1.2 Zone B (South of Howth Junction & Donaghmede Station to north of Malahide Viaduct, including Howth Branch)

Historical OSI 6-inch mapping indicates that prior to 1837, there was no existing railway line along Zone B with agricultural land the predominant land use. Isolated settlements and notable estates are also evident. Sand pits are located south of Sutton Station and at Baldoyle Road and quarries are located at Clermont Road in Howth.

The historical OSI 25-inch mapping shows that by the period 1888–1913, the railway line had been constructed including the section of railway line from Howth Junction and Donaghmede Station to Howth Station. Urban development is evident in Malahide and Howth, although much of the land remains agricultural and undeveloped. An electricity generating station is located southeast of Sutton Station. A brick works was located adjacent to the railway line north of Portmarnock Station, and a gas works is located east of the railway line in Malahide.

The OSI 6-inch Cassini mapping shows significant development occurred along Zone B with numerous residential, commercial, and industrial developments constructed, particularly around Howth Junction and Donaghmede Station, Howth, Sutton and Malahide. A significant area of sand pits is located south of Sutton Station.

Recent aerial imagery indicates continued development along Zone B including widespread residential developments surrounding Clongriffin and Portmarnock Stations. There was significant land reclamation along the southern portion of the Malahide viaduct. A wastewater treatment plant is located at Malahide. Clongriffin Station was constructed in 2009 and opened to railway passengers in 2010.

The CORINE 2018 database classifies Zone B as predominantly discontinuous urban fabric. There is an area classified as non-irrigated arable land between Clongriffin and Portmarnock. There is also an area of natural vegetation cover to the north of Portmarnock Station.

9.4.1.3 Zone C (North of Malahide Viaduct to south of Gormanston Station)

Historical OSI 6-inch mapping shows that the railway line was under construction in the period 1837–1842, with much of the land surrounding the railway line undeveloped with dispersed urban settlements and the villages of Donabate and Balbriggan. A brick yard is located north of Balbriggan Station and a graveyard is located in Donabate.

According to the OSI 25-inch mapping (1888–1913), the construction of the railway line was complete by this time. South of Donabate where the River Pill discharges to the Malahide estuary land was reclaimed to the west of the Malahide Viaduct. Much of the land remained rural agricultural land with scattered settlements. In Balbriggan a hosiery factory was located north of Balbriggan Station, a linen factory was located on Mill Street, a salt works was located along the quay and a gas works was located on Quay Street. East of the R127 at Ardgillan Castle a relatively short section of tramway was present as well as a gravel pit. East of Skerries there was a relatively large gravel pit which was serviced by an extension off the main railway line.

The OSI 6-inch Cassini mapping shows further industrial and commercial development in the vicinity of Donabate, Skerries and Balbriggan.

Recent aerial imagery indicates further development and expansion of the urban areas of Donabate, Skerries and Balbriggan, as well as the development of Rogerstown Park on the northern shore of Rogerstown Estuary which is the site of the former Balleally landfill. Recent aerial imagery indicates features such as Roadstone Milverton Quarry (Limestone) and Skerries Golf Club. Recent aerial imagery shows widespread residential developments in Skerries and Balbriggan surrounded by agricultural land.

The CORINE 2018 database identifies several different land use classes within Zone C including intertidal flats, non-irrigated arable land, pastures, complex cultivation patterns, sport and leisure facilities, a dump associated with a licenced landfill (Balleally – W0009-03) (Rogerstown Park), and discontinuous urban fabric in the urban areas.

9.4.1.4 Zone D (South of Gormanston Station to County Meath/County Louth border)

Historical mapping indicates that there was no railway construction in Zone D during the period 1837–1842. By 1913 OSI 25-inch historical mapping shows considerable commercial and industrial developments, including the construction of the railway line, a viaduct over the Delvin River, and Gormanston and Laytown Stations.

Recent aerial imagery indicates widespread agricultural land with urban development at Laytown and Bettystown. The Gormanston Army Camp is located to the north of Gormanston Station.

The CORINE 2018 database classifies the majority of Zone D as non-irrigated arable land and pastures, with urban land around Laytown.

9.4.1.5 Zone E (Drogheda MacBride Station and surrounds, including Drogheda Freight Sidings)

The historical OSI 6-inch mapping indicates that there was no railway construction in Zone E prior to 1842. An historic corn mill was located east of the railway line at Newfoundwell Road.

The OSI 25-inch historical mapping shows the railway line, Drogheda MacBride Station, Newtown Bridge (now known as McGraths Bridge), and the Boyne Viaduct were built by the period 1888–1913 as well as an increase in urban development in the Drogheda area. A disused quarry is located to the south of the railway station. A cemetery is located at Blackbush Lane.

The OSI 6-inch Cassini mapping indicates the presence of coal yards adjacent to the Boyne Viaduct.

During the 20th and 21st Centuries, Drogheda expanded along the railway line with large scale residential developments and recent aerial imagery shows important features such as Drogheda Wastewater Treatment Plant. During the late 1990's, the platforms and track layout were altered at Drogheda MacBride Station, along with the removal of a goods shed, to facilitate the construction of the Drogheda MacBride Station carpark. The railway depot at Drogheda MacBride Station was constructed in the early 2000's.

The CORINE 2018 database classifies the land use in Zone E as non-irrigated arable land, fruit trees and berries plantation, and complex cultivation patterns north of the railway line, with discontinuous urban fabric south of the railway line. There is an area of urban green space to the east of Drogheda MacBride Station.

9.4.2 Topography and Geomorphology

The topography of the region is characterised by relatively low-lying, gently undulating lands. There are localised elevated areas across the region generally synonymous with bedrock at or near the surface. There is a gradual reduction in elevation across the region from west to east approaching the coast. The landscape of the region primarily reflects the erosional and depositional processes active during the last period of glaciation. Glacial erosion of pre-existing topographic features and deposition of thick glacial drift deposits, mainly as till (boulder clay), resulted in a subdued post-glacial topography across the region.

According to the GSI Quaternary Geomorphology mapping, the region exhibits a large number of geomorphological features, including mega scale glacial lineation, meltwater channels, and depositional features (refer to Figure 9.1 in Volume 3A of this EIAR). The post-glacial landscape also reflects the effects of fluvial (river) processes that have altered the topography, albeit to a small extent, since the ice sheet retreat. The coastline within the region is characterised by sandy beaches and rock outcrops.

According to the GSI Physiographic Unit mapping, most of the region is classified as rolling ice-moulded sediments. There are localised areas classified as hummocky sediments, hill to rolling lowland bedrock, and flat to undulating sediments.

9.4.2.1 Zone A (North of Connolly Station to south of Howth Junction & Donaghmede Station)

The topography of Zone A is characterised by gently undulating land. The topography ranges from approximately 4mOD north of Connolly Station to a high point of approximately 30mOD at Raheny Station, with elevation reducing to 12mOD at Howth Junction and Donaghmede Station. In general, the topography slopes eastwards towards the coastline.

According to the GSI Quaternary Geomorphology mapping, there are several mega scale glacial lineation features crossing Zone A, trending in an east-west direction.

The southern boundary of Zone A is marked by the Tolka River. The EPA river network mapping also indicates that the Santry River crosses the Proposed Development in Zone A, approximately 200m south of Raheny Station. The Rivers of Dublin map (Sweeney, 2017) indicates that numerous historic rivers/streams cross the railway line along Zone A, including the Grace Park Stream, Marino Stream, the Naniken River, Blackbanks Stream, Kilbarrack Stream, and several unnamed streams. A culvert (UBQ0A) is present within the station crossing the Howth Branch and may relate to the northern section of the Kilbarrack Stream; no details of a culvert to the south of the station are known or available.

9.4.2.2 Zone B (South of Howth Junction & Donaghmede Station to north of Malahide Viaduct, including Howth Branch)

The topography of Zone B is generally gently undulating and low-lying. The topography ranges from approximately 5mOD north of Clongriffin Station to a maximum of approximately 25mOD to the south of Malahide Station. The topography reduces to 2mOD at the southern portion of the Malahide viaduct. The track elevation ranges between 3mOD and 4mOD along the Malahide Viaduct to the northern extent of Zone B. Bathymetric survey data of the Malahide Estuary (see Section 9.3.2) indicates that the estuary bed is generally flat with a level of approximately -1mOD to 0mOD. The estuary bed drops to a level of approximately -9.5mOD immediately to the west of the Malahide Viaduct structure.

The GSI Quaternary Geomorphology mapping indicates that there are several mega scale glacial lineation features crossing the Proposed Development along Zone B, including at Howth Junction and Donaghmede, and Portmarnock Stations. There are several meltwater channels indicated approximately 1.5km west of the railway line between Clongriffin and Portmarnock Stations. There are glaciofluvial terrace deposits located approximately 750m west of the railway line at Portmarnock Station associated with the Sluice River system. There is streamlined bedrock shown in Malahide.

The EPA river network mapping indicates that the Proposed Development is crossed by several watercourses along Zone B, including the Mayne River, Sluice River, and Hazelbrook Stream. The Rivers of Dublin map (Sweeney, 2017) also indicates that the Grange Stream may also cross the railway line along Zone B between Howth Junction and Donaghmede and Clongriffin Stations.

9.4.2.3 Zone C (North of Malahide Viaduct to south of Gormanston Station)

The topography along Zone C is variable, but generally undulating and low-lying. South of Skerries Station, the topography ranges from approximately 2mOD around Malahide Estuary to a maximum of 44mOD approximately 2.2km south of Skerries Station. The topography reduces to approximately 16mOD at Skerries Station. North of Skerries Station, the topography is relatively consistent, ranging between 10mOD and 20mOD, with reduced elevation noted along watercourse crossings.

The GSI Quaternary Geomorphology mapping indicates widespread geomorphological features along Zone C of the Proposed Development. There are numerous mega scale glacial lineation features noted between Donabate and Skerries Stations. There are two drumlin features trending east-west crossing the railway line to the south of Donabate Station, with another drumlin feature to the south of Skerries Station. There is an esker ridge classified as long bead subglacial tunnel fill located approximately 200m west of Donabate Station. There are several meltwater channels recorded in the vicinity of Zone C. There are numerous Crag-and-Tail features to the west of the railway line around Skerries Station.

The EPA river network mapping indicates that the railway line is crossed by numerous rivers and streams along Zone C of the Proposed Development. South of Skerries Station, the watercourse crossings include the Malahide and Rogerstown Estuaries, Turvey Stream, Rahillion, Rathmooney, Palmerstown, Rush, Balcunnin, and Mill Streams. North of Skerries Station, the watercourse crossings include the Barnageeragh Stream, the Bracken (Matt) River, and Bremore Stream. The Delvin River marks the boundary with Zone D.

9.4.2.4 Zone D (South of Gormanston Station to County Meath/County Louth border)

The topography of Zone D is generally flat and low-lying. The topography of Zone D ranges from approximately 13mOD at Gormanston Station to a maximum of approximately 30mOD at the northern boundary of Zone D. There is lower elevation to the south of Laytown Station at the River Nanny watercourse crossing.

The GSI Quaternary Geomorphology mapping indicates widespread glaciofluvial terrace deposits associated with the Delvin River system between Gormanston and Laytown Stations. The area to the north of Laytown Station is also underlain by glaciofluvial terraces associated with the Nanny River system. North of Laytown Station there is a series of mega scale glacial lineation features crossing the railway line, trending in a generally northeast-southwest direction. The railway line crosses at meltwater channel between Gormanston and Laytown Station, located at the Mosney Stream outflow.

The EPA river network mapping indicates that the southern boundary of Zone D is marked by the Delvin River. Along Zone D, the railway line also crosses the Mosney Stream, Nanny River, Mornington Stream, Pilltown Stream and Betaghstown Stream.

9.4.2.5 Zone E (Drogheda MacBride Station and surrounds, including Drogheda Freight Sidings)

The topography along Zone E is generally flat with elevations ranging between 26mOD and 33mOD. There is a marked reduction in elevation at the Boyne River watercourse to the north of Drogheda MacBride Station where the elevation ranges between 3mOD and 5mOD.

According to the GSI Quaternary Geomorphology mapping, there are no geomorphological features along Zone E of the Proposed Development. There is a meltwater channel located approximately 500m east of the railway line in Drogheda town centre. There are widespread glaciofluvial terraces associated with the Boyne River system located approximately 2.4km west of the railway line. There is a series of Ribbed Moraine deposits located to the north of Drogheda.

The EPA river network mapping indicates that the railway line crosses the Stagrennan Stream and Boyne River in Zone E of the Proposed Development.

9.4.3 Soils

Soils comprise the unconsolidated geological deposits which cover the subsoil (for example, topsoil). The main soil types within the region, according to Teagasc (Teagasc, *et al*., 2017), are presented in Figure 9.2 in Volume 3A of this EIAR and are summarised in Table 9.8.

The soil type is variable across the region. Made ground associated with urban centres is common across the region. South of Lusk in north County Dublin, the main soil types include well drained mineral soils derived from basic parent material of varying thickness. Further north, the main soil types include well drained mineral soils derived from acidic parent material of varying thickness. There are also alluvial, estuarine, and marine deposits across the region associated with existing and/or historic water bodies.

Where relevant the soils encountered during the project specific ground investigations are described below.

9.4.3.1 Zone A (North of Connolly Station to south of Howth Junction & Donaghmede Station)

The primary soil type in Zone A is made ground associated with Dublin City and the surrounding suburban area. There is a minor deposit of marine/estuarine sediments (MarSed) beneath Fairview Park west and north of the Clontarf depot. A minor strip of beach sand and gravels (MarSands) are located on the northern boundary of Fairview Park east of Clontarf Station. According to the Teagasc soil mapping, there are several small pockets of shallow well drained mineral mainly basic soils (BminSW) between Clontarf Station and Killester Station. There is a deposit of alluvium (AlluvMIN) located immediately south of Raheny Station associated with the Santry River.

There was no project-specific ground investigation carried out within Zone A of the Proposed Development.

9.4.3.2 Zone B (South of Howth Junction & Donaghmede Station to north of Malahide Viaduct, including Howth Branch)

Zone B denotes the change from the northern suburbs of Dublin City to more agriculturally based land use. The southern extent of Zone B south of Clongriffin Station and east towards Howth is classified as made ground. Along the northern shore of Howth Peninsula there are areas of windblown sands (AeoUND), beach sands and gravels (MarSands) and deep well drained mainly basic soils (BminDW).

North of Clongriffin Station, the soil is primarily classified as mineral poorly drained, mainly basic soil (BminPD) and deep well drained mineral, mainly basic soil (BminDW). A deposit of alluvium (AlluvMIN) is associated with the Mayne River to the north of Clongriffin Station. There is a significant deposit of marine/estuarine sediments (MarSed) to the north of Portmarnock Station. There is widespread made ground in the urban area of Malahide at the northern extent of Zone B. Along the railway line near Malahide the soil is classified as shallow well drained mineral mainly basic soils (BminSW).

The project-specific intrusive ground investigation indicated made ground along Zone B of the Proposed Development. Typically, made ground was encountered at ground level along Zone B with a thickness range of 0.3m to 3.0m, with greater depths of 5.5m recorded at Howth Junction & Donaghmede Station and 6.9m at Malahide Viaduct. Along the Malahide Viaduct, made ground was encountered to a maximum depth of 6.9mOD. The made ground encountered included bitmac, tarmac, ballast material associated with the current railway, and reworked material. The reworked material was typically described as soft to stiff slightly sandy to sandy slightly gravelly to gravelly clay. There were also small pockets of sand, gravel, and cobbles encountered.

9.4.3.3 Zone C (North of Malahide Viaduct to south of Gormanston Station)

The soil type is highly variable along Zone C. In the southern section of Zone C, there are widespread deposits of mineral poorly drained, mainly basic soil (BminPD) and deep well drained mineral, mainly basic soil (BminDW). Isolated areas of shallow well drained mineral mainly basic soils (BminSW) are located north of Rush and Lusk Station and south of Skerries.

There is a change in soil type to the south of Skerries Station where the soil transitions to deep well drained mainly acidic mineral soil (AminDW), poorly drained mainly acidic mineral soil (AminPD), and shallow well drained mainly acidic mineral soil (AminSW).

There are several deposits of alluvium (AlluvMIN) crossing the Proposed Development trending east-west associated with watercourses in Zone C. An area of beach sand and gravels (MarSands) is located on the northern shore of Malahide Estuary and at Balbriggan. There are also several pockets of made ground in Zone C associated with larger urban centres, such as Donabate, Skerries, and Balbriggan.

The project-specific intrusive ground investigation indicated that Zone C is underlain by areas of topsoil with extensive made ground. The topsoil was encountered at ground level with a thickness range of 0.1 to 0.5m. The topsoil was typically described as firm brown slightly sandy to sandy gravelly clay with rootlets. The made ground was encountered from ground level to 0.5m below ground level (BGL) with a thickness range of 0.2 to 0.5m. The made ground encountered along Zone C of the Proposed Development included bitmac, ballast material associated with the current railway,

and reworked material. The reworked material was typically described as soft to firm brown to grey slightly sandy to sandy slightly gravelly to gravelly clay, light brown to dark grey slightly clayey slightly silty to silty slightly gravelly to gravelly sand, and loose to dense brown to greyish black slightly sandy to very sandy subangular to angular fine to coarse gravel. Cobble content in the made ground is variable from low to high.

9.4.3.4 Zone D (South of Gormanston Station to County Meath/County Louth border)

The primary soil type between Gormanston and Laytown in Zone D is shallow, well drained mainly basic mineral soil (BminSW). North of Laytown Station, the primary soil type is poorly drained mainly acidic mineral soil (AminPD). Small pockets of shallow poorly drained mineral mainly basic soil (BminSP) are located in the northern part of Zone D and south of Laytown.

There are several deposits of alluvium (AlluvMIN) traversing the Proposed Development associated with watercourses, particularly to the south of Laytown Station. Areas of beach sand and gravels (MarSands) are located where these watercourses enter the sea. An area of Aeolian undifferentiated windblown sands (AeoUND) is located between Laytown and Gormanston.

Pockets of made ground are associated with the urban area of Laytown, Bettystown and Mosney. Isolated areas of cutaway/cutover peat (Cut) are located north of Mosney.

The project-specific intrusive ground investigation indicated that soils along Zone D of the Proposed Development include topsoil, alluvium, and extensive made ground. The topsoil was encountered at ground level with a thickness range of 0.1m to 0.4m. Alluvial deposits were encountered adjacent to river and stream crossings, such as the River Nanny in Laytown, Co. Louth. These alluvial deposits were encountered at ground level to a maximum depth of 1.7m. The made ground was encountered at ground level with a thickness range of 0.2 to 4.2m. The made ground encountered included bitmac, ballast material associated with the current railway, and reworked material. The reworked material was typically described as soft to stiff brown slightly sandy to sandy gravelly clay, medium dense slightly silty slightly gravelly to gravelly sand, and slightly clayey to clayey slightly sandy to very sandy subangular to angular fine to coarse gravel.

9.4.3.5 Zone E (Drogheda MacBride Station and surrounds, including Drogheda Freight Sidings)

Zone E is primarily underlain by made ground associated with the large urban centre of Drogheda. There are also deposits of poorly drained mainly acidic mineral soil (AminPD), mainly in the southern portion of Zone E. Pockets of alluvium (AlluvMIN) traversing the Proposed Development are associated with watercourses. An isolated area of shallow, well drained mainly basic mineral soil (BminSW) is located in the northern part of Zone E.

The project-specific intrusive ground investigation indicated that the soils in Zone E include topsoil and extensive made ground. The topsoil was encountered at ground level to a maximum depth of 0.3m BGL. The made ground was encountered at ground level with a thickness range of 0.3m to 3.1m. The made ground encountered included bitmac, concrete, ballast material associated with the current railway, and reworked material. The reworked material was typically described as soft to stiff slightly sandy to sandy slightly gravelly to gravelly clay, firm to stiff slightly sandy slightly gravelly to gravelly silt, light brown to grey clayey silty gravelly sand, and brown to grey very silty sandy to very

sandy subangular to angular fine to coarse gravel. The reworked made ground material included fragments of plastic, red brick, concrete, and glass.

Table 9.8 Summary of soils within the Proposed Development.

Soil Type	Description	Location	Importance	Justification for Importance rating
Made Ground – Made	Associated with urban development.	Urban centres in Zone A to Zone E.	Low	Poorly drained and/or low fertility soils
Marine Sediments – MarSed	Marine/Estuarine sediments	Localised areas within Zone A to Zone C.	Medium	Moderately drained and / or moderate fertility soils
Marine Sediments – MarSands	Beach sand and gravels	Localised area in Zone A and Zone C	Medium	Moderately drained and / or moderate fertility soils
Marine Sediments – AeoUND	Aeolian undifferentiated	Localised area in Zone A	Medium	Moderately drained and / or moderate fertility soils
Alluvium – AlluvMIN	Mineral alluvium	Localised areas within Zone A to Zone E.	Medium	Moderately drained and/or moderate fertility soils
Peat – Cut	Cutaway/cutover peat	Localised area in Zone D	Low	Poorly drained and/or low fertility soils
Topsoil – AminDW	Deep well drained mineral (Mainly acidic)	Localised areas along Zone C, particularly between Skerries and Balbriggan.	High	Well drained and / or high fertility soils
Topsoil – AminSW	Shallow well drained mineral (mainly acidic)	Localised areas in Zone C, particularly around Skerries.	High	Well drained and / or high fertility soils
Topsoil – AminPD	Mineral poorly drained mineral (mainly acidic)	Localised areas in Zone C, widespread in Zone D north of Laytown and in Zone E.	Low	Poorly drained and/or low fertility soils
Topsoil – BminDW	Deep well drained (mainly basic)	Widespread within Zone B, and southern half of Zone C.	High	Well drained and / or high fertility soils
Topsoil – BminPD	Mineral poorly drained (mainly basic)	Widespread within Zone B, and southern half of Zone C.	Low	Poorly drained and/or low fertility soils
Topsoil – BminSW	Shallow well drained mineral (mainly basic)	Localised areas in Zone B to Zone E.	High	Well drained and / or high fertility soils
Topsoil – BminSP	Shallow poorly drained mineral (Mainly basic)	Localised areas in Zone D.	Low	Poorly drained and/or low fertility soils

9.4.4 Subsoils

The subsoil comprises the unconsolidated geological deposits which overlie the solid geology. The subsoils within the region, as classified by the GSI Quaternary sediments mapping (GSI, 2016a), are presented in Figure 9.3 in Volume 3A of this EIAR and are summarised in Table 9.9. Due to the variety of depositional environments and processes, subsoil deposits can exhibit significant lateral and vertical variations in grain size distributions and geotechnical parameters over short distances.

The predominant subsoil across the region, particularly in the south, is glacial till derived from limestones. Further north, the Quaternary deposits are more varied, including deposits of Irish Sea till, tills derived from Lower Palaeozoic sandstone, and till derived from Namurian sandstones and shales. There are also widespread alluvial, gravel, and lacustrine deposits associated with ancient and more recent watercourses.

Where relevant the subsoils encountered during the project specific ground investigation are described below.

9.4.4.1 Zone A (North of Connolly Station to south of Howth Junction & Donaghmede Station)

Within Zone A, the primary subsoil type is till derived from limestones (TLs). Between Connolly Station and Clontarf Station, the primary subsoil type is made ground (Urban), where significant deposits of natural quaternary sediments were excavated during expansion of Dublin City. There are also deposits of gravelly alluvium (Ag) associated with the quaternary drainage of the River Tolka. Further north, beside Raheny Station, there is a deposit of Alluvium (A) and gravels derived from limestones (GLs) associated with the quaternary drainage of the Santry River.

There was no project-specific ground investigation carried out within Zone A of the Proposed Development.

9.4.4.2 Zone B (South of Howth Junction & Donaghmede Station to north of Malahide Viaduct, including Howth Branch)

Within Zone B, the primary subsoil type is till derived from limestone (TLs). At the northern extent of Zone B in Malahide, the subsoil is classified as Irish Sea Till derived from limestones (IrSTLs). There is also a deposit of Gravels derived from limestones (GLs) immediately north of Malahide Station. There is a large deposit of estuarine silts and clays (Mesc) north of Portmarnock Station. There are several deposits of alluvium (A) along the Proposed Development in Zone B associated with local watercourses.

The project-specific ground investigation indicated that Zone B is underlain predominantly by subsoils of glacial origin. The glacial deposits were encountered from ground level to 3.5m BGL and reached a maximum depth exceeding 13.1m BGL. The glacial deposits were typically described as soft to very stiff slightly sandy slightly gravelly to gravelly clay.

Subsoils derived from estuarine origin were encountered in Malahide and were associated with the Malahide Estuary outflow. The estuarine deposits were encountered from 2.0m to 3.6m BGL with a thickness range of 8.8m to excess of 13.0m. The estuarine deposits were typically described as loose to dense sandy subrounded fine to coarse gravels with pockets of soft material. The estuarine deposits are underlain by stiff to very stiff glacial till, underlain by gravel at depth.

9.4.4.3 Zone C (North of Malahide Viaduct to south of Gormanston Station)

Within Zone C, the primary subsoil type is Irish Sea Till derived from Lower Palaeozoic sandstones and shales (IrSTLPSsS). There are widespread deposits of gravels derived from Lower Palaeozoic sandstones and shales (GLPSsS), along with karstified bedrock outcrop or subcrop (KaRck) surrounding Skerries. Further north, at the northern extent of Zone C, there is a deposit of till derived from Lower Palaeozoic sandstones and shales (TLPSsS). The Proposed Development overlaps with the eastern edge of a large deposit of till derived from Namurian sandstones and shales (TNSSs) to the south of Skerries. There are deposits of estuarine silts and clays (Mesc), and marine beach sands (Mbs) to the north of Malahide Estuary. There is a landfill on the northern shore of Rogerstown Estuary and made ground (Urban) subsoil in the urban area of Balbriggan. There are several deposits of alluvium (A) along the Proposed Development in Zone C associated with local watercourses.

The project-specific intrusive ground investigation indicated that Zone C of the Proposed Development is underlain by subsoils of glacial origin. These subsoils were encountered from ground level to 4.8m BGL with a maximum thickness in excess of 14.2m. The subsoil is typically described as brown to grey slightly sandy to sandy slightly gravelly to gravelly clay with pockets of soft to stiff slightly sandy to very sandy slightly gravelly to gravelly silt, loose to dense slightly clayey to clayey slightly silty to very silty slightly gravelly to very gravelly sand, and medium dense to dense sandy to very sandy clayey subangular to subrounded fine to coarse gravel. Cobbles and boulders of various lithologies, predominantly limestone, were encountered in the subsoils of Zone C.

9.4.4.4 Zone D (South of Gormanston Station to County Meath/County Louth border)

Along Zone D, between Gormanston Station and Laytown Station, the primary subsoil type is gravels derived from limestones (GLs), with smaller deposits of cut over raised peat (Cut), windblown sands (Ws), marine beach sands (Mbs), and alluvium (A). Further north, between Laytown Station and the northern extent of Zone D, the primary subsoil type is Irish Sea Till derived from Lower Palaeozoic sandstones and shales (IrSTLPSsS), with minor deposits of alluvium (A).

The project-specific intrusive ground investigation indicated that Zone D of the Proposed Development is predominantly underlain by sands and gravels to the south of Laytown, whereas the subsoils are of glacial origin to the north of Laytown. The subsoils were encountered from 0.1m to 4.2m BGL with thickness of up to 14.9m. The sands and gravels were typically described as loose to dense slightly gravelly to vey gravelly sand, and medium dense to dense sandy clayey subangular to rounded fine to coarse gravel. The glacial subsoils were typically described as slightly sandy to sandy slightly gravelly to gravelly clay.

9.4.4.5 Zone E (Drogheda MacBride Station and surrounds, including Drogheda Freight Sidings)

The primary subsoil type in Zone E is made ground associated with the urban centre of Drogheda. There are also deposits of Irish Sea Till derived from Lower Palaeozoic sandstones and shales (IrSTLPSsS) and areas of alluvium (A) associated with watercourses.

The project-specific intrusive ground investigation indicated that Zone E is underlain by subsoils of glacial origin. The subsoils were encountered from 0.3m to 3.0m BGL with thickness in excess of 12.0m. The subsoils were typically described as firm to stiff slightly sandy to sandy slightly gravelly to gravelly clay. There were pockets of firm to very stiff slightly sandy slightly gravelly silt, medium dense to dense slightly gravelly to gravelly silty sand, and medium dense to dense silty angular to rounded gravel also encountered.

Table 9.9 Summary of subsoils within the Proposed Development.

Soil Type	Description	Location	Importance	Justification for Importance rating
Alluvium – A	Alluvium	Localised areas within all zones	Low	Low significance or value on a local scale
Alluvium – Ag	Alluvium (gravelly)	Localised areas in Zone A	Low	Low significance or value on a local scale
Estuarine deposits – Mesc	Estuarine silts and clays	Localised areas in Zone B and C	Low	Low significance or value on a local scale
Glacial till – TLs	Tills derived from Limestones	Widespread along Zone A and Zone B	Low	Low significance or value on a local scale
Glacial till – GLs	Gravels derived from Limestones	Localised areas in Zones A and B, widespread in southern part of Zone D	Low	Low significance or value on a local scale
Glacial till – IrSTLs	Irish Sea Till derived from Limestones	Localised areas in Zone B around Malahide	Low	Low significance or value on a local scale
Glacial till – IrSTLPSsS	Irish Sea Till derived from Lower Palaeozoic sandstones and shales	Widespread in Zone C and northern half of Zone D, with localised areas in Zone E	Low	Low significance or value on a local scale
Gravels – GLPSsS	Gravels derived from Lower Palaeozoic sandstones and shales	Localised areas along Zone C, particularly around Skerries	Low	Low significance or value on a local scale
Glacial till – TLPSsS	Till derived from Lower Palaeozoic sandstones and shales	Northern extent of Zone C	Low	Low significance or value on a local scale
Glacial till – TNSSs	Till derived from Namurian sandstones and shales	Localised area along Zone C to the south of Skerries Station	Low	Low significance or value on a local scale
Windblown sands – Ws	Windblown sands	Localised area along Zone D to the south of Laytown Station	Medium	Medium significance or value on a local scale
Sands – Mbs	Marine beach sands	Localised area in Zone B (Howth Branch) and Zone C. Widespread in Zone D between Gormanston and Laytown Stations along coastline	Medium	Medium significance or value on a local scale
Peat – Cut	Cut over raised peat	Localised areas in Zone D to south of Laytown Station	Low	Low significance or value on a local scale

Soil Type	Description	Location	Importance	Justification for Importance rating
Bedrock outcrop or subcrop – KaRck	Karstified bedrock outcrop or subcrop	Localised areas in Zone C, particularly around Skerries	Low	Low significance or value on a local scale
Made ground – Urban	Made ground associated with urban development	Widespread in southern portion of Zone A	Low	Low significance or value on a local scale

9.4.5 Bedrock Geology

The bedrock geology of the region, as classified by the GSI Bedrock Geology mapping (1:100k), is presented on Figure 9.4 in Volume 3A of this EIAR and summarised in Table 9.10. The underlying bedrock is variable across the region, being dominated by Carboniferous limestones and calcareous shales, with older Silurian deep marine sediments (mudstones, greywacke and conglomerates) and volcanic Ordovician basalt (andesite, tuff, slate and mudstone) also described.

The depth to bedrock is variable across north County Dublin, according to the GSI Depth to Bedrock mapping (GSI, 2011). Bedrock depth in north County Dublin is indicated to be between less than 1 metre below ground level (mBGL) up to 45mBGL.

The structural geology of the region is highly variable and complex. In the south of the region at Dublin City and the neighbouring suburbs, the Dublin Basin is the dominant structural feature. Around Malahide, there is a series of northwest–southeast trending faults with a series of southwest–northeast trending anticlinal and synclinal axes. Further north around Skerries, there is a series of parallel faults running primarily in a southwest–northeast direction with a series of east–west trending anticlinal and synclinal axes. At Drogheda, there is a series of southwest–northeast trending faults.

The bedrock encountered during the project specific ground investigations is described below.

9.4.5.1 Zone A (North of Connolly Station to south of Howth Junction & Donaghmede Station)

Along Zone A, the youngest rocks comprise the Lower Carboniferous (Late Chadian Stage) age Lucan Formation. The Lucan Formation, known locally as the Calp Limestone, underlies much of the Dublin City area. In Zone A, the Lucan Formation is found to the south of Harmonstown Station. The Lucan Formation comprises dark grey to black, fine grained, occasionally cherty, micritic limestones that usually weather to pale grey. There are rare dark coarser grained calcarenite limestones, sometimes graded, and interbedded dark grey calcarenites. The formation ranges from 300m to 800m in thickness.

The northern portion of Zone A is underlain by the older Lower Carboniferous (Courceyan Stage) age Tober Colleen Formation. In Zone A, the Tober Colleen Formation is found north of Harmonstown Station. The Tober Colleen Formation is typically described as dark grey, calcareous commonly bioturbated mudstones and subordinate thin micritic limestones. The formation ranges from 50m to 250m in thickness.

There was no project-specific ground investigation carried out within Zone A of the Proposed Development.

9.4.5.2 Zone B (South of Howth Junction & Donaghmede Station to north of Malahide Viaduct, including Howth Branch)

The youngest rock type in Zone B is the Tober Colleen Formation. The Tober Colleen Formation is located from Howth Junction and Donaghmede Station to south of Clongriffin Station, and again from north of Portmarnock Station to south of Malahide Station.

The oldest rocks within Zone B are part of the Lower Carboniferous (Courceyan Stage) Malahide Formation. The Malahide Formation is the most common bedrock type and is located from south of Clongriffin Station to north of Portmarnock Station, and again from south of Malahide Station to the northern end of Zone B (north of Malahide Viaduct). The Malahide Formation is typically described as calcareous shales, siltstones and sandstones, and occasional thin limestones at its base. These are overlain by cyclical, peloidal, occasionally nodular micrites and thin interclastics. The formation ranges from 300m to more than 1,200m in thickness.

Smaller sections of Zone B located north of Portmarnock Station are underlain by the Waulsortian Limestones Formation. Waulsortian Limestones are typically described as predominantly pale grey, crudely bedded or massive limestone. The formation typically ranges from 300m to 500m in thickness but can be over 1,200m thick.

The bedrock of Zone B is heavily faulted and folded. The faults generally trend in an east-west direction, with a number of northeast-southwest trending anticlinal and synclinal folds.

Bedrock was only proven at the northern extent of Zone B of the Proposed Development in three boreholes along the Malahide Viaduct. Bedrock was encountered from 11.0 to 14.5m BGL. The bedrock appears to be dipping in a southerly direction. The bedrock encountered is sedimentary and is typically described as strong, indistinctly thinly laminated greyish brown limestone interbedded with very weak to weak thinly laminated to medium spaced beds of thinly laminated brownish grey mudstone.

9.4.5.3 Zone C (North of Malahide Viaduct to south of Gormanston Station)

The bedrock geology in Zone C is highly variable, with younger Carboniferous geological formations south of Skerries Station and older Silurian and Ordovician geological formations north of Skerries Station to the northern end of Zone C.

In Zone C, south of Skerries Station, the Carboniferous rocks (from younger to older) include the Walshestown, Balrickard, Loughshinny, Naul, Holmpatrick, Lucan, Rush Conglomerate, Tober Colleen, Malahide, and Donabate Formations. In general, the bedrock geology becomes younger when moving north through Zone C when south of Skerries Station.

A small section of the Walshestown Formation can be found between north of Rusk and Lusk Station and south of Skerries Station. The Walshestown Formation is typically described as predominantly black shales, with subordinate siltstones, fine sandstone bands with rippled lenses, calcareous mudstones, and occasional limestones (biosparite). The formation is around 200m thick.

The Balrickard Formation is located between north of Rusk and Lusk Station and south of Skerries Station. The Balrickard Formation is typically described as metre thick feldspathic micaceous sandstone with shale and argillaceous fossiliferous micrite interbeds. The formation ranges from 75m to 100m in thickness.

The Loughshinny Formation is located in two sections between north of Rusk and Lusk Station and south of Skerries Station. The Loughshinny Formation is typically described as laminated to thinly bedded, argillaceous, pyritic, locally cherty limestone interbedded with dark grey to black shale. The limestones include argillaceous micrites and graded calcarenites. The formation is typically between 100m and 150m thick.

A relatively thin band of the Naul Formation is located between north of Rusk and Lusk Station and south of Skerries Station. The Naul Formation is generally described as calcarenite with minor chert and occasional thin shales. It is similar to the Loughshinny Formation, but the limestones are paler and less argillaceous, and there is less shale. The formation is up to 100m thick.

The Holmpatrick Formation is located around Skerries Station. The Holmpatrick Formation is typically described as well-bedded, bioclastic limestone, with oolite in the basal 20m. The lowest beds contain pebbles of Lower Palaeozoic rocks. The formation ranges from 90m to 200m in thickness.

In Zone C, the Lucan Formation is located north of Rush and Lusk Station.

The Rush Conglomerate Formation is located around Rush and Lusk Station. The Rush Conglomerate Formation is typically described as graded quartz and limestone pebble conglomerate and lithic sandstones, interbedded with laminated shale and thin limestones. The formation is generally 300m, thinning inland.

In Zone C, the Tober Colleen Formation is located from the northern shore of Rogerstown Estuary to south of Rusk and Lusk Station.

In Zone C, the Malahide Formation is located to both the north and south of Donabate Station.

The Donabate Formation underlies the area immediately surrounding Donabate Station. The Donabate Formation is generally described as red coarse-grained lithic sandstones and quartz pebble conglomerates. The formation is up to 55m thick.

Donabate Station is underlain by the Portrane Volcanic Formation, the oldest rocks south of Skerries Station. The Portrane Volcanic Formation is described as intrusive or extrusive sheets in the lower part, while the upper half includes tuffaceous sedimentary rocks, pebbly mudstone with clasts typical of the underlying igneous lithologies, limestone breccias, and black shale. The formation thickness is unknown.

In Zone C, north of Skerries Station, the Ordovician and Silurian rocks (from younger to older) include the Denhamstown, Skerries, Balbriggan, and Belcamp Formations. In general, the bedrock geology becomes younger when moving north through Zone C, north of Skerries Station.

The Denhamstown Formation is located around Gormanston Station at the northern extent of Zone C. The Denhamstown Formation is generally described as blue-grey greywacke sandstones and siltstones at the base, and metabentonites toward the top of the formation. The formation is over 1125m in thickness.

The Skerries Formation is the most common rock type between Skerries Station and Balbriggan Station. The Skerries Formation is described as laminated blue grey sandstone and siltstone. The formation is 480m in thickness.

There is a thin section of the Balbriggan Formation located to the south of Balbriggan Station. The Balbriggan Formation is typically described as variable mudstones in the lower levels, with interbedded greywacke sandstones at the upper levels. The formation is at least 560m in thickness.

The Belcamp Formation is located from Balbriggan Station to south of Gormanston Station. The Belcamp Formation is generally described as basalt to andesite sheets, pillow breccias and hyaloclastite, tuffs, and mudstones. The Belcamp Formation includes a lower mudstone and tuff dominant Lowther Lodge Member, and an upper pillow breccia and andesite dominant Bremore Member. The formation is 1600m in thickness.

The bedrock of Zone C is heavily faulted and folded, particularly in the Skerries area. The faults generally trend in a north-south direction, with a number of generally east-west trending anticlinal and synclinal folds.

During the project-specific ground investigation, weathered bedrock was encountered at a number of exploratory locations within Zone C of the Proposed Development. Weathered bedrock was encountered from 1.2m to 9.3m BGL. This was described as possible weathered bedrock recovered as stiff sandy very gravelly clay, very dense slightly gravelly very silty sand, and medium dense to very dense slightly sandy gravel.

A variety of bedrock geology types were proven during the project-specific ground investigation in Zone C of the Proposed Development. Bedrock was encountered from 1.8m to 14.5m BGL. The majority of the bedrock encountered was sedimentary and was typically described as moderately weak to strong thinly to thickly laminated dolomitised limestone, moderately weak to medium strong thinly laminated calcareous mudstone, medium strong thinly laminated siltstone, weak to strong very thinly laminated sandstone, and medium strong to strong thinly to medium bedded conglomerate. A minority of the bedrock geology encountered was of volcanic origin, being typically described as medium strong massive basalt, medium strong massive andesite, and strong breccia.

9.4.5.4 Zone D (South of Gormanston Station to County Meath/County Louth border)

The youngest rocks in Zone D are the Lower Carboniferous (Chadian Stage) Mornington Formation. The Mornington Formation is located at the northern end of Zone D. The Mornington Formation is typically described as thickly to thinly bedded, dark grey packstones, wackestones, micrites, occasional grainstones, and shales. Turbidites are common in the upper parts. The thickness of this formation is unknown.

The Tullyallen Formation is located around Laytown Station. The Tullyallen Formation is typically described as pale grey, thickly bedded, highly micritised grainstones, packstones, and wackestones. The formation is over 500m in thickness.

The rocks in the southern half of Zone D are older of Silurian (Wenlock Epoch) age and comprise the Clatterstown and Denhamstown Formations. The Clatterstown Formation is located from north of Gormanston Station to the south of Laytown Station. The Clatterstown Formation is typically described as argillaceous, thinly bedded blue-grey and green-grey siltstones and minor sandstones that are slightly calcareous. The formation is at least 650m in thickness.

In Zone D, the Denhamstown Formation is located around Gormanston Station. Bedrock was proven at five exploratory locations within Zone D during the project-specific ground investigation. The bedrock was encountered from 0.7m to 12.9m BGL. The bedrock encountered was of sedimentary origin, being typically described as very weak to moderately weak thinly laminated limestone, medium strong thinly laminated mudstone, and moderately weak to medium strong fine-grained sandstone.

9.4.5.5 Zone E (Drogheda MacBride Station and surrounds, including Drogheda Freight Sidings)

Zone E is underlain by both the Mornington and Tullyallen Formations. The Mornington Formation is located in the southern portion of Zone E and Drogheda to the south of the River Boyne. The Tullyallen Formation underlies Drogheda to the north of the River Boyne.

The GSI 1:100k Bedrock mapping also indicates that there is a granite intrusion located to the northeast of Drogheda MacBride Station. The Drogheda Granite was encountered during excavation construction works (McConnell and Kennan, 2002). The Drogheda Granite is described as hornblende-biotite quartz monzonite with common mafic enclaves up to 1m across.

Bedrock of both sedimentary and volcanic origin was encountered within Zone E during the project-specific ground investigation. Bedrock was encountered from 3.2m to 13.7m BGL. The sedimentary bedrock encountered was typically described as weathered to strong thinly to thickly laminated mudstone, medium strong to strong indistinctly laminated limestone, medium strong very thinly laminated siltstone, moderately weak to medium strong fine-grained sandstone, and medium strong thinly laminated shale. The volcanic bedrock encountered was typically described as medium strong to strong granite, and extremely weak to medium strong thinly banded andesite.

Table 9.10 Summary of Bedrock Geology within the Proposed Development.

Formation (youngest to oldest)	Description	Location	Importance	Justification for Importance rating
Walshestown Formation	Shale, sandstone, limestone	Localised area in Zone C	Low	Low significance or value on a local scale
Balrickard Formation	Coarse sandstone, shale	Localised area in Zone C	Low	Low significance or value on a local scale
Loughshinny Formation	Dark micrite and calcarenite, shale	Localised areas in Zone C	Low	Low significance or value on a local scale
Naul Formation	Calcarenite and calcisiltite	Localised area in Zone C	Low	Low significance or value on a local scale

Formation (youngest to oldest)	Description	Location	Importance	Justification for Importance rating
Holmpatrick Formation	Grainstone-packstone, micrite	Localised area in Zone C at Skerries Station	Low	Low significance or value on a local scale
Rush Conglomerate Formation	Conglomerate, shale, limestone	Localised area in Zone C at Rush and Lusk Station	Low	Low significance or value on a local scale
Lucan Formation	Dark limestone and shale	Widespread in Zone A, localised in Zone C north of Rush and Lusk Station	Low	Medium significance or value on a local scale
Tullyallen Formation	Pale micritised grainstone-wackestone	Northern extent of Zone E.	Low	Medium significance or value on a local scale
Tober Colleen Formation	Calcareous shale, limestone conglomerate	Localised areas in Zone A, Zone B, and Zone C	Low	Medium significance or value on a local scale
Mornington Formation	Dark limestone and calcareous shale	Widespread in northern Zone D and in Zone E	Low	Medium significance or value on a local scale
Malahide Formation	Argillaceous bioclastic limestone, shale	Widespread in Zone B, localised areas in Zone C	Low	Medium significance or value on a local scale
Waulsortian Formation	Massive unbedded lime-mudstone	Localised areas in Zone B	Low	Low significance or value on a local scale
Donabate Formation	Red coarse sandstone and conglomerate	Localised area in Zone C	Low	Low significance or value on a local scale
Denhamstown Formation	Greywacke sandstone and siltstone	Localised area in Zone D	Low	Low significance or value on a local scale
Skerries Formation	Laminated blue-grey siltstone, sandstone	Localised area in Zone C between Skerries and Balbriggan Station	Low	Medium significance or value on a local scale
Balbriggan Formation	Variably coloured mudstone	Localised area in Zone C south of Balbriggan Station	Low	Low significance or value on a local scale
Clatterstown Formation	Thinly bedded siltstone, sandstone	Localised area in Zone D	Low	Medium significance or value on a local scale
Belcamp Formation	Andesite, pillow breccia, mudstone, tuff	Localised area at Balbriggan Station and northern extent of Zone C.	Low	Medium significance or value on a local scale
Portrane Volcanic Formation	Andesite, tuff, pebbly mudstone, shale	Localised area in Zone C at Donabate Station	Low	Low significance or value on a local scale
Drogheda Granite	Quartz monzonite	Localised area in Zone E northeast of Drogheda MacBride Station	Low	Low significance or value on a local scale

9.4.6 Geological Heritage Areas

Natural Heritage Areas (NHA) is the basic designation for habitats which require protection. A list of geological / geomorphological sites in need of protection through NHA designation is being compiled by the GSI. The list of geological/geomorphological sites is not available at the time of writing. However, the geological heritage sites to be assessed in this study will be compiled from the existing list of County Geological Sites (CGS) (GSI, 2019c). Geological Heritage Sites that are found along the Proposed Development are presented in Figure 9.5 of Volume 3A of this EIAR and are summarised in Table 9.11.

9.4.6.1 Zone A, B, and E

There are no County Geological Heritage sites along Zone A, B, and E of the Proposed Development.

9.4.6.2 Zone C (North of Malahide Viaduct to south of Gormanston Station)

There are three County Geological Heritage sites along Zone C of the Proposed Development.

The Milverton Quarry CGS (DF015) is a working quarry located to the south of Skerries Station. This site has been designated CGS status, with recommendation for Geological NHA status. The site has been assigned the IGH theme Lower Carboniferous (IGH8), as it demonstrates exposed faces of Lower Carboniferous limestone and shale displaying karst weathering features (pipes and caves).

The Fancourt Shore (DF002) is a section of coastal cliffs and foreshore located north of Skerries Station and south of Balbriggan station. This site has been designated CGS status, with recommendation for Geological NHA status. The site has been assigned two IGH themes, including Precambrian to Devonian Palaeontology (IGH2) and Cambrian–Silurian (IGH4). This site demonstrates coastal exposures of near complete Silurian succession (slates, sandstones, and volcanics) dated by its graptolite fossils.

The Laytown to Gormanston CGS (MH008) is located in the northern part of Zone C. This site has been designated CGS status. The site has been assigned the IGH theme Quaternary (IGH7), as it demonstrates a flat to gently undulating glacial outwash plain of sandur gravels.

9.4.6.3 Zone D (South of Gormanston Station to County Meath/County Louth border)

There is one County Geological Heritage site along Zone D of the Proposed Development. Within Zone D the Laytown to Gormanston CGS (MH008) extends from the southern extent of the boundary with Zone C to approximately 1km north of Laytown Station.

Table 9.11 Summary of the Geological Heritage Areas within the Proposed Development.

Geological Heritage	Description	Location	Importance	Justification for Importance rating
Milverton Quarry (DF015)	Working quarry. Exposed faces of Lower Carboniferous limestone and shale displaying karst weathering features (pipes and caves)	Located approximately 100m to the west of the railway line in Zone C to the south of Skerries Station	High	Geological feature of high value on a local scale (County Geological Site)
Fancourt Shore (DF002)	Coastal cliffs and foreshore. Coastal exposures of near complete Silurian succession (slates, sandstones and volcanics) dated by its graptolite fossils	Located approximately 150m east of the railway line in Zone C to the south of Balbriggan	High	Geological feature of high value on a local scale (County Geological Site)
Laytown to Gormanston (MH008)	Coastal plain, including sea cliffs. Flat to gently undulating glacial outwash plain of sandur gravels	Extends along the railway line from the northern part of Zone C to north of Laytown Station in Zone D	High	Geological feature of high value on a local scale (County Geological Site)

9.4.7 Mineral/Aggregate Resources

The following datasets were consulted to assess the effect of the Proposed Development on the economic geology of the study area:

- GSI mineral localities (GSI, 2014);
- GSI active quarries (GSI, 2022); and
- GSI aggregate potential mapping (GSI 2016b; GSI, 2016c).

The mineral localities and active quarries are presented in Figure 9.5 in Volume 3A of this EIAR and are summarised in Table 9.12. The GSI aggregate potential mapping is presented on Figure 9.6 of Volume 3A of this EIAR and is summarised in Table 9.13. .

9.4.7.1 Zone A (North of Connolly Station to south of Howth Junction & Donaghmede Station)

There are no mineral localities or active quarries along Zone A of the Proposed Development.

The granular aggregate potential ranges from very low to very high potential in Zone A of the Proposed Development. Areas of very high granular aggregate potential are located between Clontarf and Connolly Stations and around Raheny Station.

The GSI aggregate potential mapping shows the crushed rock aggregate potential along Zone A is primarily classified as a low potential. There is an area of increased crushed rock aggregate potential located between Clontarf and Killester Stations where high to very high potential is present.

9.4.7.2 Zone B (South of Howth Junction & Donaghmede Station to north of Malahide Viaduct, including Howth Branch)

There are no active quarries within Zone B of the Proposed Development.

There is one joint mineral and historic quarry locality within Zone B located approximately 400m north of Portmarnock Station. The mineral locality is described as non-metallic with clay/brick (CLBR). The historic quarry site is described as a site of brick works that supplied good class red bricks to Dublin.

The granular aggregate potential ranges from very low to very high potential along Zone B of the Proposed Development. Very high granular aggregate potential is located east of Bayside Station.

The crushed rock aggregate potential along Zone B is variable. South of Portmarnock Station, the crushed rock aggregate potential is mainly low. North of Portmarnock Station within Zone B, the crushed rock aggregate potential ranges from moderate to very high potential. The area of very high crushed rock aggregate potential is noted also along the current railway line on the northwards approach to Malahide, in the area surrounding Malahide Station and east of Sutton.

9.4.7.3 Zone C (North of Malahide Viaduct to south of Gormanston Station)

Milverton Quarry is an active quarry located west of the railway line along Zone C to the south of Skerries Station. This is classified as a non-metallic mineral locality and is described as an active quarry producing limestone flour, grits, chippings.

There are two metallic mineral localities along Zone C. There is a copper mineral locality located approximately 800m south of Donabate Station where copper is noted in the red conglomerates along the railway line. There is a pyrite mineral locality located approximately 1.4km north of Skerries Station where iron pyrite is noted in slates in a railway cutting.

There is one joint mineral and historic quarry locality within Zone C located approximately 500m north of Balbriggan Station. The mineral locality is described as non-metallic with clay/brick (CLBR). The historic quarry site is described as a brick field and yard.

A historic disused quarry is also located within 150m west of the railway line south of Balbriggan Station.

The granular aggregate potential ranges from very low to high along Zone C of the Proposed Development.

The GSI aggregate potential mapping indicates that the crushed rock aggregate potential along Zone C is variable. The crushed rock aggregate potential ranges from very low to very high potential. There is a large area with a very high crushed rock aggregate potential located around Skerries Station. Smaller areas with a very high crushed rock aggregate potential are located around Rusk and Lusk Station, and north and south of Balbriggan Station.

9.4.7.4 Zone D (South of Gormanston Station to County Meath/County Louth border)

There are no mineral localities or active quarries within Zone D of the Proposed Development.

There is an historic disused pit located approximately 700m south of Laytown Station.

The granular aggregate potential ranges from low to very high along Zone D of the Proposed Development. Between Gormanston and Laytown Stations, the majority of Zone D is classified as a high granular aggregate potential. There are large areas of very high aggregate potential around Laytown Station.

The GSI crushed rock aggregate potential along Zone D is variable and ranges from very low to very high potential. There are several areas classified as very high crushed rock aggregate potential, including north of Gormanston Station, the area surrounding Laytown Station, and at the northern boundary of Zone D.

9.4.7.5 Zone E (Drogheda MacBride Station and surrounds, including Drogheda Freight Sidings)

There are no mineral localities or active quarries within Zone E of the Proposed Development.

Moderate granular aggregate potential is indicated north of Drogheda Station.

The GSI aggregate potential mapping indicates that the crushed rock aggregate potential along Zone E ranges from very low to very high. Much of the area around Drogheda Station has very low crushed rock aggregate potential. Very high levels of crushed rock aggregate potential are noted north of the River Boyne.

Table 9.12 Summary of metallic and non-metallic mineral localities within the vicinity of the Proposed Development.

Mineral Type and Reference	Description	Location	Importance	Justification for Importance rating
Clay, brick 3258	Non-metallic. Site of brick works that supplied good class red brick to Dublin	Located approximately 400m north of Portmarnock Station along Zone B	Low	Uneconomically extractable mineral resource
Copper 5304	Metallic. Copper noted in red conglomerate along the railway line	Located approximately 800m south of Donabate Station along Zone C	Low	Uneconomically extractable mineral resource
Pyrite 5322	Metallic. Iron pyrite noted in slates in a railway cutting on old GSI 6-inch map	Located approximately 1.4km north of Skerries Station along Zone C	Low	Uneconomically extractable mineral resource
Limestone (in general) 2992	Non-metallic. Active quarry producing limestone flour, grits, chippings	Located approximately west of the railway line in Zone C south of Skerries Station	High	Moderately sized existing quarry or pit
Clay, brick 3267	Non-metallic. Brick field and yard marked on old 6-inch map	Located approximately 500m north of Balbriggan Station along Zone C	Low	Uneconomically extractable mineral resource

Table 9.13 GSI aggregate potential for the Proposed Development.

Feature	Potential	Location	Importance	Justification for Importance rating
Crushed rock aggregate potential	Very Low	Localised areas along Zone C and Zone E	Low	Uneconomically extractable mineral resource
	Low	Widespread in Zone A and southern part of Zone B. Localised areas in Zones C to E	Low	Uneconomically extractable mineral resource
	Moderate	Widespread in north part of Zone B. Localised areas in all other zones	Medium	Sub-economically extractable mineral resource
	High	Widespread in northern part of Zone D. Localised areas in all other zones	High	Extractable mineral resource
	Very High	Localised areas in Zones C to E	High	Extractable mineral resource
Granular aggregate potential	Very Low	Localised areas in Zones A to D	Low	Uneconomically extractable mineral resource
	Low	Localised areas in Zones A to D	Low	Uneconomically extractable mineral resource
	Moderate	Localised areas in all zones	Medium	Sub-economically extractable mineral resource
	High	Localised areas in Zone A and Zone C. Widespread in southern part of Zone D	High	Extractable mineral resource
	Very High	Localised areas in Zone A, Zone C, and Zone D	High	Extractable mineral resource

9.4.8 Soft and/or Unstable Ground

Soft soils consist of peat, fine grained alluvium or very soft cohesive material. Their presence within the study area could result in an impact if they require excavation and are therefore considered important features. Various sources of information were consulted in establishing these areas within the study area namely:

- Teagasc soil map (Teagasc et. Al 2017);
- GSI Quaternary Map (GSI 2016a);
- Ground investigation data;
- Scheme walkover survey; and
- GSI Landslide Events (GSI, 2017).

Please refer to Section 9.4.3 which documents the occurrence of soft ground within each zone of the Proposed Development.

The GSI database for Landslide Events (GSI, 2017) shows no recorded landslide events within the study area of the Proposed Development and therefore unstable ground is not considered further in this assessment.

9.4.9 Karst

Karst is a type of geological feature characterised by caves, caverns, and other types of underground drainage resulting from the dissolution of the underlying bedrock. This typically occurs in areas of high rainfall with soluble rock.

According to the GSI Groundwater Karst Data (GSI, 2020), there are no karst features within the Proposed Development study area. The GI works referenced in Section 9.3.2.2 and Table 9-2 to 9-4 inclusive confirm that no karst features were encountered during investigations. Therefore, karst features are not considered further in this assessment.

9.4.10 Contaminated Land

The following sources of information were consulted in assessing the potential for areas of contaminated land:

- CORINE land cover mapping (EPA, 2018);
- Teagasc soil map (Teagasc, et al., 2017);
- GSI Quaternary sediments mapping (GSI, 2016a);
- EPA maps (2022);
- OSI mapping (OSI, 2022); and
- The project specific ground investigations carried out to inform the Proposed Development and EIAR listed in Table 9.4 (see Section 9.3.2.2). These provide useful verification for the data already compiled relating to the baseline environment.

The known potential sources of contamination relevant to the Proposed Development identified within the study area are detailed in Table 9.14 along with their importance as determined by Box 4.1 of the NRA Guidelines (NRA 2008a).

Table 9.14 Summary of potential sources of Contaminated Land within the Study Area

Feature	Description	Location	Importance	Justification for Importance rating
Historical landfill	Fairview Park is located on reclaimed land (OSI Mapping)	Zone A, Fairview Park	Medium	Degree or extent of soil contamination is moderate on a local scale
Historical quarry	6-inch mapping & 25-inch mapping	Zone A, Clontarf Golf Club	Medium	Degree or extent of soil contamination is moderate on a local scale
Historical sand pits	6-inch mapping & 6-inch Cassini mapping	Zone B, Baldoyle Road and Sutton Station	Medium	Degree or extent of soil contamination is moderate on a local scale
Historical quarries	6-inch mapping, 25-inch mapping & 6-inch Cassini mapping	Zone B, Clarement Road, Howth	Medium	Degree or extent of soil contamination is moderate on a local scale
Historical electricity generating station	25-inch mapping	Zone B, Sutton Station	Medium	Degree or extent of soil contamination is moderate on a local scale
Brick works	25-inch mapping	Zone B, north of Portmarnock Station	Medium	Degree or extent of soil contamination is moderate on a local scale

Feature	Description	Location	Importance	Justification for Importance rating
Gas works	25-inch mapping & 6-inch Cassini mapping	Zone B, Malahide	Medium	Degree or extent of soil contamination is moderate on a local scale
Sewage works	6-inch Cassini mapping	Zone B, Malahide	Medium	Degree or extent of soil contamination is moderate on a local scale
Historic landfill	6-inch Cassini mapping	Zone C, north shore of Malahide Estuary	Medium	Degree or extent of soil contamination is moderate on a local scale
Historic landfill	GSI Quaternary sediments mapping & CORINE 2018 database	Zone C, north shore of Rogerstown Estuary	Medium	Degree or extent of soil contamination is moderate on a local scale
Graveyard	6-inch mapping, 25-inch mapping & 6-inch Cassini mapping	Zone C, east of Donabate Station	Medium	Degree or extent of soil contamination is moderate on a local scale
Gravel pit and railway line	25-inch mapping & 6-inch Cassini mapping	Zone C, east of Skerries Station	Medium	Degree or extent of soil contamination is moderate on a local scale
Tramway	25-inch mapping	Zone C, east of R127 at Ardgillan	Medium	Degree or extent of soil contamination is moderate on a local scale
Gravel pit	25-inch mapping	Zone C, east of R127 at Ardgillan	Medium	Degree or extent of soil contamination is moderate on a local scale
Brick yard	6-inch mapping	Zone C, Balbriggan	Medium	Degree or extent of soil contamination is moderate on a local scale
Hosiery factory	25-inch mapping & 6-inch Cassini mapping	Zone C, north of Balbriggan Station	Medium	Degree or extent of soil contamination is moderate on a local scale
Linen factory	25-inch mapping	Zone C, Mill Street Balbriggan	Medium	Degree or extent of soil contamination is moderate on a local scale
Salt works	25-inch mapping & 6-inch Cassini mapping	Zone C, Quay, Balbriggan	Medium	Degree or extent of soil contamination is moderate on a local scale
Gas works	25-inch mapping & 6-inch Cassini mapping	Zone C, Balbriggan	Medium	Degree or extent of soil contamination is moderate on a local scale
Historical cemetery	6-inch mapping, 25-inch mapping & 6-inch Cassini mapping	Zone E, Blackbush Lane	Medium	Degree or extent of soil contamination is moderate on a local scale
Historical quarry	25-inch mapping	Zone E, South of Drogheda Station	Medium	Degree or extent of soil contamination is moderate on a local scale
Historic Corn Mill	6-inch mapping, 25-inch mapping & 6-inch Cassini mapping	Zone E, Newfoundwell Road	Medium	Degree or extent of soil contamination is moderate on a local scale

Feature	Description	Location	Importance	Justification for Importance rating
Coal yards	6-inch Cassini mapping	Zone E, Boyne Viaduct	Medium	Degree or extent of soil contamination is moderate on a local scale
Railway line and stations	6-inch mapping, 25-inch mapping & 6-inch Cassini mapping	Zones A to E	Medium	Degree or extent of soil contamination is moderate on a local scale

A summary of the facilities with active licenses within the study area along with their importance as determined by the NRA Guidelines Box 4.1 (NRA 2008a) is presented in Table 9.15.

Table 9.15 Summary of EPA Licensed facilities within the Study Area

Feature	Description	Location	Importance	Justification for Importance rating
Newport Synthesis Ltd.	Licensed Industrial Emissions Licence (IEL) Facility	Zone B, Grange Parade	Medium	Light industrial usage
Balleally Landfill	Licensed Industrial Emissions Licence (IEL) Recent Landfill undergoing restoration into a public amenity	Zone C, north shore of Rogerstown Estuary	Medium	Recent landfill site
Milverton Waste Recovery Facility	Licensed soil recovery facility	Zone C, south of Skerries	Medium	Light industrial usage

The soil quality results from the project-specific ground investigation were screened against the following environmental criteria:

- CL:AIRE Human Health (HH) Soil Generic Assessment Criteria (GAC) for Commercial[1]; and
- CL:AIRE Human Health Soil Generic Assessment Criteria (GAC) for Public open space (residential).

In addition, 188 no. samples were screened against the Human Health Soil GAC for Commercial and Public open space (residential), the results of which are presented in the project specific ground investigation factual report (see Section 9.3.2.2).

The following determinands did not have a GAC, however, they were noted in concentrations above the limit of detection.

- NA-WS035 at 0.5mbgl contained PCB 138, PCB 153 and PCB 180;
- NA-BH061 at 0.5mbgl contained and Dibenzofuran;
- NA-WS086 at 0.5mbgl contained PCB 138, PCB 153, PCB 180, 2-Methylnaphthalene, and Dibenzofuran;

[1] CL:AIRE, 2010. Soil Generic Assessment Criteria for Human Health Risk Assessment

- NA-BH303 at 0.5mbgl and NA-WS034 at 0.5mbgl contained 2-Methylnaphthalene and Dibenzofuran;
- NA-WS008 at 0.5mbgl contained PCB 138, PCB 153, PCB 180, PCB 90+101, 2-Methylnaphthalene, and Dibenzofuran;
- NA-WS102 at 1mbgl contained 2-Methylnaphthalene;
- 186 samples were tested for barium. All were detected above the detection limit with the value ranging from 5mg/kg to 1200mg/kg;
- 186 samples were tested for loss of ignition. All were detected above the detection limit with the value ranging from 0.12% to 100%;
- 186 samples were tested for molybdenum. 161 samples detected molybdenum above the detection limit with the value ranging from 0.5mg/kg to 24mg/kg; and
- 186 samples were tested for carbazole. 21 samples detected Carbazole above the detection limit with the value ranging from 0.053mg/kg to 0.82mg/kg.

The soils were also classified as wastes for disposal by following the methodology outlined below:

1. The soils were classified according to the EPA document "Waste Classification, List of Waste & Determining if Waste is Hazardous or Non-hazardous, Valid from July 2018". The HazWasteOnline cloud-based software was used to perform this classification.
    - If the material was classified as '17 05 03*' as defined in the EPA 2018 guidance referenced above, the material is hazardous under the Waste Framework Directive 2008/98/ EC and must comply with the Regulation (EC) No 1013/2006 on shipment of waste (Waste Shipment Regulations) requirements for hazardous waste.
    - Alternatively, if the material is classified as '17 05 04 – Soil and Stones excluding those included in 17 05 03*'. The material is non-hazardous under Waste Framework Directive 2008/98/ EC and Waste Shipment Regulations and must comply with the Waste Shipment Regulations requirements for non-hazardous waste.
2. Once the List of Waste code is assigned to the soil sample, the materials are further classified according to the Council Decision 2003/33/EC establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 of and Annex II to Directive 1999/31/EC (Waste Acceptance Criteria (WAC)). This classification will determine the type of landfill at which the material will be accepted.
3. Naturally occurring materials may be considered for disposal to a Soil Recovery Facility (SRF) which has different waste acceptance criteria relating to the geochemistry of the underlying soils at the facility location. These samples were assessed against the SRF limits for suitability for disposal to these facilities.

To determine the soil disposal options for the material in each zone across the Proposed Development, 193 no. environmental samples were screened against the HazWasteOnline, WAC and SRF values. Out of the 193 no. samples, 102 no. samples were collected in made ground. These made ground samples have been deemed unsuitable for a soil recovery facility due to the categorisation of the material as made ground. These made ground samples may be suitable for a soil recovery facility if further analysis of the material is undertaken by weighing the anthropogenic materials and confirming if they constitute less than 2% of the soil sample.

91 no. samples were taken from the natural ground beneath the site.

Table 9.16 below outlines the breakdown of disposal options for the sampled materials:

Table 9.16 Disposal Options.

Made Ground	No. of Samples	%
Inert	81	79%
Non-Hazardous	16	16%
Non-Hazardous w/asbestos	1	1%
Hazardous	4	4%
Totals	102	100%
Natural Ground	**No. of Samples**	**%**
Soil Recovery Facility	74	81%
Inert	14	15%
Non-Haz	3	3%
Totals	91	100%
Overall	**No. of Samples**	**%**
Soil Recovery Facility	74	38%
Inert	95	49%
Non-Hazardous	19	10%
Non-Hazardous w/asbestos	1	1%
Hazardous	4	2%
Totals	193	100%

The results of the environmental screening for Human Health Soil GACs, WACs, and SRF are summarised in each zone below.

9.4.10.1 Zone A (North of Connolly Station to south of Howth Junction & Donaghmede Station)

No samples were taken from Zone A during the project-specific ground investigation as there are minimal works required within this zone of the Proposed Development.

9.4.10.2 Zone B (South of Howth Junction & Donaghmede Station to north of Malahide Viaduct, including Howth Branch)

Soil analysis was carried out on samples retrieved during the ground investigations at depths ranging from 0.5mbgl to 1mbgl.

Human Health Soil Generic Assessment Criteria

The main findings of the soil analysis carried out within Zone B are as follows:

- Asbestos was not detected in any of the recorded results;and
- All results passed below the HH GAC for Commercial and Public open space (residential).

Soil Disposal Screening

Three soil samples were tested and classified for disposal. Of these three samples, two were taken from the made ground and one sample was taken from the natural ground.

- Made Ground.

Of the made ground samples, both (2) samples were classified as requiring disposal to an inert licensed landfill.

- Natural Ground.

For the one sample in natural ground, it was deemed suitable for disposal to an SRF.

9.4.10.3 Zone C (North of Malahide Viaduct to south of Gormanston Station)

Soil analysis was carried out on samples retrieved during the ground investigations at depths ranging from 0.5mbgl to 5mbgl.

Human Health Soil Generic Assessment Criteria

The main findings of the soil analysis carried out within Zone C are as follows:

- Asbestos was not detected in any of the recorded results;
- NA-BH50 at 0.5mbgl, NA-WS086 at 0.5mbgl and NA-WS088 at 5mbgl exceeded the HH GAC limits for Public open space (residential);
- NA-BH50 at 0.5mbgl exceeded the HH GAC limits for Public open space (residential) for lead, dibenz(a,h)anthracene, benzo[a]pyrene and benzo[b]fluoranthene;
- NA-WS086 at 0.5mbgl exceeded the HH GAC limits for Public open space (residential) and Commercial for lead;and
- NA-WS088 at 5mbgl exceeded the HH GAC limits for Public open space (residential) for dibenz(a,h)anthracene.

Soil Disposal Screening

75 no. soil samples were tested and classified for disposal. Of these 75 no. samples, 40 no. samples were taken from the made ground, and 35 no. samples were taken from the natural ground.

- Made Ground.

Of the made ground samples, 30 no. samples were classified as requiring disposal to an inert licensed landfill, eight to a non-hazardous licensed landfill, and two to a hazardous licensed landfill.

The made ground samples which were categorised as requiring disposal to a non-hazardous licensed landfill were triggered by; high total organic carbon, elevated metals, and elevated hydrocarbons.

The made ground samples which were categorised as requiring disposal to a hazardous licensed landfill were triggered by; high total organic carbon, elevated metals, and elevated hydrocarbons.

- Natural Ground.

Of the natural ground samples, three were classified as requiring disposal to an inert licensed landfill and two to a non-hazardous licensed landfill. The remaining 30 no. samples were suitable for disposal to a Soil Recovery Facility.

The natural samples which were categorised as requiring disposal to a non-hazardous licensed landfill were triggered by; high total organic carbon and mineral oil.

The natural samples which were categorised as requiring disposal to a hazardous licensed landfill were triggered by; high total organic carbon, elevated metals, and elevated hydrocarbons.

9.4.10.4 Zone D (South of Gormanston Station to County Meath/County Louth border)

Soil analysis was carried out on samples retrieved during the ground investigations at depths ranging from 0.5mbgl to 4mbgl.

Human Health Soil Generic Assessment Criteria

The main findings of the soil analysis carried out within Zone D are as follows:

- Asbestos was detected in one of the recorded results at NA-DP003IP at 0.5mbgl. The asbestos was identified as amosite in fibres/clumps with the total asbestos at <0.001%;
- All results passed below the HH GAC for Commercial; and
- NA-WS053 at 4mbgl exceeded the HH GAC limits for Public open space (residential) for dibenz(a,h)anthracene.

Soil Disposal Screening

61 no. soil samples were tested and classified for disposal. Of these 61 no. samples, 29 no. were taken from the made ground, and 32 no. samples were taken from the natural ground.

- Made Ground.

Of the made ground samples, 25 no. samples required disposal to an inert licensed landfill and four samples to a non-hazardous licensed landfill with one of those samples containing asbestos.

The made ground samples which were categorised as requiring disposal to a non-hazardous licensed landfill were triggered by; high total organic carbon, mineral oil, hydrocarbons, asbestos, and elevated copper.

- Natural Ground.

Of the 32 no. natural samples, seven were classified as requiring disposal to an inert licensed landfill. The remaining 25 no. samples were suitable for disposal to a Soil Recovery Facility.

9.4.10.5 Zone E (Drogheda MacBride Station and surrounds, including Drogheda Freight Sidings)

Soil analysis was carried out on samples retrieved during the ground investigations at depths ranging from 0.3mbgl to 3.5mbgl.

Human Health Soil Generic Assessment Criteria

The main findings of the soil analysis carried out within Zone E are as follows:

- Asbestos was not detected in any of the recorded results;
- NA-BH017 at 0.5mbgl exceeded the HH GAC limits for Public open space (residential) for lead, dibenz(a,h)anthracene, benzo[a]pyrene and benzo[b]fluoranthene;
- NA-WS008 at 0.5mbgl exceeded the HH GAC limits for Public open space (residential) for dibenz(a,h)anthracene, benzo[a]pyrene and benzo[b]fluoranthene;and
- NA-BH017 at 0.5mbgl exceeded the HH GAC limits for Commercial for lead.

Soil Disposal Screening

54 no. soil samples were tested and classified for disposal. Of these 54 no. samples, 31 no. samples were taken from the made ground, and 23 no. samples were taken from the natural ground.

- Made Ground.

Of the made ground samples, 24 no. samples were classified as requiring disposal to an inert licensed landfill, five to a non-hazardous licensed landfill, and two to a hazardous licensed landfill.

The made ground samples which were categorised as requiring disposal to a non-hazardous licensed landfill were triggered by; high total organic carbon, mineral oil, hydrocarbons, and polychlorinated biphenyls.

The made ground samples which were categorised as requiring disposal to a hazardous licensed landfill were triggered by; high total organic carbon, dissolved organic carbon, elevated metals, and hydrocarbons.

- Natural Ground.

Of the natural samples, four were classified as requiring disposal to an inert licensed landfill and one sample was classified as requiring disposal to a non-hazardous licensed landfill. 18 no. samples were classified as suitable for a Soil Recovery Facility. The natural samples which were categorised as requiring disposal to a non-hazardous licensed landfill were triggered by mineral oil.

9.4.11 Summary of Key Features

The feature importance ranking based on the Guidelines for the Preparation of Soil, Geology, and Hydrology Chapters of Environmental Impact Statements (IGI, 2013) and Guidelines on procedures for Assessment and Treatment of Geology, Hydrology, and Hydrogeology for National Road Schemes (NRA, 2008) are summarized below.

Features with an importance ranking of low are not considered further as they will not result in a significant impact according to Box 5.4 of the NRA Guidelines (NRA, 2008a). These are summarised in Table 9.17 for completeness. Features with an importance ranking of medium or higher are summarised in Table 9.18 and the impact of the Proposed Development on these features is assessed in Section 9.7.

Table 9.17 Summary of Land, Soils, and Geology features with low importance within the Study Area.

Category	Feature	Description	Location	Importance	Justification for Importance rating
Soil Fertility	Made Ground – Made	Associated with urban development.	Urban centres in Zone A to Zone E.	Low	Poorly drained and/or low fertility soils
	Peat – Cut	Cutaway/cutover peat	Localised area in Zone D	Low	Poorly drained and/or low fertility soils
	Topsoil – AminPD	Mineral poorly drained mineral (mainly acidic)	Localised areas in Zone C, widespread in Zone D north of Laytown and in Zone E.	Low	Poorly drained and/or low fertility soils
	Topsoil – BminPD	Mineral poorly drained (mainly basic)	Widespread within Zone B, and southern half of Zone C.	Low	Poorly drained and/or low fertility soils
	Topsoil – BminSP	Shallow poorly drained mineral (Mainly basic)	Localised areas in Zone D.	Low	Poorly drained and/or low fertility soils
Subsoils	Alluvium – A	Alluvium	Localised areas within all zones	Low	Low significance or value on a local scale
	Alluvium – Ag	Alluvium (gravelly)	Localised areas in Zone A	Low	Low significance or value on a local scale
	Estuarine deposits – Mesc	Estuarine silts and clays	Localised areas in Zone B and C	Low	Low significance or value on a local scale
	Glacial till – TLs	Tills derived from Limestones	Widespread along Zone A and Zone B	Low	Low significance or value on a local scale
	Glacial till – GLs	Gravels derived from Limestones	Localised areas in Zones A and B, widespread in southern part of Zone D	Low	Low significance or value on a local scale
	Glacial till – IrSTLs	Irish Sea Till derived from Limestones	Localised areas in Zone B around Malahide	Low	Low significance or value on a local scale
	Glacial till – IrSTLPSsS	Irish Sea Till derived from Lower Palaeozoic sandstones and shales	Widespread in Zone C and northern half of Zone D, with localised areas in Zone E	Low	Low significance or value on a local scale
	Gravels – GLPSsS	Gravels derived from Lower Palaeozoic	Localised areas along Zone C,	Low	Low significance or value on a local scale

Category	Feature	Description	Location	Importance	Justification for Importance rating
		sandstones and shales	particularly around Skerries		
	Glacial till – TLPSsS	Till derived from Lower Palaeozoic sandstones and shales	Northern extent of Zone C	Low	Low significance or value on a local scale
	Glacial till – TNSSs	Till derived from Namurian sandstones and shales	Localised area along Zone C to the south of Skerries Station	Low	Low significance or value on a local scale
	Peat – Cut	Cut over raised peat	Localised areas in Zone D to south of Laytown Station	Low	Low significance or value on a local scale
	Bedrock outcrop or subcrop – KaRck	Karstified bedrock outcrop or subcrop	Localised areas in Zone C, particularly around Skerries	Low	Low significance or value on a local scale
	Made ground – Urban	Made ground associated with urban development	Widespread in southern portion of Zone A	Low	Low significance or value on a local scale
Bedrock	Walshestown Formation	Shale, sandstone, limestone	Localised area in Zone C	Low	Low significance or value on a local scale
	Balrickard Formation	Coarse sandstone, shale	Localised area in Zone C	Low	Low significance or value on a local scale
	Loughshinny Formation	Dark micrite and calcarenite, shale	Localised areas in Zone C	Low	Low significance or value on a local scale
	Naul Formation	Calcarenite and calcisiltite	Localised area in Zone C	Low	Low significance or value on a local scale
	Holmpatrick Formation	Grainstone-packstone, micrite	Localised area in Zone C at Skerries Station	Low	Low significance or value on a local scale
	Rush Conglomerate Formation	Conglomerate, shale, limestone	Localised area in Zone C at Rush and Lusk Station	Low	Low significance or value on a local scale
	Lucan Formation	Dark limestone and shale	Widespread in Zone A, localised in Zone C north of Rush and Lusk Station	Low	Medium significance or value on a local scale
	Tullyallen Formation	Pale micritised grainstone-wackestone	Northern extent of Zone E.	Low	Medium significance or value on a local scale
	Tober Colleen Formation	Calcareous shale, limestone conglomerate	Localised areas in Zone A, Zone B, and Zone C	Low	Medium significance or value on a local scale

Category	Feature	Description	Location	Importance	Justification for Importance rating
	Mornington Formation	Dark limestone and calcareous shale	Widespread in northern Zone D and in Zone E	Low	Medium significance or value on a local scale
	Malahide Formation	Argillaceous bioclastic limestone, shale	Widespread in Zone B, localised areas in Zone C	Low	Medium significance or value on a local scale
	Waulsortian Formation	Massive unbedded lime-mudstone	Localised areas in Zone B	Low	Low significance or value on a local scale
	Donabate Formation	Red coarse sandstone and conglomerate	Localised area in Zone C	Low	Low significance or value on a local scale
	Denhamstown Formation	Greywacke sandstone and siltstone	Localised area in Zone D	Low	Low significance or value on a local scale
	Skerries Formation	Laminated blue-grey siltstone, sandstone	Localised area in Zone C between Skerries and Balbriggan Station	Low	Medium significance or value on a local scale
	Balbriggan Formation	Variably coloured mudstone	Localised area in Zone C south of Balbriggan Station	Low	Low significance or value on a local scale
	Clatterstown Formation	Thinly bedded siltstone, sandstone	Localised area in Zone D	Low	Medium significance or value on a local scale
	Belcamp Formation	Andesite, pillow breccia, mudstone, tuff	Localised area at Balbriggan Station and northern extent of Zone C.	Low	Medium significance or value on a local scale
	Portrane Volcanic Formation	Andesite, tuff, pebbly mudstone, shale	Localised area in Zone C at Donabate Station	Low	Low significance or value on a local scale
	Drogheda Granite	Quartz monzonite	Localised area in Zone E northeast of Drogheda MacBride Station	Low	Low significance or value on a local scale
Economic Geology	Clay, brick 3258	Non-metallic. Site of brick works that supplied good class red brick to Dublin	Located approximately 400m north of Portmarnock Station along Zone B	Low	Uneconomically extractable mineral resource
	Copper 5304	Metallic. Copper noted in red conglomerate along the railway line	Located approximately 800m south of Donabate Station along Zone C	Low	Uneconomically extractable mineral resource
	Pyrite 5322	Metallic. Iron pyrite noted in slates in a railway cutting on	Located approximately 1.4km north of Skerries Station along Zone C	Low	Uneconomically extractable mineral resource

Category	Feature	Description	Location	Importance	Justification for Importance rating
		old GSI 6-inch map			
	Clay, brick 3267	Non-metallic. Brick field and yard marked on old 6-inch map	Located approximately 500m north of Balbriggan Station along Zone C	Low	Uneconomically extractable mineral resource
	Crushed rock aggregate potential	Very Low	Localised areas along Zone C and Zone E	Low	Uneconomically extractable mineral resource
	Crushed rock aggregate potential	Low	Widespread in Zone A and southern part of Zone B. Localised areas in Zones C to E	Low	Uneconomically extractable mineral resource
	Granular aggregate potential	Very Low	Localised areas in Zones A to D	Low	Uneconomically extractable mineral resource
	Granular aggregate potential	Low	Localised areas in Zones A to D	Low	Uneconomically extractable mineral resource

Table 9.18 Summary of Land and Soils features with medium to high importance within the Study Area.

Category	Feature	Description	Location	Importance	Justification for Importance rating
Soil Fertility	Marine Sediments – MarSed	Marine/Estuarine sediments	Localised areas within Zone A to Zone C.	Medium	Moderately drained and / or moderate fertility soils
	Marine Sediments – MarSands	Beach sand and gravels	Localised area in Zone A and Zone C	Medium	Moderately drained and / or moderate fertility soils
	Marine Sediments – AeoUND	Aeolian undifferentiated	Localised area in Zone A	Medium	Moderately drained and / or moderate fertility soils
	Alluvium – AlluvMIN	Mineral alluvium	Localised areas within Zone A to Zone E.	Medium	Moderately drained and/or moderate fertility soils
	Topsoil – AminDW	Deep well drained mineral (Mainly acidic)	Localised areas along Zone C, particularly between Skerries and Balbriggan.	High	Well drained and / or high fertility soils
	Topsoil – AminSW	Shallow well drained mineral (mainly acidic)	Localised areas in Zone C, particularly around Skerries.	High	Well drained and / or high fertility soils
	Topsoil – BminDW	Deep well drained (mainly basic)	Widespread within Zone B, and southern half of Zone C.	High	Well drained and / or high fertility soils

Category	Feature	Description	Location	Importance	Justification for Importance rating
	Topsoil – BminSW	Shallow well drained mineral (mainly basic)	Localised areas in Zone B to Zone E.	High	Well drained and / or high fertility soils
Subsoils	Windblown sands – Ws	Windblown sands	Localised area along Zone D to the south of Laytown Station	Medium	Medium significance or value on a local scale
	Sands – Mbs	Marine beach sands	Localised area in Zone B (Howth Branch) and Zone C. Widespread in Zone D between Gormanston and Laytown Stations along coastline	Medium	Medium significance or value on a local scale
Geological Heritage Areas	Milverton Quarry (DF015)	Working quarry. Exposed faces of Lower Carboniferous limestone and shale displaying karst weathering features (pipes and caves)	Located approximately 100m to the west of the railway line in Zone C to the south of Skerries Station	High	Geological feature of high value on a local scale (County Geological Site)
	Fancourt Shore (DF002)	Coastal cliffs and foreshore. Coastal exposures of near complete Silurian succession (slates, sandstones and volcanics) dated by its graptolite fossils	Located approximately 150m east of the railway line in Zone C to the south of Balbriggan	High	Geological feature of high value on a local scale (County Geological Site)
	Laytown to Gormanston (MH008)	Coastal plain, including sea cliffs. Flat to gently undulating glacial outwash plain of sandur gravels	Extends along the railway line from the northern part of Zone C to north of Laytown Station in Zone D	High	Geological feature of high value on a local scale (County Geological Site)
Economic Geology	Limestone (in general) 2992	Non-metallic. Active quarry producing limestone flour, grits, chippings	Located approximately 100m west of the railway line in Zone C south of Skerries Station	High	Moderately sized existing quarry or pit
	Crushed rock aggregate potential	Moderate	Widespread in north part of Zone B. Localised areas in all other zones	Medium	Sub-economically extractable mineral resource
	Crushed rock aggregate potential	High	Widespread in northern part of Zone D. Localised areas in all other zones	High	Extractable mineral resource

Category	Feature	Description	Location	Importance	Justification for Importance rating
	Crushed rock aggregate potential	Very High	Localised areas in Zones C to E	High	Extractable mineral resource
	Granular aggregate potential	Moderate	Localised areas in all zones	Medium	Sub-economically extractable mineral resource
	Granular aggregate potential	High	Localised areas in Zone A and Zone C. Widespread in southern part of Zone D	High	Extractable mineral resource
	Granular aggregate potential	Very High	Localised areas in Zone A, Zone C, and Zone D	High	Extractable mineral resource
Potential Contaminated Land	Historical landfill	Fairview Park is located on reclaimed land (OSI Mapping)	Zone A, Fairview Park	Medium	Degree or extent of soil contamination is moderate on a local scale
	Historical quarry	6-inch mapping & 25-inch mapping	Zone A, Clontarf Golf Club	Medium	Degree or extent of soil contamination is moderate on a local scale
	Historical sand pits	6-inch mapping & 6-inch Cassini mapping	Zone B, Baldoyle Road and Sutton Station	Medium	Degree or extent of soil contamination is moderate on a local scale
	Historical quarries	6-inch mapping, 25-inch mapping & 6-inch Cassini mapping	Zone B, Clarement Road, Howth	Medium	Degree or extent of soil contamination is moderate on a local scale
	Historical electricity generating station	25-inch mapping	Zone B, Sutton Station	Medium	Degree or extent of soil contamination is moderate on a local scale
	Brick works	25-inch mapping	Zone B, north of Portmarnock Station	Medium	Degree or extent of soil contamination is moderate on a local scale
	Gas works	25-inch mapping & 6-inch Cassini mapping	Zone B, Malahide	Medium	Degree or extent of soil contamination is moderate on a local scale
	Sewage works	6-inch Cassini mapping	Zone B, Malahide	Medium	Degree or extent of soil contamination is moderate on a local scale
	Historic landfill	6-inch Cassini mapping	Zone C, north shore of Malahide Estuary	Medium	Degree or extent of soil contamination is moderate on a local scale
	Historic landfill	GSI Quaternary sediments mapping & CORINE 2018 database	Zone C, north shore of Rogerstown Estuary	Medium	Degree or extent of soil contamination is moderate on a local scale

Category	Feature	Description	Location	Importance	Justification for Importance rating
	Grave yard	6-inch mapping, 25-inch mapping & 6-inch Cassini mapping	Zone C, east of Donabate Station	Medium	Degree or extent of soil contamination is moderate on a local scale
	Gravel pit and railway line	25-inch mapping & 6-inch Cassini mapping	Zone C, east of Skerries Station	Medium	Degree or extent of soil contamination is moderate on a local scale
	Tramway	25-inch mapping	Zone C, east of R127 at Ardgillan	Medium	Degree or extent of soil contamination is moderate on a local scale
	Gravel pit	25-inch mapping	Zone C, east of R127 at Ardgillan	Medium	Degree or extent of soil contamination is moderate on a local scale
	Brick yard	6-inch mapping	Zone C, Balbriggan	Medium	Degree or extent of soil contamination is moderate on a local scale
	Hosiery factory	25-inch mapping & 6-inch Cassini mapping	Zone C, north of Balbriggan Station	Medium	Degree or extent of soil contamination is moderate on a local scale
	Linen factory	25-inch mapping	Zone C, Mill Street Balbriggan	Medium	Degree or extent of soil contamination is moderate on a local scale
	Salt works	25-inch mapping & 6-inch Cassini mapping	Zone C, Quay, Balbriggan	Medium	Degree or extent of soil contamination is moderate on a local scale
	Gas works	25-inch mapping & 6-inch Cassini mapping	Zone C, Balbriggan	Medium	Degree or extent of soil contamination is moderate on a local scale
	Historical cemetery	6-inch mapping, 25-inch mapping & 6-inch Cassini mapping	Zone E, Blackbush Lane	Medium	Degree or extent of soil contamination is moderate on a local scale
	Historical quarry	25-inch mapping	Zone E, South of Drogheda Station	Medium	Degree or extent of soil contamination is moderate on a local scale
	Historic Corn Mill	6-inch mapping, 25-inch mapping & 6-inch Cassini mapping	Zone E, Newfoundwell Road	Medium	Degree or extent of soil contamination is moderate on a local scale
	Coal yards	6-inch Cassini mapping	Zone E, Boyne Viaduct	Medium	Degree or extent of soil contamination is moderate on a local scale

Category	Feature	Description	Location	Importance	Justification for Importance rating
	Railway line and stations	6-inch mapping, 25-inch mapping & 6-inch Cassini mapping	Zones A to E	Medium	Degree or extent of soil contamination is moderate on a local scale
Industry	Newport Synthesis Ltd.	Licensed Industrial Emissions Licence (IEL) Facility	Zone B, Grange Parade	Medium	Light industrial usage
	Balleally Landfill	Licensed Industrial Emissions Licence (IEL) Landfill	Zone C, north shore of Rogerstown Estuary	Medium	Light industrial usage
	Milverton Waste Recovery Facility	Licensed soil recovery facility	Zone C, south of Skerries	Medium	Light industrial usage

9.5 Conceptual Site Model

A tabulated Conceptual Site Model (CSM) for the Proposed Development (which was developed based on the public available data and with the project-specific ground investigation data) is presented in Table 9.19.

Graphical CSMs as Geological Plan and Profile drawings are presented in Appendix A9.1 of Volume 4 of this EIAR. These CSMs are in plan and profile format with the profile illustrating the existing ground levels, project-specific ground investigation logs, and proposed works.

The CSM presented in Table 9.19 consider the proposed earthworks cut and fill volumes. The materials encountered during excavation and fill, including ballast and demolition material are discussed further in Chapter 19 (Material Assets: Resources and Waste Management). Temporary works material volumes are discussed in Chapter 19 (Material Assets: Resources and Waste Management).

Table 9.19 Conceptual Site Model for the Proposed Development.

Location	Element	Cut (m^3)*	Fill (m^3)*	Ground Conditions
Route wide				
Route Wide	OHLE	*7,000*	*0*	Variable across the scheme. Generally Made Ground underlain by glacial till and bedrock
	Lineside Civils – UTX Crossings	*3,000*	*2,000*	Variable across the scheme. Generally Made Ground underlain by glacial till and bedrock
	Lineside Civils – LOC (Location Cases) suites	*1,500*	*500*	Variable across the scheme. Generally Made Ground underlain by glacial till and bedrock

Location	Element	Cut (m^3)*	Fill (m^3)*	Ground Conditions
Route wide				
	Lineside Civils – Signalling	*400*	*100*	Variable across the scheme. Generally Made Ground underlain by glacial till and bedrock
Zone A				
Fairview	Depot	*1,500*	*1,500*	Made Ground underlain by glacial till
Zone B				
Howth Junction	Station Upgrades – Platform extension and station modifications	*1,100*	*800*	Made Ground underlain by glacial till
Howth Junction	SEB and TER	*300*	*200*	Made Ground underlain by glacial till
Howth Junction	Turnback	*70*	*70*	Made Ground underlain by glacial till
Clongriffin	SEB	*400*	*400*	Made Ground underlain by glacial till
Clongriffin	TER	*10*	*5*	Made Ground underlain by glacial till
Clongriffin	Station and Turnback (including embankment and UBB19 extension)	*14,000* *(Includes 2,500m^3 of site won topsoil to be reused on site)*	*36,500* *(Includes 2,500m^3 of site won topsoil to be reused on site)*	Made Ground, topsoil, and alluvium underlain by glacial till
Malahide	Turnback	*8,000*	*11,500*	Made Ground underlain by glacial till and estuarine deposits
Malahide	SEB and TER	*60*	*30*	Made Ground underlain by glacial till
Zone C				
Donabate	Substation	*2,000*	*3,000*	Topsoil underlain by glacial till and bedrock
Rush and Lusk	Substation, OHLE Maintenance Building & new Access Road to Carpark	*6,000*	*5,000*	Topsoil and Made Ground underlain by glacial till
Skerries – South	Substation	*1,100*	*4,100*	Topsoil underlain by glacial till with sands and gravels underlain by bedrock
Skerries – North	Substation	*2,000*	*3,300*	Topsoil and Made Ground underlain by glacial till and glacial sands/gravels
Skerries	TPH	*25*	*70*	Topsoil and Made Ground underlain by glacial till and glacial sands/gravels Bedrock not encountered

Location	Element	Cut (m^3)*	Fill (m^3)*	Ground Conditions
Route wide				
Balbriggan	Substation	*5,500*	*4,500*	Topsoil underlain by glacial till
Bridge OBB39	Bridge Lowering	*150*	*150*	Topsoil underlain by glacial till
Bridge OBB44	Bridge Lowering	*1,500*	*900*	Topsoil and Made Ground underlain by glacial till
Bridge OBB55	Bridge Lowering	*900*	*600*	Topsoil and Made Ground underlain by glacial till and bedrock
Zone D				
Gormanston	Substation	*1,700*	*8,000*	Topsoil and Made Ground underlain by glacial sands and gravels
Bettystown	Substation	*5,000*	*6,000*	Topsoil underlain by glacial till and bedrock
Bridge OBB78	Bridge Lowering	*350*	*300*	Made Ground underlain by glacial till
Zone E				
Drogheda	Substation	*2,500*	*3,000*	Topsoil underlain by glacial till and glacial sands underlain by bedrock
Drogheda	Turnback	*1,500*	*2,000*	Topsoil and Made Ground underlain by glacial till
Drogheda	SEB	*750*	*500*	Topsoil and Made Ground underlain by glacial till
Drogheda	TEB	*60*	*45*	Made Ground underlain by glacial till
Drogheda	Depot	*13,000*	*2,000*	Topsoil and Made Ground underlain by glacial till
Drogheda	Station Upgrades	*1,800*	*1,000*	Topsoil and Made Ground underlain by glacial till
Bridge OBB80	Bridge Modification	*6,000*	*7,000*	Topsoil and Made Ground underlain by glacial tills and glacial sands underlain by bedrock
Bridge UBK01	Bridge Modification	*1,000*	*1,000*	Made Ground underlain by glacial till and glacial sands underlain by bedrock

9.5.1 Environment Type

Based on the derived CSM the area across the Proposed Development is generally described as a Type A environment in accordance with the IGI Guidelines (IGI, 2013). The Type A environment is described as a passive geological/hydrogeological environment with areas of thick low permeability subsoils.

9.6 Characteristics of the Proposed Development

A detailed description of the Proposed Development and construction activities are provided in Chapter 4 (Description of the Proposed Development) and Chapter 5 (Construction Strategy). This Section outlines the key design features, characteristics, and construction activities of the Proposed Development of relevance to land and soils. The generation of earthworks volumes has been considered throughout the Preliminary Design and where possible, proposed excavation and/or depositional depths have been kept to a minimum to reduce cut and fill material volumes. Where possible, suitable excavated material will be retained within the project boundary for reuse.

9.6.1 Zone A (North of Connolly Station to south of Howth Junction & Donaghmede Station)

- Upgrades to signalling equipment and associated power supply installations north of Dublin City Centre to accommodate the proposed infrastructure works;
- Modifications to the existing depot at Fairview to support the new train fleet, and;
- Ancillary civil, drainage and landscaping works in areas of intervention.

9.6.2 Zone B (South of Howth Junction & Donaghmede Station (including Howth Branch) to north of Malahide Viaduct)

- Modifications to the existing 1500V DC electrification at Howth Junction, Clongriffin and Malahide and extension of the electrification north of Malahide to the limit of Zone B. This includes the installation of foundations for the OHLE masts;
- Upgrades to signalling equipment and associated power supply installations between Howth Junction and Donaghmede Station and Malahide, inclusive of the Howth Branch, to accommodate the proposed infrastructure works;
- Ancillary civil, drainage, utility diversions, and landscaping works in areas of intervention;
- Infrastructure works to facilitate the increase in service frequency and capacity, in specific areas of intervention as outlined below:
    - works around Howth Junction & Donaghmede Station;
    - works around Clongriffin Station including earthworks embankment and retaining walls;
    - works around Malahide Station & Viaduct including earthworks embankment and modular reinforced earth retaining wall;
- Modification to existing tracks and platforms, including the addition of new tracks to stable and facilitate the turn back and through running of trains; and
- Localised bridge modifications (UBB19) and landscaping works.

9.6.3 Zone C (North of Malahide Viaduct to south of Gormanston Station)

- Extension of existing 1500V DC electrification for the entirety of Zone C. This entails the installation of foundations for the OHLE masts, substations, and utility diversions;
- Improvements/modifications to bridges spanning the railway arising from track reconfigurations and/or meeting required electrical clearances;
- Undertaking localised bridge modifications to enable OHLE to be fixed to bridges carrying the railway;
- Ancillary civil, drainage and landscaping works in areas of intervention;
- Modification to railway boundary fences at relevant locations including substations and railway station;
- Modification to existing track levels (lowering) to provide the required clearance for OHLE at relevant structures; and
- Infrastructure works to facilitate the increase in service frequency and capacity, in specific areas of intervention as outlined below:
    - works to the existing user worked level crossing (closure) south of Donabate.

9.6.4 Zone D (South of Gormanston Station to County Meath/County Louth border)

- Extension of existing 1500V DC electrification for entirety of Zone D. This entails the installation of foundations for the OHLE masts and substations;
- Improvements/modifications to bridges spanning the railway arising from track reconfigurations and/or meeting required electrical clearances;
- Undertaking localised bridge modifications to enable OHLE to be fixed to bridges carrying the railway;
- Modification to railway boundary fences at relevant locations including substations and railway station;
- Modification to existing track levels (lowering) to provide the required clearance for OHLE at relevant structures; and
- Ancillary civil, drainage, utility diversions, and landscaping works in areas of intervention.

9.6.5 Zone E (Drogheda MacBride Station and surrounds)

- Extension of existing 1500V DC electrification for the entirety of Zone E. This entails the installation of foundations for the OHLE masts and substations;
- Modifications to station canopies at Drogheda MacBride Station;
- Improvements/modifications to road and rail bridges arising from track reconfigurations and /or meeting required electrical clearances;
- Undertaking localised bridge modifications to enable OHLE to be fixed to bridges carrying the railway;
- Modifications to existing depots at Drogheda to support the new train fleet, including earthworks cuttings for the provision of additional train stabling at Drogheda;
- Ancillary civil, drainage, utility diversions, and landscaping works in areas of intervention;
- Modification to railway boundary fences at relevant locations including substations and railway station;
- Modification to existing tracks and platforms, include the addition of new tracks, to stable and facilitate the turn back and through running of trains; and

- Infrastructure works to facilitate the increase in service frequency and capacity, in specific areas of intervention as outlined below:
    - works around Drogheda MacBride Station;
    - bridge demolition and replacement at OBB80/80A/80B; and
    - bridge modification at UBK01.

As discussed in Chapter 4 (Description of the Proposed Development):

- Overhead Line Equipment (OHLE) required for the electrification will consist of OHLE wires, masts and other infrastructure that will be erected along the line and through stations, from north of Malahide to Drogheda. Typical spacing between OHLE support structures will be between 40m and 50m, with a maximum spacing of 65m on shallow ground bearing pad or deeper pile foundations;
- Retaining walls (with piled or ground bearing foundations) and earthworks embankments will provide support to the modified/new track, road and substation layouts; and
- New bridge and platform with piled or ground bearing foundations.

Chapter 5 (Construction Strategy), describes:

- Three OHLE support foundations have been considered for the project, namely, concrete bored piles, steel driven piles or shallow ground bearing foundations such as concrete footings; and
- Piled or ground bearing foundations have been considered for the substation, retaining wall, bridge and platform foundations.

The reasonable “worst case” scenario in terms of land and soils impact has been assessed for the foundation types proposed. Thus, it is assumed that the foundations will require; a degree of earthworks, piling into subsoils and/or rock and pouring concrete in-situ.

9.7 Description of Potential Impacts

9.7.1 Do Nothing Scenario

In the Do-Nothing scenario, ongoing maintenance and renewal of the existing mainline infrastructure is likely to require more frequent intervention and replacement of materials such as ballast, particularly where soft subgrade and/or flooding or contamination are present.

In the current conditions, some of the potentially contaminated materials present in the ground could be subject to ingress of water spreading the contamination further below ground or allowing it to disperse up to the surface and into surface waterbodies. This is a particular risk in areas of permeable subsoil, such as the sand and gravel deposits encountered in Zone D. This is perceived to be a negative impact of the Do-Nothing scenario on the adjacent soils and associated ecosystems.

9.7.2 Construction Phase

The construction activities associated with the Proposed Development are described in detail in Chapter 5 (Construction Strategy).

The potential land and soils effects during the Construction Phase for the relevant construction activities described in Section 9.7.2 are presented in this section, along with their impact significance.

These potential effects also relate and interact with other environmental factors which are described within the EIAR. Specific interactions are outlined in Chapter 25 (Interactions) and Chapter 26 (Cumulative Effects) in Volume 2 of this EIAR.

9.7.2.1 Zone A (North of Connolly Station to south of Howth Junction & Donaghmede Station)

Construction activities in Zone A mainly include internal modifications to Fairview depot, including new cleaning platforms, improvements to signalling, telecommunications, walkways, lighting, and drainage. These modifications will have the following potential effects on land and soils as discussed below and summarised in Table 9.20.

- Excavation of potentially contaminated ground.

Though the magnitude of the impact may vary depending on the scale of activities and location of the Proposed Development relative to the impacted important feature, in order to ensure a robust assessment, only the maximum magnitude or "worst case" of the impact of the Proposed Development is considered.

9.7.2.1.1 Excavation of Potentially Contaminated Ground

Excavations in areas of unknown contaminated ground for the construction works may mobilise pollution contained in the soils into the nearby topsoil. This may potentially lead to a risk to the surrounding environment or underlying soil if not dealt with in an appropriate manner in accordance with the EPA guidance on Land Contamination. The underlying soil could be impacted from the exposure of previous buried hazardous material.

Due to the site history and adjacent historic landfill, there is the potential to encounter contaminated soils at the Fairview Depot.

The magnitude of this impact is small adverse as it results in the excavation of a small proportion of potentially contaminated land. As the potentially contaminated ground is of medium importance the resulting significance of the permanent small adverse impact is slight.

Table 9.20 Summary of predicted Construction Phase impacts in Zone A of the Proposed Development.

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Magnitude	Significance
Excavation of Potentially Contaminated Ground									
Potential Contaminated Land	Historical landfill	Fairview Park	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight

9.7.2.2 Zone B (South of Howth Junction & Donaghmede Station to north of Malahide Viaduct, including Howth Branch)

The majority of the construction works in Zone B will be carried out at: Howth Junction and Donaghmede Station, Clongriffin Station and at Malahide. Works in Zone B which may impact land and soils include excavation and earthworks associated with:

- Partial demolition and expansion of the station, piling, in-situ concreting, and Construction Compound at Howth Junction and Donaghmede Station;
- Construction of a retaining wall at Clongriffin Station and the works related Construction Compound;
- Embankment construction and new bridge construction to the north of Clongriffin station;
- Construction of a modular reinforced earth retaining wall, modification to the earth embankment, and Construction Compounds at Malahide;
- Modifications to existing OHLE at Howth Junction, Clongriffin and Malahide;
- OHLE works between Malahide Station and the northern boundary of Zone B, north of the Malahide Estuary;
- Turnback between Malahide station and Malahide viaduct with associated track works and embankment widening; and
- Signalling and telecommunications buildings and infrastructure.

Construction activities in Zone B will have the following potential effects on land and soils as discussed below and summarised in Table 9.21.

- Loss or damage of topsoil;
- Earthworks haulage;
- Effect on the surrounding ground;
- Loss of future quarry or pit reserve; and
- Excavation of potentially contaminated ground.

Though the magnitude of the impact may vary depending on the scale of activities and location of the Proposed Development relative to the impacted important feature, in order to ensure a robust assessment, only the maximum magnitude or “worst case” of the impact of the Proposed Development is considered.

9.7.2.2.1 Loss and damage of topsoil

Topsoil is a non-renewable resource which if removed or damaged can result in a permanent irreversible negative effect. There are a number of ways this could happen:

- There is the potential for materials on site to be spilled resulting in the pollution of the topsoil;
- These excavated soil materials will be stockpiled using appropriate methods to minimise the effects of weathering. Materials that are stockpiled incorrectly can be exposed to erosion and weathering which reduces the quality of the resource;
- Excavations in areas of unknown contaminated ground for the construction works may mobilise pollution contained in the soils into the nearby topsoil;
- Permanent damage of topsoil through waterlogging and erosion. This is due to the trafficking of plant, regrading of slopes and storage of materials in areas not intended to be paved as part of the Proposed Development; and

- Excavation and disposal of topsoil instead of its reuse or reinstatement.

It is expected that topsoil will be encountered and excavated at Clongriffin Station (and it surrounds) and at Malahide where it may be stripped and temporarily stored separately at designated excavated material storage area or as close as possible to the excavation.

Where topsoil is stripped to accommodate the works, all the above effects have the potential to occur at these locations.

The magnitude of this potential impact on the topsoil located at Clongriffin and Malahide is considered to be small adverse as it is an irreversible loss of a small proportion of local high fertility soils and/or high proportion of local low fertility soils and the significance of this permanent small adverse impact is moderate/slight.

The magnitude of this potential impact on the topsoil located at Howth Junction and Donaghmede Station is considered to be negligible as it results in an impact of insufficient magnitude to affect either its use or integrity and the significance of this impact is imperceptible.

9.7.2.2.2 Earthworks Haulage

During earthworks, heavily loaded large earthmoving vehicles may be used and may travel through the temporary Construction Compounds. The Construction Compounds within Zone B are located around the areas of major works, including Howth Junction and Donaghmede, Clongriffin, and Malahide stations. Heavy loaded large earthmoving vehicles may cause ground vibrations, soil compaction and disturbance of natural ground on unfinished road surfaces. This will also result in increased traffic on the roads along the Proposed Development. Increased noise, dust and vibration will also be generated.

The impact on the underlying soils and subsoils attribute is negligible as it is considered to be of insufficient magnitude to affect either its use or integrity, therefore the resulting significance is imperceptible and will not be assessed further.

Volume 2: Chapter 12 (Air Quality) and Volume 2: Chapter 14 (Noise and Vibration) provide more information on noise, dust, and vibration.

Chapter 6 (Traffic and Transport) provides more information on earthworks haulage within the Proposed Development.

9.7.2.2.3 Effect on the surrounding ground

The soil and rock removed during the construction process may have the potential to induce movement and settlement of the surrounding ground. The removal of the soil and rock that may be required for the construction activities proposed in Zone B may be carried out using earthworks or piling equipment which could result in minor ground vibrations with effects felt in the immediate vicinity of the works.

Expansion works at Howth Junction and Donaghmede Station, construction of the new bridge and earthworks embankment to the north of Clongriffin Station, and construction of the OHLE foundations will involve piling. Piling at these locations will result in the removal of minor quantities of subsoil material, with potential for minor rock excavation in areas of shallow bedrock.

The new retaining wall and earthworks slope at Malahide to facilitate track widening and construction of the Malahide turnback will result in the removal and replacement of existing embankment material. Slope stabilisation works may include the installation of soil nails.

The impact on the subsoils and bedrock in the surrounding area is negligible as it is considered to be of insufficient magnitude to affect either its use or integrity, therefore the resulting significance is imperceptible and will not be assessed further.

9.7.2.2.4 Loss of Future Quarry or Pit Reserve

The excavation of soil and rock during construction can diminish future quarry and pit reserves. This can result in a permanent irreversible loss of the in-situ characteristics of the land and soils area. There are no notable existing or historic quarries with the study area. The GSI crushed aggregate potential for Howth Junction and Donaghmede Station and Clongriffin Station is of low potential. However, Malahide is mapped as high to very high potential. The section of land at Malahide where the majority of the works are proposed is unmapped by the GSI but is considered as high to very high.

The magnitude of this effect is negligible as it results in an impact on the attribute of insufficient magnitude to affect either its use or integrity, thus the resulting significance is imperceptible and will not be considered further.

9.7.2.2.5 Excavation of Potentially Contaminated Ground

The excavation of made ground results in the production of excess material that requires placement elsewhere in the Proposed Development or removal off-site and may lead to the mobilisation of possible contaminants.

Due to the industrial historic nature of the railway line and historic development of the surrounding lands, the construction works in Zone B may encounter potentially contaminated land at all locations along the railway line and at the stations.

Exposure of locations of contamination and excavation of contaminated soil may potentially lead to a risk to the surrounding environment or underlying soil if not dealt with in an appropriate manner in accordance with the EPA guidance on Land Contamination. The underlying soil could be impacted from the exposure of previous buried hazardous material, in an unlicensed dumping site for example.

The magnitude of this impact is small adverse as it results in the excavation of a small proportion of contaminated land. As the potential contaminated ground is of medium importance the resulting significance of the permanent small adverse impact is slight.

Table 9.21 Summary of predicted Construction Phase impacts in Zone B of the Proposed Development.

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Magnitude	Significance
Loss or Damage of Topsoil									
Topsoil	BminDW	Clongriffin Station and Malahide	High	Loss or damage of topsoil	Negative	Permanent	Local	Small adverse	Moderate / Slight
Alluvium	AlluvMIN	Howth Junction and Donaghmede Station	Medium	Loss or damage of topsoil	Negative	Permanent	Local	Negligible	Imperceptible
Earthworks Haulage									
Topsoil	BminDW	Clongriffin Station and Malahide	High	Ground vibrations, soil compaction and disturbance of natural ground	Negative	Permanent	Local	Negligible	Imperceptible
Alluvium	AlluvMIN	Howth Junction and Donaghmede Station	Medium	Ground vibrations, soil compaction and disturbance of natural ground	Negative	Permanent	Local	Negligible	Imperceptible
Effect on the Surrounding Ground									
Topsoil	BminDW	Clongriffin Station	High	Effect on the surrounding ground	Negative	Permanent	Local	Negligible	Imperceptible
Topsoil	BminPD	Clongriffin Station	High	Effect on the surrounding ground	Negative	Permanent	Local	Negligible	Imperceptible

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Magnitude	Significance
Alluvium	AlluvMIN	Localised areas	Medium	Effect on the surrounding ground	Negative	Permanent	Local	Negligible	Imperceptible
Subsoil	AlluvMIN	Localised areas	Medium	Effect on the surrounding ground	Negative	Permanent	Local	Negligible	Imperceptible
Loss of Future Quarry or Pit Reserve									
Crushed rock aggregate	High potential	Malahide	High	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible
Crushed rock aggregate	Very high potential	Malahide	High	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible
Excavation of Potentially Contaminated Ground									
Potential Contaminated Land	Existing railway network.	All locations	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight

9.7.2.3 Zone C (North of Malahide Viaduct to south of Gormanston Station)

The Construction Phase works in Zone C include excavation and earthworks associated with the OHLE works across the length of Zone C and substation construction in Donabate, Rush and Lusk, Skerries South, Skerries North, and Balbriggan. Construction Compounds are located at Donabate, Rogerstown Park, Rush and Lusk Station, OBB44, Skerries South, Skerries North and Balbriggan. At Rush and Lusk, there will be a new access road constructed for the station, as well as a new OHLE maintenance building. Minor excavations may also be required to accommodate line lowering works at OBB39, OBB44 Tyrrelstown Bridge and OBB55, as well as horizontal directional drilling for Underground Track Crossing (UTXs) at seven locations along Zone C of the Proposed Development (UTX5, UTX6, UTX7, UTX8, UTX8, UTX9, and UTX10).

Construction activities in Zone C will have the following potential effects on land and soils as discussed below and summarised in Table 9.22:

- Loss or damage of topsoil and subsoil;
- Earthworks haulage;
- Effect on the surrounding ground;
- Loss or damage of proportion of Geological Heritage Area;
- Loss of future quarry or pit reserve; and
- Excavation of potentially contaminated ground.

Though the magnitude of the impact may vary depending on the scale of activities and location of the Proposed Development relative to the impacted important feature, in order to ensure a robust assessment, only the maximum magnitude or “worst case” of the impact of the Proposed Development is considered.

9.7.2.3.1 Loss and damage of topsoil

Topsoil is a non-renewable resource which if removed or damaged can result in a permanent irreversible negative effect. There are a number of ways this could happen:

- There is the potential for materials on site to be spilled resulting in the pollution of the topsoil.
- These excavated soil materials will be stockpiled using appropriate methods to minimise the effects of weathering. Materials that are stockpiled incorrectly can be exposed to erosion and weathering which reduces the quality of the resource;
- Excavations in areas of unknown contaminated ground for the construction works may mobilise pollution contained in the soils into the nearby topsoil;
- Permanent damage of topsoil through waterlogging and erosion. This would be due to the trafficking of plant, regrading of slopes and storage of materials in areas not intended to be paved as part of the Proposed Development; and
- Excavation and disposal of topsoil instead of its reuse or reinstatement.

It is expected that topsoil will be encountered and excavated along Zone C of the Proposed Development, including at substation locations in Donabate, Rush and Lusk, Skerries South, Skerries North, and Balbriggan. Topsoil may be stripped and temporarily stored separately at designated excavated material storage areas or as close as possible to the excavation. Where topsoil is stripped to accommodate the works, all the above effects have the potential to occur at these locations.

The magnitude of these impacts of the Proposed Development on the topsoil is small adverse as it results in a permanent irreversible loss of a small proportion of locally high fertility topsoil and/or a high proportion of locally low fertility topsoil within the study area. As the topsoil is of high importance the resulting significance of this permanent small adverse impact is moderate/slight.

The impact of the Proposed Development on the alluvium, marine sediments and marine sands and gravels is negligible. As these soils are of medium importance the resulting significance of this negligible impact is imperceptible.

9.7.2.3.2 Earthworks Haulage

During earthworks, heavily loaded large earthmoving vehicles may be used and may travel through the substation construction sites and temporary Construction Compounds. The temporary Construction Compounds within Zone C are located around areas of major works including substations and bridge modifications, as well as in line to facilitate OHLE support construction. Heavily loaded earthmoving vehicles may cause ground vibrations, soil compaction and disturbance of natural ground on unfinished road surfaces. This will also result in increased traffic on the roads along the Proposed Development. Increased noise, dust, vibration will also be generated.

The impact on the underlying soils and subsoils attribute is negligible as it is considered to be of insufficient magnitude to affect either its use or integrity, therefore the resulting significance is imperceptible and will not be assessed further.

Chapter 12 (Air Quality) and Chapter 14 (Noise and Vibration) provide more information on noise, dust, and vibration.

Chapter 6 (Traffic and Transport) provides more information on earthworks haulage within the Proposed Development.

9.7.2.3.3 Effect on the surrounding ground

The potential soil and rock removed during the construction process may have the potential to induce movement and settlement of the surrounding ground. The potential removal of the soil and rock that may be required for the construction activities proposed in Zone C may be carried out using earthworks and piling equipment which could result in minor ground vibrations with effects felt in the immediate vicinity of the works.

Utility diversions are widespread across the Proposed Development. The main impact on land and soil regarding utility diversions is related to horizontal directional drilling (HDD) for underground track crossings (UTX). Within Zone C of the Proposed Development, HDD is required for seven utility diversions (UTX5, UTX6, UTX7, UTX8, UTX8, UTX9, and UTX10). HDD will result in the removal of minor quantities of subsoil material, with potential for rock excavation in areas of shallow bedrock along the Proposed Development. Chapter 18 (Material Assets: Utilities) provides more information on the utility diversions along the Proposed Development.

The impact on the subsoils and bedrock in the surrounding area is negligible as it is considered to be of insufficient magnitude to affect either its use or integrity, therefore the resulting significance is imperceptible and will not be assessed further.

9.7.2.3.4 Loss or damage of proportion of Geological Heritage Area

There are no proposed works within the Milverton Quarry CGS (DF015) and Fancourt Shore (DF002) County Geological Heritage sites as part of the Proposed Development. The Laytown to Gormanston CGS (MH008) is located in the northern part of Zone C and encompasses the Proposed Development.

Excavation associated with foundations for the OHLE will take place within the CGS. However, as the excavations are very small the magnitude of this impact is negligible as it results in an insufficient permanent irreversible change on a local scale to affect the integrity of the county geological site. While the CGS has an importance ranking of high the resulting significance of this negligible impact is imperceptible and therefore will not be considered further.

9.7.2.3.5 Loss of Future Quarry or Pit Reserve

The excavation of soil and rock during construction can diminish future quarry and pit reserves. This can result in a permanent irreversible loss of the in-situ characteristics of the land and soils area. There are no notable existing or historic quarries with Zone C.

The granular aggregate potential ranges from very low to high along Zone C of the Proposed Development and the crushed rock aggregate potential ranges from very low to very high.

The magnitude of this effect is negligible as it results in an impact on the attribute of insufficient magnitude to affect either its use or integrity. The resulting significance is imperceptible and will not be considered further.

9.7.2.3.6 Excavation of Potentially Contaminated Ground

The excavation of made ground results in the production of excess material that requires placement elsewhere in the Proposed Development or removal off-site and may lead to the mobilisation of possible contaminants.

Potential sources of contamination relevant to the Proposed Development identified within the study area are detailed in Table 9.14 and include the railway line and stations, historic landfills north of Malahide estuary and at Rogerstown Estuary, gravel pits, historical tramways, and various historical industrial operations in Balbriggan.

Exposure of locations of contamination and excavation of contaminated soil may potentially lead to a risk to the surrounding environment or underlying soil if not dealt with in an appropriate manner in accordance with the EPA guidance on Land Contamination. The underlying soil could be impacted from the exposure of previous buried hazardous material, in an unlicensed dumping site for example.

The magnitude of this impact is small adverse as it results in the excavation of a small proportion of contaminated land. As the potential contaminated ground is of medium importance the resulting significance of the permanent small adverse impact is slight.

Table 9.22 Summary of predicted Construction Phase impacts in Zone C of the Proposed Development.

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Magnitude	Significance
Loss or Damage of Topsoil									
Marine Sediments	MarSed	Localised areas	Medium	Loss or damage of fertile soil	Negative	Permanent	Local	Negligible	Imperceptible
Marine Sands and gravels	MarSands	Localised area	Medium	Loss or damage of fertile soil	Negative	Permanent	Local	Negligible	Imperceptible
Topsoil	AminDW	Localised areas	High	Loss or damage of fertile soil	Negative	Permanent	Local	Small adverse	Moderate / Slight
Topsoil	AminSW	Localised areas particularly around Skerries.	High	Loss or damage of fertile soil	Negative	Permanent	Local	Small adverse	Moderate / Slight
Topsoil	BminDW	Widespread within southern half of Zone C.	High	Loss or damage of fertile soil	Negative	Permanent	Local	Small adverse	Moderate / Slight
Topsoil	BminSW	Localised areas.	High	Loss or damage of fertile soil	Negative	Permanent	Local	Small adverse	Moderate / Slight
Alluvium	AlluvMIN	Along watercourses in Zone C	Medium	Loss or damage of fertile soil	Negative	Permanent	Local	Negligible	Imperceptible
Earthworks Haulage									
Marine Sediments	MarSed	Localised areas	Medium	Soil compaction and disturbance of natural ground	Negative	Permanent	Local	Negligible	Imperceptible
Marine Sands and gravels	MarSands	Localised area	Medium	Soil compaction and disturbance of natural ground	Negative	Permanent	Local	Negligible	Imperceptible
Topsoil	AminDW	Localised areas	High	Soil compaction and disturbance of natural ground	Negative	Permanent	Local	Negligible	Imperceptible

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Magnitude	Significance
Topsoil	AminSW	Localised areas particularly around Skerries.	High	Soil compaction and disturbance of natural ground	Negative	Permanent	Local	Negligible	Imperceptible
Topsoil	BminDW	Widespread within southern half of Zone C.	High	Soil compaction and disturbance of natural ground	Negative	Permanent	Local	Negligible	Imperceptible
Topsoil	BminSW	Localised areas	High	Soil compaction and disturbance of natural ground	Negative	Permanent	Local	Negligible	Imperceptible
Alluvium	AlluvMIN	Along watercourses in Zone C	Medium	Soil compaction and disturbance of natural ground	Negative	Permanent	Local	Negligible	Imperceptible
Subsoil	Sands – Mbs	Balbriggan	Medium	Soil compaction and disturbance of natural ground	Negative	Permanent	Local	Negligible	Imperceptible
Effect on the Surrounding Ground									
Marine Sediments	MarSed	Localised areas	Medium	Effect on the surrounding ground	Negative	Permanent	Local	Negligible	Imperceptible
Marine Sands and gravels	MarSands	Localised area	Medium	Effect on the surrounding ground	Negative	Permanent	Local	Negligible	Imperceptible
Topsoil	AminDW	Localised areas	High	Effect on the surrounding ground	Negative	Permanent	Local	Negligible	Imperceptible
Topsoil	AminSW	Localised areas particularly around Skerries.	High	Effect on the surrounding ground	Negative	Permanent	Local	Negligible	Imperceptible
Topsoil	BminDW	Widespread within southern half of Zone C.	High	Effect on the surrounding ground	Negative	Permanent	Local	Negligible	Imperceptible

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Magnitude	Significance
Topsoil	BminSW	Localised areas.	High	Effect on the surrounding ground	Negative	Permanent	Local	Negligible	Imperceptible
Alluvium	AlluvMIN	Along watercourses in Zone C	Medium	Effect on the surrounding ground	Negative	Permanent	Local	Negligible	Imperceptible
Subsoil	Sands – Mbs	Balbriggan	Medium	Effect on the surrounding ground	Negative	Permanent	Local	Negligible	Imperceptible
Loss or damage of proportion of Geological Heritage Area									
Geological Heritage Area	Laytown to Gormanston (MH008)	South of River Delvin	High	Loss or damage of proportion of Geological Heritage Area	Negative	Permanent	Local	Negligible	Imperceptible
Loss of Future Quarry or Pit Reserve									
Crushed rock aggregate potential	Moderate	Localised areas	Medium	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible
Crushed rock aggregate potential	High	Localised areas	High	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible
Crushed rock aggregate potential	Very high	Localised areas	High	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible
Granular aggregate potential	Moderate	Localised areas	Medium	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible
Granular aggregate potential	High	Localised areas	High	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Magnitude	Significance
Granular aggregate potential	Very high	Localised areas	High	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible
Excavation of Potentially Contaminated Ground									
Potential Contaminated Land	Existing railway network	Widespread	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Contaminated Land	Historic landfill	North shore of Malahide Estuary	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Contaminated Land	Historic landfill	North shore of Rogerstown Estuary	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Contaminated Land	Graveyard	East of Donabate Station	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Contaminated Land	Gravel pit and railway line	East of Skerries Station	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Contaminated Land	Tramway	East of R127 at Ardgillan	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Contaminated Land	Gravel pit	East of R127 at Ardgillan	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Contaminated Land	Brick yard	Balbriggan	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Contaminated Land	Hosiery factory	North of Balbriggan Station	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Magnitude	Significance
Potential Contaminated Land	Linen factory	Mill Street Balbriggan	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Contaminated Land	Salt works	Quay, Balbriggan	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Contaminated Land	Gas works	Balbriggan	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight

9.7.2.4 Zone D (South of Gormanston Station to County Meath/County Louth border)

The Construction Phase works in Zone D include excavation and earthworks associated with the OHLE works across the length of Zone D, as well as substation construction at Gormanston and Bettystown. Excavation and earthworks associated with substation and access roads construction are planned for Gormanston and Bettystown. Construction Compounds are located at Gormanston, UBB72 Laytown Viaduct, Bettystown and OBB78 Colpe Road Bridge. Excavations may also be required to accommodate line lowering works at OBB78 Colpe Road Bridge. Minor excavations may also be required during horizontal directional drilling for Underground Track Crossing (UTXs) at four locations along Zone D of the Proposed Development (UTX2, UTX3, UTX4 and UTX4).

Construction activities in Zone D will have the following potential effects on land and soils as discussed below and summarised in Table 9.23:

- Loss or damage of topsoil;
- Earthworks haulage;
- Effect on the surrounding ground;
- Loss or damage of proportion of Geological Heritage Area;
- Loss of future quarry or pit reserve; and
- Excavation of potentially contaminated ground.

Though the magnitude of the impact may vary depending on the scale of activities and location of the Proposed Development relative to the impacted important feature, in order to ensure a robust assessment, only the maximum magnitude or "worst case" of the impact of the Proposed Development is considered.

9.7.2.4.1 Loss and damage of topsoil

Topsoil is a non-renewable resource which if removed or damaged can result in a permanent irreversible negative effect. There are a number of ways this could happen:

- There is the potential for materials on site to be spilled resulting in the pollution of the topsoil;
- These excavated soil materials will be stockpiled using appropriate methods to minimise the effects of weathering. Materials that are stockpiled incorrectly can be exposed to erosion and weathering which reduces the quality of the resource;
- Excavations in areas of unknown contaminated ground for the construction works may mobilise pollution contained in the soils into the nearby topsoil;
- Permanent damage of topsoil through waterlogging and erosion. This would be due to the trafficking of plant, regrading of slopes and storage of materials in areas not intended to be paved as part of the Proposed Development; and
- Excavation and disposal of topsoil instead of its reuse or reinstatement.

It is expected that topsoil will be encountered and excavated along Zone D of the Proposed Development, including substations at Gormanston and Bettystown. Topsoil may be stripped and temporarily stored separately at designated excavated material storage areas or as close as possible to the excavation. Where topsoil is stripped to accommodate the works, all the above effects have the potential to occur at these locations.

The magnitude of these impacts of the Proposed Development on the topsoil is small adverse as it results in a permanent irreversible loss of a small proportion of locally high fertility topsoil and/or a high proportion of locally low fertility topsoil within the study area. As the topsoil is of high importance the resulting significance of this permanent small adverse impact is moderate/slight.

The impact of the Proposed Development on the alluvium within this zone is negligible. As the alluvium is of medium importance the resulting significance of this negligible impact is imperceptible.

9.7.2.4.2 Earthworks Haulage

During earthworks, heavily loaded large earthmoving vehicles may be used and may travel through the substation construction sites and temporary Construction Compounds. The temporary Construction Compounds within Zone D are located around areas of major works including substations as well as in line to facilitate OHLE support construction. Heavily loaded earthmoving vehicles may cause ground vibrations, soil compaction and disturbance of natural ground on unfinished road surfaces. This will also result in increased traffic on the roads along the Proposed Development. Increased noise, dust, vibration will also be generated.

The impact on the underlying soils and subsoils attribute is negligible as it is considered to be of insufficient magnitude to affect either its use or integrity, therefore the resulting significance is imperceptible and will not be assessed further.

Chapter 12 (Air Quality) and Chapter 14 (Noise and Vibration) provide more information on noise, dust, and vibration.

Chapter 6 (Traffic and Transport) provides more information on earthworks haulage within the Proposed Development.

9.7.2.4.3 Effect on the surrounding ground

The potential soil and rock removed during the construction process may have the potential to induce movement and settlement of the surrounding ground. The potential removal of the soil and rock that may be required for the construction proposed in Zone D may be carried out using piling machinery which could result in minor ground vibrations with effects felt in the immediate vicinity of the works.

Utility diversions are widespread across the Proposed Development. The main impact on land and soils regarding utility diversions is related to horizontal directional drilling (HDD) for underground track crossings (UTX). Within Zone D of the Proposed Development, HDD is required for four diversions (UTX2, UTX3, UTX4 and UTX4). HDD will result in the removal of minor quantities of subsoil material with potential for rock excavation in areas of shallow bedrock along the Proposed Development. Chapter 18 (Material Assets: Utilities) provides more information on the utility diversions along the Proposed Development.

These works may also give rise to noise and vibration effects and may result in the generation of dust. Chapter 12 (Air Quality) and Chapter 14 (Noise and Vibration) provide more information on such effects.

The impact on the subsoils and bedrock in the surrounding area is negligible as it is considered to be of insufficient magnitude to affect either its use or integrity, therefore the resulting significance is imperceptible and will not be assessed further.

9.7.2.4.4 Loss or damage of proportion of Geological Heritage Area

The Laytown to Gormanston CGS (MH008) is located in the southern part of Zone D and encompasses the Proposed Development.

Excavation associated with foundations for the OHLE will take place within the CGS. However, as the excavations are very small the magnitude of this impact is negligible as it results in an insufficient permanent irreversible change on a local scale to affect the integrity of the county geological site. While the CGS has an importance ranking of high the resulting significance of this negligible impact is imperceptible and therefore will not be considered further.

9.7.2.4.5 Loss of Future Quarry or Pit Reserve

The excavation of soil and rock during construction can diminish future quarry and pit reserves. This can result in a permanent irreversible loss of the in-situ characteristics of the land and soils area. There are no notable existing or historic quarries within Zone D.

The granular aggregate potential ranges from low to very high along Zone D. The crushed rock aggregate potential ranges from very low to very high potential.

The magnitude of this effect is negligible as it results in impact on the attribute of insufficient magnitude to affect either its use or integrity. The resulting significance of this negligible effect is imperceptible and will not be considered further.

9.7.2.4.6 Excavation of Potentially Contaminated Ground

The excavation of made ground results in the production of excess material that requires placement elsewhere in the Proposed Development or removal off-site and/or may lead to the mobilisation of possible contaminants.

Potential sources of contamination relevant to the Proposed Development identified within the study area are detailed in Table 9.14 and include the railway line and stations.

Exposure of locations of contamination and excavation of contaminated soil may potentially lead to a risk to the surrounding environment or underlying soil if not dealt with in an appropriate manner in accordance with the EPA guidance on Land Contamination. The underlying soil could be impacted from the exposure of previous buried hazardous material, in an unlicensed dumping site for example.

The magnitude of this impact is small adverse as it results in the excavation of a small proportion of contaminated land. As the potential contaminated ground is of medium importance the resulting significance of the permanent small adverse impact is slight.

Table 9.23 Summary of predicted Construction Phase impacts in Zone D of the Proposed Development.

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Magnitude	Significance
Loss or Damage of Topsoil									
Topsoil	BminSW	Laytown and north of River Boyne	High	Loss or damage of topsoil	Negative	Permanent	Local	Small adverse	Moderate / Slight
Alluvium	AlluvMIN	Along watercourses in Zone D	Medium	Loss or damage of fertile soil	Negative	Permanent	Local	Negligible	Imperceptible
Earthworks Haulage									
Marine sands	Ws	South of Laytown Station	Medium	Compaction or disturbance to subsoil	Negative	Permanent	Local	Negligible	Imperceptible
Marine sands	Mbs	Between Gormanston and Laytown Stations	Medium	Compaction or disturbance to subsoil	Negative	Permanent	Local	Negligible	Imperceptible
Effect on the Surrounding Ground									
Marine sands	Ws	South of Laytown Station	Medium	Effect on the surrounding ground	Negative	Permanent	Local	Negligible	Imperceptible
Marine sands	Mbs	Between Gormanston and Laytown Stations	Medium	Effect on the surrounding ground	Negative	Permanent	Local	Negligible	Imperceptible
Loss or damage of proportion of Geological Heritage Area									
Geological Heritage Area	Laytown to Gormanston (MH008)	Laytown to Gormanston	High	Loss or damage of proportion of Geological Heritage Area	Negative	Permanent	Local	Negligible	Imperceptible

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Magnitude	Significance
Loss of Future Quarry or Pit Reserve									
Crushed rock aggregate potential	Moderate	Localised areas	Medium	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible
Crushed rock aggregate potential	High	Widespread	High	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible
Crushed rock aggregate potential	Very high	Widespread	High	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible
Granular aggregate potential	Moderate	Localised areas	Medium	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible
Granular aggregate potential	High	Widespread	High	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible
Granular aggregate potential	Very high	Localised areas	High	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible
Excavation of Potentially Contaminated Ground									
Potential Contaminated Land	Existing railway network	All locations	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight

9.7.2.5 Zone E (Drogheda MacBride Station and surrounds)

The Construction Phase works in Zone E which may impact land and soils include excavation and earthworks associated with:

- OHLE works across the length of the zone;
- Piled foundations and Construction Compounds for the OBB80/80A/80B Railway Terrace Bridge and the UBK01 Dublin Road Bridge;
- Construction of foundations for Platform 4, Drogheda Freight Sidings;
- Construction of a short section of new track bed for the Drogheda Freight Sidings;
- Construction of the Drogheda Substation and Construction compounds;
- Vegetation clearance and the regrading of the existing earth bank at the Drogheda Depot; and
- Horizontal directional drilling for UTX of two utility diversions at one location (UTX1 and UTX1).

Construction activities in Zone E will have the following potential effects on land and soils as discussed below and summarised in Table 9.24:

- Loss or damage of topsoil;
- Earthworks haulage;
- Effect on the surrounding ground;
- Excavation of potentially contaminated ground; and
- Loss of future quarry or pit reserve.

Though the magnitude of the impact may vary depending on the scale of activities and location of the Proposed Development relative to the impacted important feature, in order to ensure a robust assessment, only the maximum magnitude or “worst case” of the impact of the Proposed Development is considered.

9.7.2.5.1 Loss and damage of topsoil

Topsoil is a non-renewable resource which if removed or damaged can result in a permanent irreversible negative effect. There are a number of ways this could happen:

- There is the potential for materials on site to be spilled resulting in the pollution of the topsoil.
- These excavated soil materials will be stockpiled using appropriate methods to minimise the effects of weathering. Materials that are stockpiled incorrectly can be exposed to erosion and weathering which reduces the quality of the resource;
- Excavations in areas of unknown contaminated ground for the construction works may mobilise pollution contained in the soils into the nearby topsoil;
- Permanent damage of topsoil through waterlogging and erosion. This would be due to the trafficking of plant, regrading of slopes and storage of materials in areas not intended to be paved as part of the Proposed Development; and
- Excavation and disposal of topsoil instead of its reuse or reinstatement.

It is expected that topsoil will be encountered and excavated within Zone E of the Proposed Development, including at the proposed Drogheda Depot. Topsoil may be stripped and temporarily stored separately at designated excavated material storage areas or as close as possible to the excavation. Where topsoil is stripped to accommodate the works, all the above effects have the potential to occur at these locations.

The magnitude of these impacts of the Proposed Development on the topsoil is small adverse as it results in a permanent irreversible loss of a small proportion of locally high fertility topsoil and/or a high proportion of locally low fertility topsoils within Zone E. As the topsoil is of high importance the resulting significance of this permanent small adverse impact is moderate/slight.

The impact of the Proposed Development on the alluvium is negligible. As the alluvium is of medium importance the resulting significance of this negligible impact is imperceptible.

9.7.2.5.2 Effect on the surrounding ground

The potential soil and rock removed during the construction process may have the potential to induce movement and settlement of the surrounding ground. The potential removal of the soil and rock that may be required for the construction proposed in Zone E may be carried out using earthworks and piling equipment which could result in minor ground vibrations with effects felt in the immediate vicinity of the works.

Utility diversions are widespread across the Proposed Development. The main impact on land and soils regarding utility diversions is related to horizontal directional drilling (HDD) for underground track crossings (UTX). Within Zone E of the Proposed Development, HDD is required for two utility diversions at a single location (UTX1 and UTX1). HDD will result in the removal of minor quantities of subsoil material, with potential for rock excavation in areas of shallow bedrock along the Proposed Development. Chapter 18 (Material Assets: Utilities) provides more information on utility diversions along the Proposed Development.

These works may also give rise to noise and vibration effects and may result in the generation of dust. Chapter 12 (Air Quality) and Chapter 14 (Noise and Vibration) provide more information on such effects.

The impact on the subsoils and bedrock in the surrounding area is negligible as it is considered to be of insufficient magnitude to affect either its use or integrity, therefore the resulting significance is imperceptible and will not be assessed further.

9.7.2.5.3 Loss of Future Quarry or Pit Reserve

The excavation of soil and rock during construction can diminish future quarry and pit reserves. This can result in a permanent irreversible loss of the in-situ characteristics of the land and soils area. There are no notable existing or historic quarries with the study area.

No granular aggregate potential was noted along Zone E. The GSI aggregate potential mapping indicates that the crushed rock aggregate potential along Zone E ranges from low to very high.

The magnitude of this effect is negligible as it results in an impact on the attribute of insufficient magnitude to affect either its use or integrity. The resulting significance of this negligible effect is imperceptible and will not be considered further.

9.7.2.5.4 Excavation of Potentially Contaminated Ground

The excavation of made ground results in the production of excess material that requires placement elsewhere in the Proposed Development or removal off-site and/or may lead to the mobilisation of possible contaminants.

Potential sources of contamination relevant to the Proposed Development identified within the study area are detailed in Table 9.14 and include the railway line and stations and a cemetery, a historical quarry, a historical corn mill and historical coal yards.

There is potential to encounter contaminated soils during all construction activities within Zone E of the Proposed Development due to the urban historical nature of the study area. Construction activities that may encounter contaminated material include bridge modifications at OBB80/80A/80B and UBK01, modification to the existing Drogheda depots stabling roads, new track layouts for the Drogheda Freight Sidings within the vicinity of the station and Platform 4 extension.

Exposure of locations of contamination and excavation of contaminated soil may potentially lead to a risk to the surrounding environment or underlying soil if not dealt with in an appropriate manner in accordance with the EPA guidance on Land Contamination. The underlying soil could be impacted from the exposure of previous buried hazardous material, in an unlicensed dumping site for example.

The magnitude of this impact is small adverse as it results in the excavation of a small proportion of contaminated land. As the potential contaminated ground is of medium importance the resulting significance of the permanent small adverse impact is slight.

Table 9.24 Summary of predicted Construction Phase impacts in Zone E of the Proposed Development.

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Magnitude	Significance
Loss or Damage of Topsoil									
Topsoil	BminSW	Localised area	High	Loss or damage of topsoil	Negative	Permanent	Local	Small adverse	Moderate / Slight
Alluvium	AlluvMIN	Along watercourses	Medium	Loss or damage of fertile soil	Negative	Permanent	Local	Negligible	Imperceptible
Loss of Future Quarry or Pit Reserve									
Crushed rock aggregate potential	Moderate	Northern part of Zone E	Medium	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible
Crushed rock aggregate potential	High	Widespread	High	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible
Crushed rock aggregate potential	Very high	Localised areas	Medium	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible
Excavation of Potentially Contaminated Ground									
Potential Contaminated Land	Existing railway network	Widespread	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Contaminated Land	Historical cemetery	Blackbush Lane	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Contaminated Land	Historical quarry	South of Drogheda Station	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Potential Contaminated Land	Historic Corn Mill	Newfoundwell Road	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Magnitude	Significance
Potential Contaminated Land	Coal yards	Boyne Viaduct	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight

9.7.3 Operational Phase

Aside from the general and selected import fill materials to be provided, the main soil materials to be used on an ongoing basis during operation will be ballast. The construction will require excavation works to replace any existing materials containing potential contamination. Once in service, the operational removal of ballast is much less likely to be affected by contamination from hydrocarbon materials in particular; the materials will therefore remain cleaner than is currently the case in the Do-Nothing scenario. On this basis, after construction there will likely be positive, slight effects over the existing conditions.

9.7.4 Decommissioning Phase

The DART+ Coastal North project is providing rail infrastructure which will enable an increase in frequency and capacity on the Northern Line and the Howth Branch in the coming years. It is not intended that this infrastructure will be decommissioned, but rather, as the infrastructure reaches the end of its design life, it will likely be refurbished or renewed to enable continued operation of the railway. Any such future renewal or refurbishment may require additional construction works, which would be similar to, but of a much lesser impact (in terms of extent and duration) than, the Construction Phase associated with the DART+ Coastal North project.

9.8 Mitigation Measures

The following sections outline the mitigation measures designed to avoid or minimise those effects identified in Section 9.7 (potential impacts) for the Construction and Operational Phases of the Proposed Development.

9.8.1 Construction Phase

The mitigation strategy outlined in this section will be implemented during the Construction Phase of the Proposed Development. The strategy is incorporated into the overall Construction Environment Management Plan (CEMP), which is included in Appendix A5.1 in Volume 4 of this EIAR.

Construction techniques that comply with the requirements of statutory bodies (Local Authorities and EPA) in terms of noise, vibration, soil and groundwater contamination, and disposal of possible contaminated material for both soil and rock cuttings will be adopted. A summary of the pre-mitigation and post-mitigation effects is contained in Table 9.25 to Table 9.29.

9.8.1.1 Loss or Damage of Topsoil

Excavated topsoils will be stockpiled by the appointed contractor using appropriate methods to minimise the effects of weathering. Care will be taken in reworking this material to minimise dust generation, groundwater infiltration and generation of runoff.

All topsoil or subsoil shall be assessed for re-use within the Proposed Development by the appointed contractor ensuring the appropriate handling, processing, and segregation of the material. Where practical the removal of topsoil from the Proposed Development will be avoided. All earthworks will be undertaken in accordance with project-specific earthworks specifications ensuring that all excavated material and imported material is classified using the same methodology to allow maximum opportunity for the reuse of materials on site.

9.8.1.2 Effect on the surrounding ground

All earthworks and piling works will be undertaken in accordance with project-specific engineering specifications ensuring that all works are completed to the design requirements, including:

- Particular piling specification: this document will set out particulars of all piling works associated with the construction of the proposed works. In particular minimum criteria for piling, acceptable materials and testing will be specified;
- Particular earthworks specification: this document will set out the requirements during the Construction Phase in relation to any excavation or filling activities for the project. In particular minimum criteria for earthwork formations, acceptable materials and material disposal will be specified; and
- Particular instrumentation and monitoring specification; where excavation or piling works may affect the alignment of the operational railway tracks or the condition of the surrounding structures/assets, instrumentation will be installed, and monitoring completed during the works to confirm the ground response such that appropriate actions can be carried out during the construction stage to maintain movements within the acceptable design limits.
  Monitoring of operational tracks be completed to IÉ standards and monitoring of nearby structures or assets will be undertaken in accordance with project-specific earthworks specifications.

9.8.1.3 Excavation of Potentially Contaminated Ground

The appointed contractor will ensure that excavations will be kept to a minimum, using shoring or trench boxes where appropriate. For more extensive excavations, a temporary works designer will be appointed by the appointed contractor to design excavation support measures in accordance with all relevant guidelines that minimise the excavation of contaminated ground.

Excavations in made ground will be monitored by an appropriately qualified person to ensure that any hotspots of possible encountered contamination are properly identified, segregated, and disposed of appropriately. Any identified hotspots will 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 throughout the site.

The appointed contractor will be responsible for regular testing of excavated soils to monitor the suitability of the soil for reuse.

Samples of ground suspected of contamination will be tested for contamination by the appointed contractor during the construction works, and any additional ground investigation, and ground excavated from these areas will be disposed of to a suitably licensed or permitted site in accordance with the current Irish waste management legislation.

The appointed contractor shall issue copies of all waste disposal receipts/records to the Employers Representative/IÉ for the duration of works.

9.8.1.4 Pollution of Soil

Good housekeeping (e.g., daily site clean-ups, use of disposal bins, etc.) will be carried out at working areas during construction, and the proper use, storage and disposal of all substances and their containers will help prevent soil contamination. For all activities involving the use of potential pollutants or hazardous materials, there will be a requirement to ensure that material such as concrete, fuels, lubricants and hydraulic fluids will be carefully handled and stored to avoid spillages. Potential pollutants will also be adequately secured against vandalism and will be provided with proper containment according to codes of best practice. Any spillages will be immediately contained, and contaminated soil removed from site and disposed of in a licensed waste facility.

Potential soil and water pollution will be minimised by the implementation of good construction practices. Such practices will include adequate bunding for oil containers, wheel washers and dust suppression on site roads, and regular plant maintenance.

An Emergency Response Plan will be drawn up by the contractor's Site Environmental Manager prior to the commencement of works and regularly updated, identifying the actions to be taken in the event of a pollution incident. The necessary training will be provided to staff to deal with any pollution event. Further detail can be found in the CEMP in Appendix A5.1 in Volume 4 of this EIAR. The Emergency Response Plan will address the following:

- Secure oil and chemical storage in over-ground bunded areas, limited to the minimum volume required to serve immediate needs with specified delivery and refuelling areas;
- No refuelling or fuel storage within 50m of waterways and only on a sealed surface;
- Emergency spill kits will be retained at sensitive locations, with portable kits provided to plant and equipment operators;
- Cessation of work and development of measures to contain and/or remove pollutant should an incident be identified;
- Silt traps will be employed and maintained in appropriate locations;
- Temporary interception bunds and drainage ditches will be constructed up slope of excavations to minimise surface runoff ingress and in advance of excavation activities; and
- Excavation and earthworks will be suspended during and immediately following periods of heavy rainfall to minimise sediment generation and soil damage.

9.8.2 Operational Phase

With the implementation of the proposed design, no additional mitigation measures for land and soils are considered necessary for the operation of the Proposed Development.

In the Operational Phase the infrastructure will be maintained by Iarnród Éireann and will be subject to their management procedures to ensure that the correct measures are taken in the event of any accidental spillages. This will reduce the potential for any impact.

9.8.3 Decommissioning Phase

The DART+ Coastal North project is providing rail infrastructure which will enable an increase in frequency and capacity on the Northern Line and the Howth Branch in the coming years. It is not intended that this infrastructure will be decommissioned, but rather, as the infrastructure reaches the end of its design life, it will likely be refurbished or renewed to enable continued operation of the railway. Any such future renewal or refurbishment may require additional construction works, which would be similar to, but of a much lesser impact (in terms of extent and duration) than, the Construction Phase associated with the DART+ Coastal North project. The mitigation measures outlined herein for the Construction Phase, will be applied as appropriate, during any future decommissioning.

9.9 Residual Effects

9.9.1 Construction Phase

With the efficacious implementation of the above mitigation measures, there will be no significant residual impacts on land and soils as a result of the construction of the Proposed Development. A summary of the predicted Construction Phase impacts in Zones A to E following the implementation of mitigation and monitoring measures are presented in Table 9.25 to Table 9.29.

Table 9.25 Summary of predicted Construction Phase impacts in Zone A following the Implementation of Mitigation and Monitoring Measures.

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Pre-mitigation Magnitude	Pre-mitigation Significance	Post-mitigation Magnitude	Post-mitigation Significance
Excavation of Potentially Contaminated Ground											
Potential Contaminated Land	Historical landfill	Fairview Depot	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible

Table 9.26 Summary of predicted Construction Phase impacts in Zone B Following the Implementation of Mitigation and Monitoring Measures.

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Pre-mitigation Magnitude	Pre-mitigation Significance	Post-mitigation Magnitude	Post-mitigation Significance
Loss or Damage of Topsoil											
Topsoil	BminDW	Clongriffin Station and Malahide	High	Loss or damage of topsoil	Negative	Permanent	Local	Small adverse	Moderate / Slight	Negligible	Imperceptible
Excavation of Potentially Contaminated Ground											
Potential Contaminated Land	Existing railway network.	All locations	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible

Table 9.27 Summary of predicted Construction Phase impacts in Zone C Following the Implementation of Mitigation and Monitoring Measures.

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Pre-mitigation Magnitude	Pre-mitigation Significance	Post-mitigation Magnitude	Post-mitigation Significance
Loss or Damage of Topsoil											
Topsoil	BminDW	Clongriffin Station and Malahide	High	Loss or damage of topsoil	Negative	Permanent	Local	Small adverse	Moderate / Slight	Negligible	Imperceptible
Topsoil	AminDW	Localised areas	High	Loss or damage of fertile soil	Negative	Permanent	Local	Small adverse	Moderate / Slight	Negligible	Imperceptible
Topsoil	AminSW	Localised areas particularly around Skerries.	High	Loss or damage of fertile soil	Negative	Permanent	Local	Small adverse	Moderate / Slight	Negligible	Imperceptible
Topsoil	BminDW	Widespread within southern half of Zone C.	High	Loss or damage of fertile soil	Negative	Permanent	Local	Small adverse	Moderate / Slight	Negligible	Imperceptible
Excavation of Potentially Contaminated Ground											
Potential Contaminated Land	Existing railway network.	All locations	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Contaminated Land	Existing railway network	Widespread	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Contaminated Land	Historic landfill	North shore of Malahide Estuary	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Pre-mitigation Magnitude	Pre-mitigation Significance	Post-mitigation Magnitude	Post-mitigation Significance
Potential Contaminated Land	Historic landfill	North shore of Rogerstown Estuary	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Contaminated Land	Grave yard	East of Donabate Station	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Contaminated Land	Gravel pit and railway line	East of Skerries Station	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Contaminated Land	Tramway	East of R127 at Ardgillan	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Contaminated Land	Gravel pit	East of R127 at Ardgillan	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Contaminated Land	Brick yard	Balbriggan	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Contaminated Land	Hosiery factory	North of Balbriggan Station	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Contaminated Land	Linen factory	Mill Street Balbriggan	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Contaminated Land	Salt works	Quay, Balbriggan	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Contaminated Land	Gas works	Balbriggan	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible

Table 9.28 Summary of predicted Construction Phase impacts in Zone D Following the Implementation of Mitigation and Monitoring Measures.

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Pre-mitigation Magnitude	Pre-mitigation Significance	Post-mitigation Magnitude	Post-mitigation Significance
Loss or Damage of Topsoil											
Topsoil	BminSW	Localised area	High	Loss or damage of topsoil	Negative	Permanent	Local	Small adverse	Moderate / Slight	Negligible	Imperceptible
Excavation of Potentially Contaminated Ground											
Potential Contaminated Land	Existing railway network	Widespread	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Contaminated Land	Historical cemetery	Blackbush Lane	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Contaminated Land	Historical quarry	South of Drogheda Station	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Contaminated Land	Historic Corn Mill	Newfoundwell Road	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible

Table 9.29 Summary of predicted Construction Phase impacts in Zone E Following the Implementation of Mitigation and Monitoring Measures.

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Pre-mitigation Magnitude	Pre-mitigation Significance	Post-mitigation Magnitude	Post-mitigation Significance
Loss or Damage of Topsoil											
Topsoil	BminSW	Localised area	High	Loss or damage of topsoil	Negative	Permanent	Local	Small adverse	Moderate / Slight	Negligible	Imperceptible
Excavation of Potentially Contaminated Ground											
Potential Contaminated Land	Existing railway network	Widespread	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Contaminated Land	Historical cemetery	Blackbush Lane	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Contaminated Land	Historical quarry	South of Drogheda Station	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Contaminated Land	Historic Corn Mill	Newfoundwell Road	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Potential Contaminated Land	Coal yards	Boyne Viaduct	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible

9.9.2 Operational Phase

No significant residual impacts on land and soils as a result of the Operational Phase of the Proposed Development have been identified.

9.9.3 Decommissioning Phase

No significant residual impacts on land and soils as a result of the Decommissioning Phase of the Proposed Development have been identified. Cumulative Operational Effects

9.10 Cumulative Effects

The cumulative assessment of relevant plans and proposed works is undertaken separately in Chapter 26 (Cumulative Effects) in Volume 2 of this EIAR.

9.11 References

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