# **Chapter 14** Land, Soils, Geology & Hydrogeology





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# 14 LAND, SOILS, GEOLOGY AND HYDROGEOLOGY

## 14.1 Introduction

This Chapter of the Environmental Impact Assessment Report (EIAR) considers the potential impacts on land, soils, geology and hydrogeology as a result of the proposed BusConnects Galway - Dublin Road scheme (hereafter referred to as the Proposed Development).

The Proposed Development extends from the western end at the Moneenageisha Junction where it will join the Galway BusConnects: Cross City Link project, to the Doughiska Junction in the east, where the Proposed Development will terminate. Chapter 4 (Proposed Development Description) includes a full description of the Proposed Development.

The aim of the Proposed Development when in operation is to provide enhanced walking, cycling, and bus infrastructure on this key access corridor in Galway City, which will enable and deliver efficient, safe, and integrated sustainable transport movement along the corridor. The objectives of the Proposed Development are outlined in Chapter 1 (Introduction). The Proposed Development, which is described in detail in Chapter 4 (Proposed Development Description), has been designed to meet these objectives.

The design of the Proposed Development has evolved through comprehensive design iteration, with particular emphasis on minimising the potential for environmental impacts, where practicable, whilst ensuring the objectives of the Proposed Development are attained. In addition, feedback received from the comprehensive consultation programme undertaken throughout the option selection and design development process have been incorporated, where appropriate.

The potential land, soils, geology, and hydrogeology impacts associated with the development of the Proposed Development have been assessed. This includes the potential for contamination of soils and groundwater, changes to groundwater regime and the loss of natural soils from excavation activities associated with utility diversions, pavement resurfacing, road widening and realignments.

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

An assessment is made of the likely significant impacts associated with the Construction and Operational Phases of the Proposed Development on the soils, subsoils, bedrock, geological resources and heritage and hydrogeology. Measures are presented to mitigate or eliminate the impacts of the Proposed Development on these resources.

Potential impacts related to the surface water environment are not considered in this assessment but are considered separately in Chapter 13 (Water). The potential impact related to the production of excess material for removal off site is discussed in Chapter 17 (Waste & Resources).

## 14.2 Methodology

The following Sections outline the legislation and guidelines considered, and the adopted methodology for defining the baseline environment and undertaking the assessment in terms of land, soils, geology, and hydrogeology. The potential impacts of the Proposed Development on land, soils, geology and hydrogeology have been assessed by classifying the importance of the relevant attributes and quantifying the likely magnitude of any impact on these attributes.

## 14.2.1 Study Area

The land, soils, geology, and hydrogeology study area for the Proposed Development extends 250m (metres) either side of the Proposed Development boundary which is in accordance with the Institute of





Geologists of Ireland (IGI) Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements (hereafter referred to as the IGI Guidelines) (IGI, 2013). It is worth noting that the study area for this Chapter, shown in Figure 14-1 below, differs from the study area outlined in Chapter 01 – Introduction.



## Figure 14-1 250m Study Area

## 14.2.2 Relevant Guidelines, Policy, and Legislation

The main documents that have been followed for the preparation of the land, soils, geology, and hydrogeology assessment are:

- Institute of Geologists of Ireland (IGI) Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements (IGI, 2013);
- 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, 2008a);
- 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;
- Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment;
- Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy (the Water Framework Directive);
- European Communities (Water Policy) Regulations 2003, as amended (S.I. No. 722/2003); and





European Union (Water Policy) Regulations 2014 (S.I. No. 350/2014).

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 assessment has been prepared using the following guidelines:

- Environmental Protection Agency (EPA) Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (hereafter referred to as the EPA Guidelines) (EPA, 2022);
- European Commission, Environmental Impact Assessment of Projects Guidance on the preparation of the Environmental Impact Assessment Report (EC, 2017);
- Environmental Impact Assessment of National Road Schemes A Practical Guide (NRA, 2008b);
- Evaluating the Influence of Groundwater Pressures on Groundwater Dependent Wetlands. Strive EPA Programme 2007 - 2013 (EPA, 2011); and
- Environmental Research Centre Report Series No. 12. A Framework for the Assessment of Groundwater-Dependent Terrestrial Ecosystems under the Water Framework Directive. Strive EPA Programme 2007 – 2013 (EPA, 2008).

## 14.2.3 Data Collection and Collation

Data was collated from publicly available datasets, the findings of ground investigations, design information, a scheme walkover survey, and other sources, as outlined below.

## 14.2.3.1 Publicly Available Datasets

The publicly available datasets listed in Table 14-1 have been acquired and consulted in the assessment of the baseline conditions. All datasets were accessed throughout 2023 and 2024.

Organization	Database Description		Link
ASI	Archaeology	The <u>Historic Environment</u> <u>Viewer</u> is a new online digital service provided by the Department of Culture, Heritage and the Gaeltacht. It has been developed to enhance the user's experience by facilitating access to the databases of the National Monuments Service Sites and Monuments Record (SMR) and the National Inventory of Architectural Heritage (NIAH) in a seamless one-stop point of access for both built heritage data resources.	<u>https://maps.archaeology.i</u> <u>e/historicenvironment</u>
GSI	Bedrock	Bedrock 100k: Bedrock geology map of Ireland at 1:100,000 scale.	<u>https://www.gsi.ie/en-</u> <u>ie/data-and-</u> <u>maps/Pages/Bedrock.aspx</u> <u>#</u>
	Geohazards	Landslides Susceptibility Mapping: Systematic mapping of Ireland identifying areas	<u>https://www.gsi.ie/en-</u> <u>ie/data-and-</u> <u>maps/Pages/Geohazards.</u> <u>aspx#</u>

## Table 14-1 Publicly Available Datasets





Organization	Database	Description	Link
		predisposed to landslides and classifying susceptibility from low to high;	
		Karst Features: Database of all known karst features in Ireland, including boreholes, caves, dry valleys, enclosed depressions, estavelles, springs, superficial solution features, swallow holes, and turloughs.	
	Geological Heritage	Geological Heritage Sites Audited: Database of all audited geological heritage sites; Geological Heritage Sites Unaudited: Database of all unaudited geological heritage sites, including buffer zones around features.	<u>https://www.gsi.ie/en-</u> <u>ie/data-and-</u> <u>maps/Pages/Geoheritage.</u> <u>aspx</u>
	Geotechnical	External Geotechnical Boreholes and Site Investigations: Borehole logs and site investigation data submitted to the National Geotechnical Borehole Database.	<u>https://www.gsi.ie/en-</u> <u>ie/data-and-</u> <u>maps/Pages/Geotechnical.</u> <u>aspx</u>
	Groundwater	Groundwater Flood Data: Mapping of historic groundwater flood events and potential groundwater flood areas; Groundwater Resources (Aquifers): Mapping of bedrock aquifers, including classification of resource potential; Groundwater Vulnerability: Mapping identifying areas susceptible to groundwater contamination; Groundwater Wells and Springs: Database of all boreholes, dug wells, springs, and ground site investigations.	<u>https://www.gsi.ie/en-</u> <u>ie/data-and-</u> <u>maps/Pages/Groundwater.</u> <u>aspx</u>
	Minerals	Mineral Localities: Database of mineral localities compiled from 6" geological maps, field investigations, exploration reports, and other sources;	<u>https://www.gsi.ie/en-</u> <u>ie/data-and-</u> maps/Pages/Minerals.aspx





Organization	Database	Description	Link	
		Quarry Directory: Comprehensive database of active quarries containing information such as quarry products, location, and contact details;		
		Aggregate Potential Mapping: <i>Mapping</i> showing the potential for crushed rock, and sand and gravel aggregates, including an inventory of active and historical pits and quarries.		
		Quaternary Geomorphology: <i>Mapping</i> of Irish glacial geomorphological features at 1:50,000 scale;		
	Quaternary	Quaternary Sediments: Mapping of all sediments within 1m of the surface, including those which were laid down during the Quaternary, bedrock at or close to the surface, and Made Ground.	<u>ie/data-and-</u> <u>ie/data-and-</u> <u>maps/Pages/Quaternary.a</u> <u>spx</u>	
	Topography	Open Topographic Viewer: Collection of published LiDAR Survey Data. Contains Irish Public Sector Data (Geological Survey Ireland & the Office of Public Works) licensed under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence	https://dcenr.maps.arcgis.c om/apps/webappviewer/in dex.html?id=b7c4b0e7639 64070ad69bf8c1572c9f5	
EPA	Industrial Emissions (IE) Facilities	Point dataset of IE- licensed facilities in Ireland, including those licensed, applied, surrendered, and others. The EPA is the competent authority for granting and enforcing these licenses for specified industrial and agricultural activities, as listed in the First Schedule of the Environmental Protection Agency Act 1992 as amended.	https://gis.epa.ie/geonetwo rk/srv/eng/catalog.search#/ metadata/7905844c-a43d- 4dd4-b262-c95c7aa0e9c7	
	Integrated Pollution Control (IPC) Facilities	Point dataset of IPC licensed facilities in Ireland, including those	https://gis.epa.ie/geonetwo rk/srv/eng/catalog.search#/	





Organization	Organization Database		Link	
		licensed, applied, surrendered, and others. The EPA is the competent authority for granting and enforcing these licenses for specified industrial and agricultural activities, as listed in the First Schedule of the Environmental Protection Agency Act 1992 as amended.	metadata/70e60147-0f3f- 4ce5-9831-6787d016f439	
	Integrated Pollution Prevention Control (IPPC) Facilities	Point dataset of IPPC licensed facilities in Ireland, including those licensed, applied, surrendered, and others. The EPA is the competent authority for granting and enforcing these licenses for specified industrial and agricultural activities, as listed in the First Schedule of the Environmental Protection Agency Act 1992 as amended.	https://gis.epa.ie/geonetwo rk/srv/eng/catalog.search#/ metadata/7459f32a-afa0- 470f-aae9-7eae49419740	
	Licensed Waste Facilities	Point dataset of waste- licensed facilities in Ireland, including licensed, applied, surrendered, and others. The EPA is the competent authority for granting and enforcing these licenses. Facilities include landfills, transfer stations, hazardous waste disposal, and other significant waste disposal and recovery activities.	https://gis.epa.ie/geonetwo rk/srv/eng/catalog.search#/ metadata/00750a6a-e2f4- 451d-b41c-0f067a40c94c	
NPWS	Protected Sites	Mapping of protected sites, including Special Protection Areas (SPAs), Special Areas of Conservation (SACs), Natural Heritage Areas (NHAs), and proposed National Heritage Areas (pNHAs).	https://dahg.maps.arcgis.c om/apps/webappviewer/in dex.html?id=8f7060450de 3485fa1c1085536d477ba	
OPW	Flood Maps	Past Flood Events: Mapping of historic flood events, including single and recurring events. National Indicative Fluvial Mapping: "Predictive" flood maps outside of CFRAM areas showing areas predicted to be inundated	<u>https://www.floodinfo.ie/ma</u> p/floodmaps/	





Organization	Database Description		Link
		during a theoretical or "design flood" event.	

## 14.2.3.2 Ground Investigation

Both a traditional intrusive ground investigation (GI) and a non-intrusive geophysical survey were employed as part of this project to examine the subsurface conditions and inform the Proposed Development design. The fieldwork for these investigations was conducted between October and November 2023. The factual report from the ground investigation is included in Appendix 14.2 of Volume 4 of this EIAR and has been used to assess the site-specific conditions discussed in Section 14.3.3.

Additionally, a number of historical ground investigations conducted within the study area have also been used in the assessment of the baseline conditions. These historical reports are presented in Table 14-2, and are publicly available from the Geotechnical layers of the GSI Spatial Resources Map Viewer (GSI, Accessed 2024).

GSI Report Ref.	Report Title	No. of exploratory holes relevant to the project	Year completed	Soil Conditions
1353	Report on Design Recommendations covering settlement and stability under fill for proposed service station for Texaco Ireland Limited at Lough Atalia, Galway	3no. trial pits 6no. boreholes	1972	The report identifies the site to be covered by fill of thickness from 1.5m to 1.8m (MADE GROUND) in the northern section, followed by brown-black fibrous PEAT (decreasing thickness going from 6.4m in the south to 3.65m in the north), followed by grey clayey MARL (variable thickness from 0.9m to 6.0m), followed by sandy silty GRAVEL (variable thickness from 0.3m to 5.8m) overlying bedrock. Type of the bedrock was not named in the report.
6727	Wellpark House Development Galway	5no. cable percussive boreholes	2006	The boreholes met shallow refusal - 0.6- 0.7m on the "presumed bedrock". The overburden was identified as MADE GROUND-gravel cobbles and boulders with a thickness ranging from 0.6m to 0.7m.
-	-	12no. boreholes	Unknown	Site of Garda Western Regional Headquarters. 9no. boreholes bedrock not met 0-5m. 1no. borehole bedrock not met 5-10m. 2no. boreholes bedrock met 10-20m.
2365	Site Investigation Report for Corrib Great Southern Hotel, Galway	3no. boreholes	1990	The report identifies the overburden consisting of brown CLAY (hard) with a thickness of 1.8288-3.048m, followed by the broken rock with a thickness of 0.6096- 0.9144m. The broken rock overlies the fractured rock with clay smearing from 0.05m to 0.18m in the top part and from 0.03m to 0.05m in the lower parts.
1340	Galway Eastern Approach Road - N6	3no. boreholes	1993	Boreholes recorded shallow limestone bedrock at levels from 0.05m to 0.17m – described as grey LIMESTONE with some

## Table 14-2 Historic Ground Investigations





GSI Report Ref.	Report Title	No. of exploratory holes relevant to the project	Year completed	Soil Conditions
		3no. trial pits		clay lenses and quartzite veins (very poor becoming fair to good with depth). Trial pits recorded TOPSOIL to depths of 0.2m-0.3m on the top of shallow bedrock.
1337	Galway Eastern Approach Road - N6	1no. Rotary core borehole	1989	The rock core record reports: 110cm of Good continuous core of fine-grained dark limestone with stylolites, followed by 25 cm of cavity–filled with grey clay and limestone fragments, followed by 100cm of fine- grained limestone with some crystalline calcite.

## 14.2.3.3 Scheme Walkover

A scheme walkover survey was carried out on 19 October 2023 to inform and verify the review of publicly available datasets.

The findings of the scheme walkover survey including photos and scheme walkover survey notes are included in Appendix 14.1 of Volume 4 of this EIAR.

## 14.2.4 Appraisal Method for the Assessment of Impacts

The impact assessment for this Chapter has been carried out in accordance with the NRA Guidelines (NRA, 2008a) and the IGI Guidelines (IGI, 2013).

The likely significant impacts have been assessed by classifying the importance of the relevant attributes and quantifying the magnitude of any likely significant impacts on these attributes as outlined below.

## 14.2.4.1 Baseline – Initial Assessment

In order to identify and quantify the likely significant impacts of the Construction Phase and Operational Phase of the Proposed Development, it is first necessary to undertake a detailed study of the (baseline) geological and hydrogeological environment of the study area for the Proposed Development.

The existing land, soils, geology, and hydrogeology conditions in the study area have been interpreted from review of existing data, consultation, and walkover survey.

This assessment includes the development of a preliminary Conceptual Site Model (CSM), which describes the ground conditions expected throughout the study area, presented in Section 14.2.1, of the Proposed Development based on existing literature. Also, as part of this initial assessment, the preliminary generic type of geological / hydrogeological environment is determined. The IGI Guidelines (IGI, 2013) provide five types of environments as examples (Types A to E, as described in Step 3 of the IGI Guidance).

## 14.2.4.2 Baseline – Direct and Indirect Site Investigation

Information gathered on the baseline environment during specific ground investigations for the Proposed Development corresponds to the second element of the methodology, 'Direct and Indirect Site Investigation and Studies'. However, no ground investigations were required to be carried out for the Proposed Development.





As part of the second element, relevant site investigations and studies close to the Proposed Development are gathered and assessed. Then, the preliminary CSM is refined accordingly.

## 14.2.4.3 Gradation of impacts

The NRA Guidelines (NRA, 2008a) provide criteria and examples for determining likely significant impacts. The relevant tables from the NRA Guidelines (NRA, 2008a) are as follows:

- Box 4.1: Criteria for Rating Site Attributes Estimation of Importance of Soil and Geology Attributes (Table 14-3);
- Box 4.3: Criteria for Rating Site Attributes Estimation of the Importance of Hydrogeology Attributes Table 14-4);
- The magnitude of impacts should be defined in accordance with the criteria provided in the NRA Guidelines. This is outlined in Table 14-5;
- Box 5.1: Criteria for Rating Site Attributes at Environmental Impact Assessment (EIA) Stage Estimation of Magnitude of Impact on Soil / Geology Attribute (
- Table 14-6);
- Box 5.3: Criteria for Rating Site Attributes at EIA Stage Estimation of Magnitude of Impact on Hydrogeology Attributes (Table 14-7); and
- Box 5.4: Rating of Significant Environmental Impacts at EIA Stage (Table 14-8).

The NRA Guidelines criteria use similar significance terminology as the EPA Guidelines (EPA, 2022). However, it has intermediate steps to justify using that terminology:

- Step 1: Quantify the importance of a feature for geology (Box 4.1) and hydrogeology (Box 4.3);
- Step 2: Estimate the magnitude of the impact on the feature from the Proposed Development (Box 5.1, Box 5.3); and
- Step 3: Determine the significance of the impact on the feature from the matrix (Box 5.4) based on the importance of the feature and the magnitude of the impact.

# Table 14-3 Criteria for Rating the Importance of Identified Soils and Geological Attributes (Table C2(IGI 2013) and Box 4.1 (NRA, 2008a))

Importance	Criteria	Typical Example
Very High	<ul> <li>Attribute has a high quality, significance or value on a regional or national scale.</li> <li>Degree or extent of soil contamination is significant on a national or regional scale.</li> <li>Volume of peat and / or soft organic soil underlying route is significant on a national or regional scale.</li> </ul>	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.	<ul> <li>Contaminated soil on site with previous heavy industrial usage</li> <li>Large recent landfill site for mixed wastes</li> <li>Geological feature of high value on a local scale (County Geological Site) Well drained and / or high fertility soils</li> <li>Moderately sized existing quarry or pit</li> </ul>





Importance	Criteria	Typical Example
		<ul> <li>Marginally economic extractable mineral resource</li> </ul>
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

# Table 14-4 Criteria for Rating the Importance of Identified Hydrogeological Attributes (Box 4.3 NRA2008a)

Importance	Criteria	Typical Example
Extremely High	Attribute has a high quality or value on an international scale	Groundwater supports river, wetland or surface water body ecosystem protected by EU legislation, e.g. Special Areas of Conservation (SAC) or Special Protection Areas (SPA) status
Very High	Attribute has a high quality or value on a regional or national scale	Regionally important aquifer with multiple well fields. Groundwater supports river, wetland or surface water body ecosystem protected by national legislation – NHA status Regionally important potable water source supplying >2500 homes Inner source protection area for regionally important water source
High	Attribute has a high quality or value on a local scale	Regionally Important Aquifer Groundwater provides large proportion of baseflow to local rivers Locally important potable water source supplying >1000 homes Outer source protection area for regionally important water source Inner source protection area for locally important water source
Medium	Attribute has a medium quality or value on a local scale	Locally Important Aquifer Potable water source supplying >50 homes Outer source protection area for locally important water source
Low	Attribute has a low quality or value on a local scale	Poor Bedrock Aquifer Potable water source supplying





#### Table 14-5 Definition of Magnitude of Impact (Table 5.1 (NRA 2008a))

Magnitude of Impact	Description
Imperceptible	An impact capable of measurement but without noticeable consequences
Slight	An impact that alters the character of the environment without affecting its sensitivities
Moderate	An impact that alters the character of the environment in a manner that is consistence with existing or emerging trends
Significant	An impact which by its character, magnitude, duration or intensity alters a sensitive aspect of the environment
Profound	An impact which obliterates all previous sensitive characteristics

# Table 14-6 Criteria for Rating Soil and Geology Impact Significance and Magnitude at EIA stage (Table C4 (IGI 2013) and Box 5.1 (NRA, 2008a))

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
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 14-7 Criteria for Rating Hydrogeological Impact Significance and Magnitude at EIA stage (Table C5 (IGI 2013) and Box 5.3 (NRA, 2008a))

Magnitude of impact	Criteria	Typical example
Large Adverse	Results in loss of attribute and/or quality and integrity of attribute	Removal of large proportion of aquifer Changes to aquifer or unsaturated zone resulting in extensive change to existing water supply springs and wells, river baseflow or ecosystems Potential high risk of pollution to groundwater from routine run-off Calculated risk of serious pollution incident during operation >2% annually
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	Removal of moderate proportion of aquifer Changes to aquifer or unsaturated zone resulting in moderate change to existing water supply springs and wells, river baseflow or ecosystems Potential medium risk of pollution to groundwater from routine run-off Calculated risk of serious pollution incident during operation >1% annually
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	Removal of small proportion of aquifer Changes to aquifer or unsaturated zone resulting in minor change to water supply springs and wells, river baseflow or ecosystems Potential low risk of pollution to groundwater from routine run-off Calculated risk of serious pollution incident during operation >0.5% annually
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	Calculated risk of serious pollution incident during operation <0.5% annually

## Table 14-8 Rating of Significant Environmental Impacts at EIA Stage (Box 5.4 (NRA 2008a))

			Magnitude of im	pact			
		Negligible	Small	Moderate	Large		
Importance of Attribute	Extremely high	Imperceptible	Significant	Profound	Profound		
	Very high	Imperceptible	Significant / moderate	Profound / significant	Profound		
	High	Imperceptible	Moderate / slight	Significant / moderate	Severe / significant		
	Medium	Imperceptible	Slight	Moderate	Significant		
	Low	Imperceptible	Imperceptible	Slight	Slight / Moderate		

## 14.2.4.4 Mitigation Measures, Residual Impacts and Final Impact Assessment

The third element of the recommended steps builds on the outcome of the preceding two elements, by identifying mitigation measures to address potential significant or profound impacts and then assessing the





significance of any remaining residual impacts taking these measures into account. Mitigation by design measures which have been incorporated into the design for the Proposed Development are also considered in Section 14.5.

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.

## 14.2.5 Consultation

As part of a pre-application scoping process, a number of national and local government agencies were contacted. Geological Survey Ireland (GSI) provided a response (Ref 23/109) that was directly relevant to this chapter. This is summarised below:

- Recommended and encouraged that the assessment reference the various publicly available datasets and attribute them correctly to 'Geological Survey Ireland';
- Highlighted that the county geological site Merlin Park Cave is adjacent to the Proposed Development;
- Highlighted the presence of several karst features in the vicinity of the Proposed Development which included springs, swallow holes and enclosed depressions;
- Highlighted that the Proposed Development is underlain by a "Regionally Important Aquifer Karstified (conduit)" and the Groundwater Vulnerability map indicates a range of categories under the Proposed Development, including both 'High' and 'Extreme' groundwater vulnerability;
- Recommended the use of the Groundwater Viewer to identify areas of High to Extreme Vulnerability in the assessment, as any groundwater-surface water interactions that might occur would be greater in these areas;
- Recommended the use of Aggregate Potential Mapping viewer to identify areas of High to Very High source aggregate potential within the area, to identify and ensure that natural resources used in the BusConnects route are sustainably sourced from properly recognised and licensed facilities, and that consideration of future resource sterilization is considered; and
- Requested a copy of the ground investigation data for inclusion in the geotechnical report database.

The land, soils, geology and hydrogeology assessment accounts for the above recommendations and the highlighted datasets have been consulted during the assessment.

## 14.3 Baseline Environment

## 14.3.1 Introduction

This section describes the existing conditions and important features in terms of the land, soils, geology, and hydrogeology within the study area of the Proposed Development. A regional overview is followed by a description of site-specific baseline conditions and a conceptual site model (CSM). Features are then identified, and their importance ranked in accordance with the NRA Guidelines (NRA 2008a) and IGI Guidelines (IGI, 2013).

## 14.3.2 Regional Overview

The regional geomorphology, topography, soils and subsoils, bedrock geology and hydrogeology are discussed in this Section.

## 14.3.2.1 Regional Topography and Geomorphology

The topography of Galway City is generally flat, gradually rising towards the outskirts, especially to the east and north. The terrain comprises gentle hills and undulating landscapes, with typical elevations ranging from approximately 5 mOD to 38 mOD, according to LiDAR data from the GSI Open Topography dataset.

Geomorphology is the study of the Earth's landforms and the processes that shape them (erosion, sedimentation, and glacial activity.) It describes the formation, evolution, and dynamic changes of





landscapes like mountains, valleys, and coastlines. The wider region surrounding the study area is dominated by geomorphological features formed during the last major glaciation period. Extensive ice sheets covered the region during this time, shaping and rounding much of the surrounding landscape through erosion.

This influence is evident in the regional area around Galway City, which is surrounded by streamlined bedrock, drumlins, and meltwater channels. The study area itself is characterized by a drumlin landscape, though only the tail ends of the drumlins are located within it. These elongated drumlins are generally oriented SSW-NNE.

The Open Topography dataset and Quaternary Geomorphology mapping is available on the GSI public data viewer and can be seen in Figure 14.1 in Volume 3 of the EIAR.

## 14.3.2.2 Regional Soils (Teagasc)

The Teagasc national indicative soil map classifies the soils of Ireland into simplified categories. Soil information is categorised from the Irish Forest Soils (IFS) project, which indicates the predominant soil type for each area, and the drainage characteristics of the soil. The Teagasc soil database is available via the GSI public data viewer and is shown on Figure 14.2 in Volume 3 of this EIAR.

The main soils within the study area are listed in Table 14-9 along with their importance with respect to drainage and fertility, as determined by Box 4.1 in the NRA Guidelines (NRA 2008a).

The Proposed Development and the study area can be described in two sections: western and eastern sections. The western section is underlain by made ground, that is soils which have been anthropogenically altered and generally used for development. The eastern section of the Proposed Development is underlain by glacial till deposits derived from limestone, bedrock outcrops and made ground.

Not shown on the Teagasc soil mapping but also present within the study area is natural topsoil. Topsoil is more prevalent in the eastern section of the Proposed Development, i.e. The Merlin Meadows, and the agricultural land north of the existing Dublin Road.

Soil Type	Notes / Description	Location	Importance	Justification for importance Rating
Topsoil	Upper layer of soil containing organic matter	East side of Proposed Development in Merlin Meadows and in agricultural land north of existing Dublin Road	High	Well drained and / or high fertility soils
Made ground – Made	Associated with urban development	Widespread under the Proposed Development	Low	Poorly drained and / or low fertility soils
Glacial Till – BminPDPT	Peaty Gleys derived from mainly calcareous parent materials	One pocket found along the Dublin Road between The Meadows Forest and Lios An Uisce	Low	Peaty poorly drained mineral
Glacial Till – BminDW	Grey Brown Podzolics, Brown Earths derived from	Widespread under the eastern section of the Proposed	High	Deep well drained mineral

## Table 14-9 Soils within the Study Area





Soil Type	Notes / Description	Location	Importance	Justification for importance Rating
	mainly calcareous parent materials	Development on top of bedrock		
Bedrock at surface – RckCa	Renzinas, Lithosols derived from mainly calcareous parent materials	Widespread under the eastern section of the Proposed Development	Low	Shallow well drained mineral

## 14.3.2.3 Regional Subsoils (GSI Quaternary Classification)

Quaternary sediments are the most recently deposited geological strata. Based on the GSI Quaternary Sediments mapping, the overburden consists of till derived from limestone, urban and karstified bedrock outcrop or suboutcrop. The western end of the Proposed Development from Lough Atalia to Bon Secours Hospital is located within the sediments classified as urban. Till derived from limestones is to be found in the central part and eastern end of the Proposed Development. The karstified bedrock outcrops or suboutcrops are located to the north and south of the Proposed Development along the Merlin Woods. The Quaternary Geology database is available on the GSI public data viewer and can be seen in Figure 14.3 in Volume 3 of the EIAR.

The importance with respect to feature quality and significance has been determined using Box 4.1 of the NRA Guidelines (NRA 2008a) and it is presented in Table 14-10Table 14-10.

Soil Type	Notes / Description	Location	Importance	Justification for importance Rating
Made Ground – Urban	Associated with urban development	Widespread on the western area of the Proposed Development	Low	Low value on a local scale
Glacial till – TLs	Till derived from limestones	Widespread on the mid and eastern area of the Proposed Development	Low	Abundant within the study area and has a low value on a local scale

#### Table 14-10 Subsoils within the Study Area

## 14.3.2.4 Regional Bedrock Geology

The bedrock geology of the study area according to the online mapping "Bedrock Geology 100k" can be seen on Figure 14.4 in Volume 3 of this EIAR and is listed in Table 14-11 along with their importance with respect to feature quality and significance as determined by Box 4.1 in the NRA Guidelines (NRA 2008a).

The bedrock geology of the region is comprised by the Burren Formation. The Burren Formation is described as pale grey clean skeletal limestone. According to GSI Bedrock Geology mapping, there are no structural features reported within the study area. Multiple bedrock outcrops are identified within the study area.



Soil Type	Notes / Description	Location	Importance	Justification for importance Rating
The Burren Formation	Pale grey clean skeletal limestone – Carboniferous.	Widespread across the Proposed Development	Low	Low value on a local scale

## Table 14-11 Rock Formation within the Study Area

## 14.3.2.5 Regional Aquifer Type and Classification

The GSI has devised a system for classifying both bedrock and gravel aquifers in Ireland based on the hydrogeological characteristics, size, and productivity of the groundwater resource. The aquifers within the study area can be seen in Figure 14.5 in Volume 3 of this EIAR and are listed in Table 14-12 below along with their importance with respect to feature quality and significance as determined by Box 4.1 in the NRA Guidelines (NRA 2008a).

GSI mapping classifies the limestones of the Burren Formation underlying the study area as a Regionally Important Aquifer with karstified (conduit) groundwater flow (Rkc).

Table 14-12	GSI Bedrock Aquifers	within the Study Area
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Soil Type	Notes / Description	Location	Importance	Justification for importance Rating
Regionally Important Aquifer	Bedrock which is regionally important and is Karstified conduits (Rkc)	Widespread across the Proposed Development	High	Regionally important aquifer which is important on a regional scale

Groundwater bodies (GWBs) were delineated and described by the GSI in 2004. A groundwater body is the management unit under the WFD that is necessary for the subdivision of large geographical areas of aquifer in order for them to be effectively managed (Working Group on Groundwater, 2005).

The Clarinbridge GWB (IE\_WE\_G\_0008) underlies the study area and has a GWB status of 'Good' under the Ground Waterbody WFD 2016-2021. These rocks are generally devoid of intergranular permeability (GSI, 2004). Groundwater flows through fissures, faults, joints and bedding planes. According to the GWB descriptions, groundwater flow is through a shallow epikarstic layer and in a zone of interconnected enlarged fissures and conduits that extends up to approximately 35m below the epikarstic layer. Groundwater flow paths can be up to several kilometres long, but shorter paths are noted as well due to the highly karstified nature of the GWB. The degree of interconnection in this karstic system is high and they support regional scale flow systems. Rapid groundwater flow velocities have been recorded through groundwater tracing.

Transmissivity is a measure of the rate of groundwater flow through an aquifer and is dependent on aquifer thickness. The transmissivity of the Clarinbridge GWB ranges from 1 to greater than 3000 m<sup>2</sup>/d (GSI, 2004).

EPA mapping indicates the Corrib Estuary (IE\_WE\_170\_0700) is a Transitional Waterbody at the western end of the study area and found south of the study area. The Corrib Estuary has a WFD 2016-2021 status of "Moderate" and includes Lough Atalia. The WFD 2016-2021 status of the Oranmore Bay Transitional Waterbody (IE\_WE\_170\_0500) to the east of the study area is unassigned. The Inner Galway Bay Coastal Waterbody (IE\_WE\_170\_0000) to the southeast of the Proposed Development has a WFD 2016-2021 status of "Good". These water bodies are considered further in Chapter 13 (Water).

## 14.3.2.6 Regional Aquifer Vulnerability

Groundwater vulnerability is a relative measure of the ease with which groundwater may be contaminated by human activity. It is based on the aquifer's intrinsic geological and hydrogeological characteristics. The vulnerability is determined by the thickness and permeability of overlying deposits and the depth to the





bedrock aquifer. For example, bedrock with a thick, low permeability, clay rich overburden is less vulnerable than bedrock with a thin, high permeability, gravelly overburden.

GSI groundwater vulnerability mapping, as shown on Figure 14.6 in Volume 3 of this EIAR, indicates groundwater vulnerability within the study area ranges from moderate/ high on the west to extreme vulnerability on the east of the Proposed Development. This variability is attributed to the composition of soils, influenced by anthropogenic or natural factors. In the western region, characterized by urban development, vulnerability is rated as moderate. However, areas with natural soils, such as The Merlin Meadows, are classified as having extreme vulnerability according to the GSI classification.

#### 14.3.2.7 Regional 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.

A review of GSI mapping, and the results from the geophysical survey indicated that there are eight (8 no.) karst features located within the study area. The karst features have been assigned IDs for ease of identification. The features and information available are summarised in Table 14-13Table 14-13, and are shown in Figure 14.9 in Volume 3 of this EIAR.

Feature Type	Description	Location	Importance	Justification for importance rating
Swallow Hole ID: K1	-	West end of Merlin Park, approx. 128m to NE from Dublin Road and access road to Merlin Hospital 66m from Proposed Development	Medium	Feature has a medium significance on a local scale
Enclosed Depression ID: K2	Never has water	On the opposite side of the road from Castlegar GAA Club, Approx. 45m to NE from the disused quarry in the greenfield 45m from Proposed Development	Medium	Feature has a medium significance on a local scale
Enclosed Depression ID: K3	Water present all year round. Quarrying was carried out in the pit at one time.	On the southern side of Rosshill Park Woods. Roughly 225m from Proposed Development	Medium	Feature has a medium significance on a local scale
Enclosed Depression ID: K4	No water present in the depression.	On the southern side of Rosshill Park Woods. Roughly 235m from Proposed Development	Medium	Feature has a medium significance on a local scale

#### Table 14-13 GSI Regional Karst Features within Study Area





Feature Type	Description	Location	Importance	Justification for importance rating
Spring ID: K5	Spring that forms pond.	Approx. 75m to NW from Dublin Road and Doughiska Road junction 67m from Proposed Development	Medium	Feature has a medium significance on a local scale
Spring ID: K6	Spring that never dries.	Approx. 350m to WNW of Dublin Road and Doughiska Road junction 230m from Proposed Development	Medium	Feature has a medium significance on a local scale
Sinkhole / Enclosed Depression / Infilled Doline ID: K7	ldentified in geophysical survey.	Near entrance to Rosshill Park Woods. Under Proposed Development footprint	High	Feature has a high significance on a local scale
Sinkhole / Enclosed Depression / Infilled Doline ID: K8	Identified in geophysical survey.	On the road beside Castlegar GAA Club Under Proposed Development footprint	High	Feature has a high significance on a local scale

## 14.3.2.8 Regional Geoheritage Sites

The GSI Geoheritage programme have identified County Geological Sites (CGSs) under 16 different geological themes across Ireland. Two CGSs have been identified within the study area and are presented in Figure 14.9 in Volume 3 of this EIAR and summarised in Table 14-14.

Name / Code	CGS Description	Location	Importance	Justification for importance rating
Merlin Park Cave / GC005	Narrow cave mouth at the floor of an enclosed depression. Steep-sided enclosed depression with cave entrance at the floor of the 10 m deep depression.	Rosshill Park Woods Immediately neighbouring Proposed Development to the south	High	Feature has a high significance on a local scale
Merlin Park Quarry / GC006	A disused limestone quarry. Historically, the quarry was famous as a source of Galway 'Black Marble'.	Approx. 130m to W of Dublin Road and Doughiska Road junction	High	Feature has a high significance on a local scale

## Table 14-14: County Geological Sites within the study area





Name / Code	CGS Description	Location	Importance	Justification for importance rating
		70m from Proposed Development		

It is not anticipated that these CGSs shall be impacted by the Proposed Development. Therefore, impacts associated with geological heritage areas have not been considered further in the assessment.

## 14.3.2.9 Regional Mineral / Aggregate Resources

Considering the location of the Proposed Development in an urban environment, there are unlikely to be many opportunities to extract mineral or aggregate resources, however the GSI aggregate potential mapping was consulted in order to assess the impact of the Proposed Development on the economic geology of the study area.

A summary of the aggregate resources identified in the study area are outlined in Figure 14.7 in Volume 3 of this EIAR and Table 14-15 along with their importance as determined by Box 4.1 of the NRA Guidelines (NRA 2008a).

GSI Aggregate Potential Type	Potential	Location	Importance	Justification for importance rating
Crushed Rock Aggregate	Very high potential	From the Skerritt Roundabout to Doughiska	Low	Considering the site's urban setting the potential to extract mineral resource is considered very low
Crushed Rock Aggregate	High potential	From the westernmost end of study area as far as Skerritt Roundabout	Low	Considering the site's urban setting the potential to extract mineral resource is considered very low

## Table 14-15 GSI Aggregate Potential

The mining history of the Proposed Development corridor was researched using the GSI's interactive data portal and the EPA interactive environmental data portal. The GSI's database of mines and quarries was assessed to identify aggregate and mineral extraction sites within the Proposed Development. The details of the quarry are summarised in Table 14-16.

Two historical quarries are in the vicinity of the study area. The historical limestone quarry is located approximately 850m to the SE from the end of the Proposed Development and the other one is on the opposite site of the road from Castlegar GAA Club. There are no active quarries within the study area.

#### Table 14-16 GSI Mines and Quarries

Feature Type	Description	Location	Importance	Justification for importance rating
Quarry	Disused Quarry	On the opposite side of the road	Low	Feature has a low value on a local scale





Feature Type	Description	Location	Importance	Justification for importance rating
		from Castlegar GAA Club		
Quarry	Disused Quarry	Approximately 850m to the SE from the end of the Proposed Development	Low	Feature has a low value on a local scale

## 14.3.2.10 Regional Recharge

Recharge is the amount of effective rainfall that replenishes the aquifer. It is a function of the effective rainfall (i.e. rainfall minus evaporation and run off), transpiration (uptake by plants) and the aquifer characteristics.

GSI mapping indicates groundwater recharge for the regionally important aquifer ranges from 151 to 700 mm/yr depending on the overlying subsoil type. The highest recharge values are related to the exposition at the surface of the bedrock and its permeability. The regional groundwater recharge is shown on Figure 14.8 in Volume 3 of this EIAR.

## 14.3.2.11 Regional Groundwater Abstractions

Based on available data sources from the GSI there are no Public Water Supply or National Federation of Group Water Scheme groundwater source protection areas within the study area.

According to the GSI database, there is one groundwater well recorded within the study area. Details of the abstraction well are displayed in Table 14-17 along with its importance with respect to feature quality and significance as determined by Box 4.1 in the NRA Guidelines (NRA 2008a) and is presented on Figure 14.5 in Volume 3 of this EIAR.

Abstraction Feature	Description	Location	Importance	Justification for importance rating
1121NEW001	Agricultural and domestic use Depth of hole is 19.8m	Lios an Uisce, on opposite side of the road from Merlin Park Hospital	Medium	Locally important abstraction point which is important on a local scale

## Table 14-17 GSI Groundwater Abstractions

## 14.3.2.12 Regional Environmentally Sensitive Sites

## 14.3.2.12.1 Protected areas

The National Parks and Wildlife Services (NPWS) is responsible for the designation of environmentally protected sites in Ireland and maintains a publicly available database of these sites. These sites include Special Areas of Conservation (SACs), candidate Special Areas of Conservation (cSACs), Special Protection Areas (SPAs), candidate Special Protection Areas (cSPAs) and Natural Heritage Areas (NHAs). In addition to these sites, the NPWS also maintains a database of proposed Natural Heritage Areas (pNHAs). There are two designated protected areas within the study area of the Proposed Development. These are shown on Figure 14.5 in Volume 3 of this EIAR.

In addition, the Merlin Meadows are identified as being of national ecological importance and are discussed in Chapter 12 (Biodiversity). These protected areas are listed in Table 14-18 below.





Feature	Description	Location	Importance	Justification for importance rating
The Galway Bay Complex (Lough Atalia) SAC (and pNHA)	This area includes the coastal waters of inner Galway Bay and Lough Atalia. This is classified as a SAC as it supports a number of species that are listed on Annex I / II of the EU Habitats Directive.	West end of the study area south of the Proposed Development at Lough Atalia	Extremely High	Attribute has a high quality or value on an international scale
The Inner Galway Bay SPA	This area includes the coastal waters of the Corrib Estuary, inner Galway Bay and Lough Corrib. This is designated a SPA under the EU Birds Directive as it is of special conservation interest for a number of bird species.	West end of the study area south of the Proposed Development at Lough Atalia	Extremely High	Attribute has a high quality or value on an international scale
Merlin Meadows	This habitat was represented by two (western and eastern) of the three fields. These fields are known locally as 'The Meadows' where the habitat are affiliated to the Annex I habitat Lowland Hay Meadows	South of Merlin Park Hospital	High	Attribute has a high quality or value on a local scale

#### Table 14-18 Protected Areas within the Study Area

These protected sites do not contain groundwater dependant habitats in the vicinity of the site development. While these sites may not be groundwater dependent, they will receive groundwater flow from within the study area.

## 14.3.3 Site Specific Environment

The following section discusses the site-specific conditions within the study area for the Proposed Development as defined in Section 14.2.1.

Where applicable the importance of the attributes for which the impact of the Proposed Development is to be assessed are reported in this Section.

## 14.3.3.1 Current and Historic Land Use

The current and historic land use is discussed in order to give context to any potential changes to land, soils, geology and hydrogeology that have the potential to 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 Tailte Éireann, formerly Ordnance Survey Ireland (OSI), (Tailte Éireann, Accessed 2024), Google (Google Maps, Accessed 2024), Bing (Bing Maps, Accessed 2024) and the Corine Land Cover maps (EPA, Accessed 2024). The historic land use is based on the following OSI (Tailte Éireann, Accessed 2024) historic 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;
- OSI 1995 aerial photography;
- OSI 2000 aerial photography;
- OSI 2005 aerial photography; and
- Corine Land Cover map.

The OSI 6-inch mapping (1837-1842) shows the area underlying the Proposed Development was comprised mainly of greenfield sites, with some properties scattered throughout the study area. The landscape was primarily characterised by agricultural land use. There was a marble quarry located near the northeast of the study area, roughly 250m from the Proposed Development centreline.

The OSI 25-inch mapping (1888-1913) shows an increase in residential property development in the west of the study area. There is a flood plain reported in the area known as 'The Meadows' immediately west of what is now the Merlin Park Hospital. There is a disused quarry located within the study area which is the marble quarry mentioned in previous paragraph.

Aerial photography from 1995 shows the distinct development of the urban landscape. Progressing west of the Skerritt Roundabout, a substantial amount of residential property was developed. East of the Skerritt Roundabout, at this stage, was still primarily greenfield sites consisting of The Merlin Meadows and Rosshill Park Woods.

Aerial photography from 2005 reveals the residential development that occurred in Rosshill, located at the eastern end of the study area. The land use in the western half of the study area remained the same throughout this time period.

The current land use has remained largely unchanged since 2005, with Merlin Meadows and Rosshill Park Woods being the only areas that remain undeveloped.

## 14.3.3.2 Local Geology

The following site-specific ground investigations have been completed at the site:

- Minerex Geophysics Ltd, 2023. A non-intrusive geo-physical survey was carried out over the footprint
  of the Proposed Development to determine the ground conditions under the site, to determine the depth
  to rock and the overburden thickness, to estimate the strength or stiffness or compaction of overburden
  and the rock quality, and to detect possible karstified rock.
- IGSL, 2023. Intrusive ground investigation carried out over the entire footprint of the Proposed Development to determine the ground and groundwater conditions to assist the preliminary design of the Proposed Development. The ground investigation consisted of:
  - Cable Percussive Boreholes with rotary core follow-on;
  - Cable Percussive Boreholes only;
  - Rotary Core Boreholes only;
  - Dynamic Probing;
  - Windowless Sampling;
  - Trial Pits;





- Soil Infiltration testing (BRE Digest 365);
- Installation of standpipes for groundwater level monitoring; and,
- In situ testing (Plate Load Testing, Hand Shear Vane and Permeability)

An interpreted generalised stratigraphy based on the results of the 2023 ground investigations is presented in Table 14-19. The location of the exploratory holes are shown on the 'Exploratory Hole Location Plan' included in Appendices 14.2 of Volume 4 of this EIAR. Copies of the logs for the exploratory holes within the study area are also presented as Appendix 14.2 of Volume 4 of this EIAR. The factual reports for the ground investigation and the interpretive report for the geophysical survey are presented in Appendix 14.2 of Volume 4 of this EIAR.

Stratum	Description	Depth to Top of Stratum (m bgl)	Thickness of Stratum (m)
Topsoil	-	0	0.1 – 0.6
Made Ground	Firm brown sandy gravelly CLAY with medium cobble content and boulders up to 50cm. Sand is medium. Gravel is subrounded to subangular, fine to course.	0 – 0.8	0.2 - 0.9
	Firm grey brown slightly sandy slightly gravelly CLAY with low cobble content. Sand is medium. Gravel is subrounded to subangular, fine to course	0.1 – 8.0	0.1 – 5.7
Glacial Deposits	Firm to soft grey sandy gravelly SILT with high cobble content and boulders and cobbles up to 60cm. Sand is course. Gravel is subrounded to subangular, fine to course.	0.3 – 3.7	0.2 – 2.3
	Brown grey clayey sandy GRAVEL with high cobble content and boulders up to 80cm. Sand is course. Gravel is subrounded to subangular, fine to course	0.2 - 6.0	0.5 - 3.5
	Grey brown slightly gravelly SAND. Sand is fine. Gravel is subangular to subrounded, fine to course.	0.3 – 1.8	0.3 – 0.9
	The Burren Formation – Weak structureless to very locally thinly bedded, pale to dark blueish grey/black, fine-grained LIMESTONE, moderately weathered	1.4 - 6.0	2.0 - 6.6
Deutock	The Burren Formation – Strong to very strong, thickly to thinly bedded, pale to dark blueish grey/black. Fine grained, LIMESTONE. Fresh to locally slightly weathered	2.0 – 11.2	Unknown

#### Table 14-19 General Stratigraphy of the Proposed Development





## 14.3.3.3 Made Ground

Made ground is present throughout the site and has been described as deposits which vary from soft to firm gravelly clay to gravelly cobbles. The predominant composition is firm brown sandy gravelly clay with medium cobble content. Made ground consists of a mixture of natural soil, brick fragments, metal wires, concrete and building materials. During the investigation, no visual or olfactory evidence of contamination was noted in the made ground.

#### 14.3.3.4 Silt

Silt deposits have been identified in 6 No. exploratory holes carried out from Belmont housing estate to the eastern end of the Proposed Development. The silt deposits vary from very soft to firm sandy gravelly, with low to high cobble contents.

#### 14.3.3.5 Clay

Clay deposits have been located throughout the study area at depths ranging from 0.1 - 8.0m. The deposits have been described as fine soils described as very soft to stiff sandy gravelly clay with low to high cobble content. Gravel is subrounded to subangular, fine to coarse.

#### 14.3.3.6 Gravel and Cobbles

Deposits of gravel and cobbles were found throughout the study area in 12 No. exploratory holes. The gravel and cobble deposits typically overlie the limestone bedrock.

#### 14.3.3.7 Bedrock

The Burren Formation was found to be underlying the entirety of the site at varying depths from 2.0 - 11.2 m bgl. The bedrock is likely to form part of the regional bedrock Regionally Important Aquifer.

#### 14.3.3.8 Local Hydrogeology

There were 5 No. groundwater strikes recorded at depths ranging from 5.1 to 12.4 m bgl in the limestone bedrock and 1 No. groundwater strike recorded at 7.4 mBGL in a clay layer.

There were 4 No. standpipes installed as part of the 2023 site investigation from the 30/10/2023 to the 08/11/2023, of which three (3 no.) have been monitored with a data logger. All standpipes were installed in limestone bedrock. Groundwater readings have been recorded in these three standpipes at depths ranging from 4.56 to 6.98 mBGL. Groundwater monitoring for a 12-month period is scheduled to capture seasonal variation. The readings began on 10/04/2024 and will continue until April 2025.

## 14.3.4 Summary of Features of Importance

The importance ranking of the features, based on Box 4.1 of the NRA Guidelines (NRA, 2008a), established for the baseline conditions is summarised below.

Features with an importance ranking of low are not considered any further as they will not result in a significant impact according to Box 5.4 of the NRA Guidelines (NRA, 2008a) and are summarised in Table 14-19 Table 14-20 for completeness.

Features with an importance ranking of medium or higher are summarised in Table 14-20 Table 14-21 and the impact of the Proposed Development on these features is assessed in Section 14.4.





Category	Feature	Description	Location	Importance	Justification
Soils (Teagasc soil classification)	Made ground – Made	Associated with urban development	Widespread under the Proposed Development	Low	Low value on a local scale
	Glacial Till – BminPDPT	Peaty Gleys derived from mainly calcareous parent materials	One pocket found along the Dublin Road between The Meadows Forest and Lios An Uisce.	Low	Low value on a local scale
	Bedrock at surface – RckCa	Renzinas, Lithosols derived from mainly calcareous parent materials	Widespread under the eastern section of the Proposed Development	Low	Low value on a local scale
Subsoil deposits (GSI Quaternary Classification)	Made Ground – Urban	Associated with urban development	Widespread on the western area of the Proposed Development	Low	Low value on a local scale
	Glacial till – TLs	Till derived from limestones	Widespread on the mid and eastern area of the Proposed Development	Low	Abundant within the study area and has a low value on a local scale
Bedrock Geology	The Burren Formation	Pale grey clean skeletal limestone – Carboniferous.	Widespread across the Proposed Development	Low	Low value on a local scale
Mineral / Aggregate Resources	Crushed Rock Aggregate	Very high potential	From the Skerritt Roundabout to Doughiska	Low	Although there is very high potential for aggregate resource extraction, due to the site's urban nature the likelihood of the site being considered for aggregate extraction is very low
	Crushed Rock Aggregate	High potential	From the westernmost end of study area as far as Skerritt Roundabout	Low	Although there is high potential for aggregate resource extraction, due to the site's urban nature the likelihood of the site being

## Table 14-20 Summary of Features with Low Importance





Category	Feature	Description	Location	Importance	Justification
					considered for aggregate extraction is very low
	Quarry	Disused Quarry	Approximately 850m to the SE from the end of the Proposed Development	Low	Feature has a low value on a local scale
	Quarry	Disused Quarry	On the opposite side of the road from Castlegar GAA Club	Low	Feature has a low value on a local scale

## Table 14-21 Summary of Features with Medium to Extremely High Importance

Category	Feature	Description	Location	Importance	Justification
Soils (Teagasc soil classification)	Glacial Till – BminDW	Grey Brown Podzolics, Brown Earths derived from mainly calcareous parent materials	Widespread under the eastern section of the Proposed Development on top of bedrock.	High	Deep well drained mineral
Aquifer type and classification	Regionally Important Aquifer	Bedrock which is regionally important and is Karstified conduits (Rkc)	Widespread across the Proposed Development	High	Regionally important aquifer which is important on a regional scale
Karst feature	Swallow hole. ID: K1	The GSI have not provided information about the swallow hole.	West end of Merlin Park, approx. 128m to NE from Dublin Road and access road to Merlin Hospital 66m from Proposed Development	Medium	Feature has a medium significance on a local scale
	Enclosed Depression. ID: K2	The GSI have identified that the enclosed depression never has water present.	On the opposite side of the road from Castlegar GAA Club, Approx. 45m to NE from the disused quarry in the greenfield	Medium	Feature has a high significance on a local scale





Category	Feature	Description	Location	Importance	Justification
			45m from Proposed Development		
	Enclosed Depression. ID: K3	The GSI have identified that - Water is present all year round. Quarrying was once carried out in the pit.	On the southern side of Rosshill Park Woods. Roughly 225m from Proposed Development	Medium	Feature has a medium significance on a local scale
	Enclosed Depression. ID: K4	The GSI have identified that no water is present in the depression.	On the southern side of Rosshill Park Woods. Roughly 235m from Proposed Development	Medium	Feature has a medium significance on a local scale
	Spring ID: K5	The GSI have identified that the spring forms a pond.	Approx. 75m to NW from Dublin Road and Doughiska Road junction 67m from Proposed Development	Medium	Feature has a medium significance on a local scale
	Spring. ID: K6	The GSI have identified that the spring never dries.	Approx. 370m to NEE from Dublin Road and Doughiska Road junction 230m from Proposed Development	Medium	Feature has a medium significance on a local scale
	Sinkhole / Enclosed Depression / Infilled Doline. ID: K7	ldentified in geophysical survey.	Near entrance to Rosshill Park Woods. Under Proposed Development footprint	High	Feature has a high significance on a local scale
	Sinkhole / Enclosed Depression / Infilled Doline. ID: K8	ldentified in geophysical survey.	On the road beside Castlegar GAA Club Under Proposed Development footprint	High	Feature has a high significance on a local scale
Geoheritage sites	Merlin Park Cave / GC005	Narrow cave mouth at the floor of an	Rosshill Park Woods	High	Feature has a high significance on a local scale





Category	Feature	Description	Location	Importance	Justification
		enclosed depression. Steep-sided enclosed depression with cave entrance at the floor of the 10 m deep depression.	Immediately neighbouring proposed Proposed Development to the south		
	Merlin Park Quarry / GC006	A disused limestone quarry. Historically, the quarry was famous as a source of Galway 'Black Marble'.	Approx. 130m to W of Dublin Road and Doughiska Road junction 70m from Proposed Development	High	Feature has a high significance on a local scale
Groundwater Abstraction points	1121NEW001	Agricultural and domestic use Depth of hole is 19.8m	Lios an Uisce, on opposite side of the road from Merlin Park Hospital	Medium	Locally important abstraction point which is important on a local scale
Environmentally Sensitive Areas	The Galway Bay Complex (Lough Atalia) SAC	This area includes the coastal waters of inner Galway Bay and Lough Atalia. This is classified as a SAC as it supports a number of species that are listed in Annex I / II of the EU Habitats Directive.	West end of the study area south of the Proposed Development at Lough Atalia	Extremely High	Attribute has a high quality or value on an international scale
	The Inner Galway Bay SPA	This area includes the coastal waters of the Corrib Estuary, inner Galway Bay and Lough Corrib. This is designated as a SPA under the EU Birds Directive as it is of special conservation	West end of the study area south of the Proposed Development at Lough Atalia	Extremely High	Attribute has a high quality or value on an international scale





Category	Feature	Description	Location	Importance	Justification
		interest for a number of bird species			
	Merlin Meadows	This habitat was represented by two (western and eastern) of the three fields. These fields are known locally as 'The Meadows' and are mown once-twice annually	South of Merlin Park Hospital	High	Attribute has a high quality or value on a local scale

## 14.3.5 Conceptual Site Model

A Conceptual Site Model (CSM) has been developed for the Proposed Development based on the ground investigation data and all publicly available data.

The CSM summarises the important geological and hydrogeological features near the Proposed Development. The subsections of the Proposed Development listed in Chapter 5 (Construction) of this EIAR are presented in Table 14-22 along with the proposed works, expected groundwater levels and the soils and geology at each earthwork area.

The Proposed Development is located on the Dublin Road, Galway. Most of the area has been developed and is covered by a layer of made ground varying in thickness from 0.2 to 0.9m. The deposits in The Merlin Meadows, the farmland at the northeast end of the study area, and Rosshill Park Woods are non-anthropogenic, and are covered by natural topsoil. The made ground is generally underlain by cohesive glacial till such as clays, but silts are also present is smaller quantities.

The entirety of the Proposed Development is underlain by limestone bedrock. The limestone bedrock is a Regionally Important Karstified Aquifer. Numerous karst features have been identified from the GSI database and the geophysical survey in the study area such as springs, enclosed depressions, and a swallow-hole.

Hardstanding is present throughout the study area aside from the northeast area containing The Merlin Meadows, Rosshill Park Woods, and agricultural land. Therefore, the level of recharge to the underlying aquifer is likely to be low under the Proposed Development.

In the study area from the Merlin Park Hospital and to the east, the groundwater vulnerability is extreme. This area contains the Merlin Meadows, Rosshill Park Woods, and multiple karst features which can act as point infiltration locations to the underlying aquifer.





Subsection	Lengt	ngt Earthwork	Cut	(m)	Fill	(m)	Expected Ground	Range of	
Subsection	h (m)	Туре	Max	Avg	Max	Avg	Conditions	Thickness (m)	Additional Notes
1 – East of Moneenageisha Junction to Skerritt Junction	1500	At grade	< 0.5	< 0.5	< 0.5	< 0.5	Road pavement and foundation (Made ground) overlying Cohesive Glacial Till (Clay) and Granular Glacial Till (Sand) overlying limestone bedrock (The Burren Formation). The Burren Formation comprises a Regionally Important Aquifer – Bedrock productive on a regional scale. Groundwater strikes recorded from 5.4 to 7.4 m bgl	Made Ground: 0.1-0.9 Clay: 1.5-3.95 Sand: 2.2 Bedrock: N/A	Localised pavement reconstruction and resurfacing of roads, footpaths, and cycle tracks. Relocation and reconstruction of boundary walls and boundary fences. Additional signage, new road markings, new and amended traffic signal infrastructure, new street furniture. Restoration of heritage monument at Brothers of Charity. Demolition of two buildings at Brothers of Charity Drainage works and utility diversions
Skerritt Junction	150	At grade	< 0.5	< 0.5	< 0.5	< 0.5	Road pavement and foundation (Made ground) overlying Cohesive Glacial Till (Clay) overlying limestone bedrock (The Burren Formation). The Burren Formation comprises a Regionally Important Aquifer – Bedrock productive on a regional scale.	Made Ground: 0.3-1.1 Clay: 1.9-5.7 Bedrock: N/A	Demolition of existing roundabout Full depth construction for the new junction arrangement Additional signage, new road markings, new and amended traffic signal infrastructure, new street furniture. Drainage works and utility diversions.

## Table 14-22: Conceptual Site Model





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Subcastion	Lengt	Dominant Earthwork	Cut	(m)	Fill	(m)	Expected Ground	Range of	Additional Notae
Subsection	h (m)	Туре	Мах	Avg	Мах	Avg	Conditions	Thickness (m)	Additional Notes
							Groundwater strikes recorded at 7.6 m bgl		
2 - Skerritt Junction to Doughiska Road Junction	2360	At grade	< 0.5	< 0.5	< 4.0	< 0.5	Road pavement and foundation (Made ground) overlying Cohesive Glacial Till (Clay and Silt) and Granular Glacial Till (Sands and Gravels) overlying limestone bedrock (The Burren Formation). The Burren Formation comprises a Regionally Important Aquifer – Bedrock productive on a regional scale. Groundwater strikes recorded from 5.1 to 12.4 m bgl	Made Ground: 0.3-1.1 Clay: 0.2-10.8 Gravel: 0.5-3.5 Sand: 0.3-2.2 Bedrock: N/A	Localised pavement reconstruction and resurfacing of roads, footpaths, and cycle tracks. Relocation and reconstruction of boundary walls and boundary fences. Additional signage, new road markings, new and amended traffic signal infrastructure, new street furniture. Drainage works and utility diversions. Construction of a retaining wall. Embankment construction





## 14.3.5.1 Environment Type

The environment across the study area has been categorised in accordance with the IGI Guidelines (IGI, 2013). It has been classified as:

**Type B Environment** – This is located in the western half of the study area extending as far as Merlin Park Hospital. This area is characterised by the underlying Regionally Important Aquifer – Karstified and is subject to a Moderate to High groundwater vulnerability. The Type B environment to the west of the study area represents a naturally dynamic hydrogeological environment. Examples include areas of groundwater discharge areas, areas underlain by regionally important aquifers, nearby spring rises, areas underlain by permeable subsoils.

**Type D Environment** – This is located in the eastern side of the study area extending from Merlin Park Hospital to Doughiska. It corresponds to the underlying Regionally Important Aquifer – Karstified and is subject to an Extreme groundwater vulnerability. There are numerous karst features identified in this part of the study area. This Type B environment represents a sensitive geological / hydrological environment.

## 14.4 Potential Impacts

This section presents potential impacts that may occur due to the Proposed Development, in the absence of mitigation. This informs the need for mitigation or monitoring to be proposed (Refer to Section 14.5). Predicted 'residual' impacts considering any proposed mitigation are presented in Section 14.6.

## 14.4.1 Do-Nothing Scenario

In the Do-Nothing scenario the Proposed Development would not be implemented and there would be no resulting impacts on the land, soils, geology, and hydrogeology along the route of the Proposed Development.

## 14.4.2 Characteristics of the Proposed Development

A detailed description of the Proposed Development and construction activities are provided in Chapter 4 (Proposed Development Description) and Chapter 5 (Construction) of this EIAR. This section outlines the key design features, characteristics, and construction activities of the Proposed Development of relevance to land, soils, geology, and hydrogeology. A Construction Environmental Management Plan (CEMP) is provided in Appendix 5.1 in Volume 4 of this EIAR.

#### 14.4.2.1 Section 1 – East of Moneenageisha Junction to Skerritt Junction

The construction activities in this section will include:

- Localised pavement reconstruction and resurfacing of roads, footpaths, and cycle tracks;
- Relocation and reconstruction of boundary walls and boundary fences;
- Additional signage, new road markings, new and amended traffic signal infrastructure, new street furniture;
- Restoration of heritage monument at Brothers of Charity;
- The demolition of two single-story buildings and a wall at Brothers of Charity;
- Drainage gullies will be relocated to the new kerb edge and will connect back to existing drainage or a new drainage network;
- Utility diversions and/or protections; including overhead electricity lines and underground cables, water distribution, gas mains and telecommunications infrastructure; and
- Realignment of Belmont estate access.

## 14.4.2.2 Skerritt Junction

The construction activities in this section will include:





- Demolition of existing roundabout;
- Full depth construction for the new junction arrangement;
- Additional signage, new road markings, new and amended traffic signal infrastructure, new street furniture;
- Drainage works;
- Utility diversions and/or protections; and
- Landscaping works.

#### 14.4.2.3 Section 2 – Skerritt Junction to Doughiska Road Junction

The construction activities in this section will include:

- Localised pavement reconstruction and resurfacing of roads, footpaths, and cycle tracks.
- Relocation and reconstruction of boundary walls and boundary fences.
- Additional signage, new road markings, new and amended traffic signal infrastructure, new street furniture.
- Drainage gullies will be relocated to the new kerb edge and will connect back to existing drainage or a new drainage network. Drainage works also include the construction of trenches for short sections of attenuation pipes and surface water chambers;
- Utility diversions and/or protections;
- Landscaping works;
- A retaining wall will be constructed along part of the boundary with the former Corrib Great Southern Hotel; and
- Construction of embankment on northern side of the Proposed Development.

## 14.4.3 Construction Phase

The potential land, soils, geology, and hydrogeology impacts during the Construction Phase for the relevant construction activities described in Section 14.4.2 are presented in this Section, along with their impact significance. These potential impacts also relate and interact with other environmental factors which are described within the EIAR.

The Proposed Development could have the following potential impacts on the land, soils, geology, and hydrogeology as discussed below and summarised in Table 14-23:

- Loss or damage of topsoil;
- Construction of structures;
- Mobilisation of contamination into the Regionally Important Aquifer as a result of the following:
  - Removal of hardstanding; and
  - Karst features acting as point source.
- Mobilisation of contamination into Protected Areas; and
- Dewatering.

#### 14.4.3.1 Loss or damage of topsoil

Topsoil is a non-renewable resource which if removed or damaged can result in a permanent irreversible negative impact.

In the east of the Proposed Development, an embankment will be required starting roughly from the entrance to Rosshill Park Woods on the northern side of the road and continuing until the Proposed Development ends in Doughiska. The embankments will be constructed using imported fill. For embankments less than 3.0m in height, topsoil will be removed from beneath the embankment footprint. As a result, it is expected that there will be a small loss of topsoil on the Proposed Development. The significance of the impact is considered imperceptible.





## 14.4.3.2 Construction of Structures

A retaining wall is required along part of the boundary with the former Corrib Great Southern Hotel site. The construction of this retaining wall consists of excavating existing material down to the proposed final road height. The potential significance of the impact is considered imperceptible.

## 14.4.3.3 Mobilisation of Contaminants into the Regionally Important Aquifer

Discharge from site runoff with a high proportion of fines, or accidental spillages of fuels and / or chemicals from plant operated on site has the potential to infiltrate the underlying Regionally Important Aquifer. The significance of the impact of site runoff is perceived to be moderate / slight.

The removal of hardstanding during the demolition of the existing Skerritt Roundabout will result in a small temporary increase in infiltration into the underlying aquifer. The groundwater vulnerability at this location is rated as High. As the area where the hardstanding will be removed is small compared to the total area of the aquifer, the significance of the impact is deemed to be imperceptible.

The study area contains the following karst features which have a geological feature importance of medium.

- Springs;
- Enclosed Depressions; and
- Sinkhole.

Karst features support the hydrogeology of an area by providing enhanced recharge at these locations. The features act as a source of point infiltration. There are several karst solution features which will likely be impacted during the construction phase due to their proximity to the footprint of the Proposed Development. The groundwater vulnerability at the karst solution features is Extreme (X).

Limestone has a wide range of aquifer properties with zones where conduit flow can occur. Similarly, the Regionally Important Karstified (conduit) Aquifer present throughout the study area has a high recharge coefficient, and as karst is present in these areas, the runoff generally recharges to ground rather than becoming overland flow.

The two enclosed depressions (K3 and K4) to the south of Rosshill Park Woods, and the spring (K6) located 230 m away from the Proposed Development in Doughiska, are located within the study area but are at a sufficient distance away to avoid potential contaminant runoff from construction activities. The significance of the impact can be considered imperceptible at these locations.

The enclosed depression (K2) on the opposite side of the road from Castlegar GAA club is located 45m from the Proposed Development, and the swallow hole (K1) to the west end of Merlin Park is located roughly 66m from the Proposed Development. The features are located within the study area but are at a sufficient distance away to avoid potential contaminant runoff from construction activities. The significance of the impact can be considered imperceptible at these locations.

The karst features (K7 and K8) identified in the ground investigation geophysical survey consist of two potential infilled dolines / enclosed depressions / sinkholes. These features were identified under the footprint of the Proposed Development and hence pose a greater risk of allowing contaminant infiltration during the construction phase. Therefore, the significance of the impact is moderate.

#### 14.4.3.4 Mobilisation of Contaminants into Lough Atalia

The Proposed Development is located roughly 120m from the Galway Bay Complex SAC and the Inner Galway Bay SPA, which cover Lough Atalia. Contaminants runoff from construction activities could infiltrate into Lough Atalia. There is a large magnitude of dilution afforded by Lough Atalia; however, as the feature has an extremely high importance rating, the significance of the impact is considered significant in the absence of mitigation.





#### 14.4.3.5 Groundwater Supply

One groundwater abstraction point was identified in the study area. If the groundwater level was lowered at the abstraction point it could be rendered unusable. However, significant dewatering activities are not expected near this location as the Proposed Development is at grade. The significance of the impact is considered imperceptible.

#### 14.4.3.6 Dewatering

Localised pumping of excavations may be required as part of the Construction Phase in order to allow works to be carried out in dry excavations. This could lead to a temporary reversible small change in the groundwater levels and flow within the regionally important aquifer underlying the Proposed Development. However, dewatering is expected to be limited, localised and temporary. Therefore, the significance of the impact is considered imperceptible.

## **14.4.4 Operational Phase**

The impact assessment for the Operational Phase is outlined in terms of impact analysis of the Proposed Development on the local environment from a lands, soils, geology, and hydrogeology perspective.

- Reduction in recharge to the aquifer; and
- Contamination of the aquifer.

#### 14.4.4.1 Reduction in Recharge to the Aquifer

The Proposed Development will slightly reduce available surface area for aquifer recharge. The Proposed Development will comprise mainly impermeable surface materials such as concrete and bituminous material. However, as the area where the Proposed Development will be developed consists largely of impermeable materials, the significance of the impact is considered imperceptible.

#### 14.4.4.2 Mobilisation of Contaminants into the Regionally Important Aquifer

Road surface runoff has the potential to contain small amounts of contaminants from vehicles. The runoff shall be collected by a sealed drainage network that will discharge to the existing surface water system. The run-off will not drain to the aquifer and therefore, the significance of this permanent negative impact on groundwater quality is considered imperceptible.

#### 14.4.4.3 Mobilisation of Contaminants into the Merlin Meadows

As mentioned in 14.5.1.2, the runoff shall be collected by a sealed drainage system and no contaminants will be entering the Merlin Meadows. Therefore, the significance of this impact is considered imperceptible.





## Table 14-23 Summary of Potential Construction Phase Impacts

Feature	Description	Receptor Location	Importance	Importance Impact		Duration	Scale	Magnitude	Significance of Impact
Earthworks Constr	uction								
Topsoil		Greenfield sites on North side of Dublin Road in east of Proposed Development	High	Loss or damage of topsoil	Negative	Permanent	Negligible	Negligible	Imperceptible
Regionally Important Aquifer	Bedrock which is regionally important and is Karstified conduits (Rkc)	Widespread across the Proposed Development	High	Reduction in groundwater recharge to the aquifer due to removal of topsoil	Negative	Permanent	Local	Negligible	Imperceptible
Removal of hardsta	anding and mater	ial for construction	n of Retaining W	all and Skerritt Junc	ction				
Regionally Important Aquifer	Bedrock which is regionally important and is Karstified conduits (Rkc)	Widespread across the Proposed Development	High	Increase in groundwater vulnerability due to material stripping	Negative	Temporary	Local	Negligible	Imperceptible
Spill from tempora	ry storage of haza	ardous substances	associated with	the operation of pl	ant				
Regionally Important Aquifer	Bedrock which is regionally important and is Karstified conduits (Rkc)	Widespread across the Proposed Development	High	Contamination of aquifer	Negative	Temporary	Local	Small Adverse	Moderate / Slight
Ecologically Sensitive Area	The Galway Bay Complex (Lough Atalia) SAC	West end of the study area south of the Proposed Development at Lough Atalia	Extremely High	Damage of SAC through pollution	Negative	Temporary	Local	Small Adverse	Significant





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Feature	Description	Receptor Location	Importance	Impact	Quality	Duration	Scale	Magnitude	Significance of Impact
	The Inner Galway Bay SPA	West end of the study area south of the Proposed Development at Lough Atalia	Extremely High	Damage of SPA through pollution	Negative	Temporary	Local	Small Adverse	Significant
	Merlin Meadows	South of Merlin Park Hospital	High	Damage of Protected Area through pollution	Negative	Temporary	Local	Small Adverse	Moderate
Groundwater abstraction (1121NEW001)	Agricultural and domestic use	Lios an Uisce, on opposite side of the road from Merlin Park Hospital	Medium	Impact on water quality	Negative	Temporary	Local	Negligible	Imperceptible
Karst Feature	Swallow hole. ID: K1	West end of Merlin Park, approx. 128m to NE from Dublin Road and access road to Merlin Hospital 66m from Proposed Development	Medium	Mobilisation of contaminant into aquifer	Negative	Temporary	Local	Negligible	Imperceptible
	Enclosed Depression. ID: K2	On the opposite side of the road from Castlegar GAA Club, Approx. 45m to NE from the disused quarry in the greenfield	Medium	Mobilisation of contaminant into aquifer	Negative	Temporary	Local	Negligible	Imperceptible





Feature	Description	Receptor Location	Importance	Impact	Quality	Duration	Scale	Magnitude	Significance of Impact
		45m from Proposed Development							
	Enclosed Depression. ID: K3	On the southern side of Rosshill Park Woods. Roughly 225m from Proposed Development	Medium	Mobilisation of contaminant into aquifer	Negative	Temporary	Local	Negligible	Imperceptible
	Enclosed Depression. ID: K4	On the southern side of Rosshill Park Woods. Roughly 235m from Proposed Development	Medium	Mobilisation of contaminant into aquifer	Negative	Temporary	Local	Negligible	Imperceptible
	Spring ID: K5	Approx. 75m to NW from Dublin Road and Doughiska Road junction 67m from Proposed Development	Medium	Mobilisation of contaminant into aquifer	Negative	Temporary	Local	Negligible	Imperceptible
	Spring. ID: K6	Approx. 370m to NEE from Dublin Road and Doughiska Road junction 230m from Proposed Development	Medium	Mobilisation of contaminant into aquifer	Negative	Temporary	Local	Negligible	Imperceptible





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Feature	Description	Receptor Location	Importance	Impact	Quality	Duration	Scale	Magnitude	Significance of Impact
	Sinkhole / Enclosed Depression / Infilled Doline. ID: K7	Near entrance to Rosshill Park Woods. Under Proposed Development footprint	High	Mobilisation of contaminant into aquifer	Negative	Temporary	Local	Small Adverse	Moderate
	Sinkhole / Enclosed Depression / Infilled Doline. ID: K8	On the road beside Castlegar GAA Club Under Proposed Development footprint	High	Mobilisation of contaminant into aquifer	Negative	Temporary	Local	Small Adverse	Moderate
Dewatering									
Regionally Important Aquifer	Bedrock which is regionally important and is Karstified conduits (Rkc)	Widespread across the Proposed Development	High	Change to groundwater regime	Negative	Temporary	Local	Negligible	Imperceptible





## Table 14-24 Summary of Potential Operational Phase Impacts

Feature	Description	Receptor Location	Importance	Impact	Quality	Duration	Scale	Magnitude	Significance of Impact		
Reduction in recharge to regionally important aquifer											
Regionally Important Aquifer	Bedrock which is regionally important and is Karstified conduits (Rkc)	Widespread across the Proposed Development	High	Reduction in groundwater recharge to the aquifer due to additional impermeable surface area	Negative	Permanent	Local	Negligible	Imperceptible		
Surface runoff	contamination										
Regionally Important Aquifer	Bedrock which is regionally important and is Karstified conduits (Rkc)	Widespread across the Proposed Development	High	Contamination of aquifer	Negative	Temporary	Local	Negligible	Imperceptible		
Ecologically Sensitive Area	Merlin Meadows	South of Merlin Park Hospital	High	Contamination of soils	Negative	Temporary	Local	Negligible	Imperceptible		





## 14.5 Mitigation and Monitoring Measures

This section describes the mitigation measures proposed to reduce or avoid potential impacts where possible, for both the construction phase and the operational phase for the Proposed Development. The impacts with a significance rating of imperceptible are not considered at this stage.

## **14.5.1 Construction Phase**

The mitigation measures for the construction phase are outlined in this Section.

#### 14.5.1.1 Mobilisation of Contaminants into the Regionally Important Aquifer

The appointed contractor will be required to ensure that the excavation footprint shall be kept to a minimum, using shoring or trench boxes where appropriate.

No contaminated ground is expected; however, if ground is suspected of contamination, samples will be taken and tested for contamination by the appointed contractor immediately or without delay. Ground excavated from areas found to be contaminated will be disposed of to a suitably licensed or permitted sites in accordance with the current Irish waste management legislation.

Silt traps will be installed by the appointed contractor to prevent silt and other fine particles from migrating off-site.

The drainage network will be sealed throughout the Proposed Development to prevent surface runoff entering the Regionally Important Karstified Aquifer.

Any dewatering shall be designed by the appointed contractor to mitigate against the mobilisation of fines/ contaminants into the surrounding environment.

## 14.5.1.2 Mobilisation of Contaminants into Lough Atalia

The mitigation measures outlined in Section 14.5.1.1 should be applied to the Galway Bay Complex (Lough Atalia) SAC and the Inner Galway Bay SPA covering the Lough Atalia area.

Lough Atalia forms part of the Corrib Estuary transitional waterbody. The Corrib Estuary, as well as the Oranmore Bay transitional waterbody and Inner Galway Bay North coastal waterbody, will be protected by the mitigation measures outlined in Section 14.5.1.1 and Section 14.5.1.3.

#### 14.5.1.3 Spills from Temporary Storage of Hazardous Substances

Good construction management practices, as outlined in the CIRIA guidance Control of Water Pollution from Construction Sites – Guidance for consultants and contractors (Masters-Williams et al., 2001) shall be employed by the appointed contractor to minimise the risk of transmission of hazardous materials as well as pollution of adjacent watercourses and groundwater. The construction management of the site will take account of these recommendations to minimise as far as possible the risk of soil, groundwater, and surface water contamination.

Measures to be implemented to minimise the risk of spills and contamination of soils and waters include:

- Ensure that all areas where liquids (including fuel) are stored, or cleaning is carried out, are in designated impermeable areas that are isolated from the surrounding area and within a secondary containment system, e.g., by a roll-over bund, raised kerb, ramps or stepped access;
- The location of any fuel storage facilities shall be considered in the design of the Construction Compound. These are to be designed in accordance with relevant guidelines and codes of best practice and will be fully bunded;





- Good housekeeping at the site (daily site clean-ups, use of disposal bins, etc.) during the entire Construction Phase;
- All concrete mixing and batching activities will be located in areas away from watercourses and drains;
- Potential pollutants to be adequately secured against vandalism;
- Provision of proper containment of potential pollutants according to codes of best practice;
- Thorough control during the entire Construction Phase to ensure that any spillage is identified at an early stage and subsequently effectively contained and managed; and
- Spill kit to be provided and to be kept close to the storage area. Staff to be trained on how to use spill kits correctly.

The appointed contractor will implement an Environmental Incident Response Plan (EIRP), detailing actions to be taken in the event of a pollution incident. This plan will cover containment measures, emergency discharge routes, a list of appropriate equipment and clean-up materials, and notification procedures for informing the relevant environmental protection authority.

Additionally, the Construction Environmental Management Plan (CEMP) mandates that the contractor develop a Sediment Control Plan (SCP) before construction begins. The CEMP also outlines good construction management practices to prevent pollution risks to the existing land, soils, geology, and hydrogeology during construction.

Refer to Appendix 5.1 CEMP in Volume 4 of this EIAR.

## 14.5.2 Operational Phase

#### 14.5.2.1 Mobilisation of Contaminants into the Regionally Important Aquifer

As outlined in Section 14.5.1.1, the drainage network will be sealed throughout the Proposed Development.

## 14.6 Residual Impacts

The residual impacts associated with the construction and operational phase of the Proposed Development are presented in this section.

## **14.6.1 Construction Phase**

Effective implementation of the outlined mitigation measures will result in imperceptible residual adverse impacts on the land, soil, geology, and hydrogeology in the construction phase of the Proposed Development.

## 14.6.2 Operational Phase

Effective implementation of the outlined mitigation measures will result in imperceptible residual adverse impacts on the land, soil, geology, and hydrogeology in the operational phase of the Proposed Development.

## 14.6.3 Summary of Residual Impacts

Table 14-25 summarises the mitigation measures during both the construction and operational phase for each feature and outlines the resulting residual impacts. Impacts with a rating of imperceptible are not presented in this table as they are discussed within the chapter.





## Table 14-25 Summary of Mitigation Measures and Residual Impacts

Feature	Description	Receptor Location	Importance	Impact	Significance of Impact	Mitigation Measure	Residual Impact						
Spill from temporary storage of hazardous substances associated with the operation of plant													
Regionally Important Aquifer	Bedrock which is regionally important and is Karstified conduits (Rkc)	Widespread across the Proposed Development	High	Contamination of aquifer	Moderate / Slight	Use of shoring and trench boxes Contaminated material disposed at permitted waste site Mitigation against mobilisation of fines through installation of silt traps and appropriately designed dewatering Implementation of an EIRP and CEMP Implement mitigation measures to prevent spills of harmful liquids	Imperceptible						
Ecologically Sensitive Area	The Galway Bay Complex (Lough Atalia) SAC	West end of the study area south of the Proposed Development at Lough Atalia	Extremely High	Damage of SAC through pollution	Significant		Imperceptible						
	The Inner Galway Bay SPA	West end of the study area south of the Proposed Development at Lough Atalia	Extremely High	Damage of SPA through pollution	Significant		Imperceptible						
	Merlin Meadows	South of Merlin Park Hospital	High	Damage of Protected Area through pollution	Moderate		Imperceptible						
	Sinkhole / Enclosed Depression / Infilled Doline. ID: K7	Near entrance to Rosshill Park Woods. Under Proposed Development footprint	High	Mobilisation of contaminant into aquifer	Moderate		Imperceptible						
	Sinkhole / Enclosed Depression / Infilled Doline. ID: K8	On the road beside Castlegar GAA Club Under Proposed Development footprint	High	Mobilisation of contaminant into aquifer	Moderate		Imperceptible						





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Feature	Description	Receptor Location	Importance	Impact	Significance of Impact	Mitigation Measure	Residual Impact
Regionally Important Aquifer	Bedrock which is regionally important and is Karstified conduits (Rkc)	Widespread across the Proposed Development	High	Change to groundwater regime	Imperceptible		Imperceptible





## 14.7 References

Archaeological Survey Ireland (Accessed 2024). ASI Historic Environment Viewer [Online]. Available at <u>https://maps.archaeology.ie/historicenvironment</u>

Bing Maps (Accessed 2024). Bing Maps. [Online] Available at: https://www.bing.com/maps/

CIRIA guidance Control of Water Pollution from Construction Sites – Guidance for consultants and contractors (Masters-Williams et al., 2001).

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.

Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment Text with EEA relevance.

Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy (the Water Framework Directive).

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

Environmental Protection Agency (EPA), (Accessed 2024). Map Viewer [Online] Available at: <a href="https://gis.epa.ie/EPAMaps/">https://gis.epa.ie/EPAMaps/</a>

Environmental Protection Agency (EPA), (2022). Guidelines on the Information to Be Contained in Environmental Impact Assessment Reports.

Environmental Protection Agency (EPA), (2011). Evaluating the Influence of Groundwater Pressures on Groundwater Dependent Wetlands. Strive EPA Programme 2007 – 2013.

Environmental Protection Agency (EPA), (2008). Environmental Research Centre Report Series No. 12. A Framework for the Assessment of Groundwater-Dependent Terrestrial Ecosystems under the Water Framework Directive. Strive EPA Programme 2007 – 2013.

European Communities (Water Policy) Regulations 2003, as amended (S.I. No. 722/2003).

European Union (Water Policy) Regulations 2014 (S.I. No. 350/2014).

Google Maps (Accessed 2024). Google Maps [Online] Available at: https://www.google.com/maps

Geological Survey Ireland (GSI) (2004). Clarinbridge GWB: Summary of Initial Characterisation.

Geological Survey Ireland (GSI) (Accessed 2024). GSI Spatial Viewer [Online] Available at: <u>http://www.gsi.ie/Mapping.htm</u>

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

National Parks & Wildlife Service (NPWS), (Accessed 2024). Protected Sites Map Viewer [Online] Available at: <u>http://www.npws.ie/protectedsites/</u>

NRA (2008a). Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes.





NRA (2008b). Environmental Impact Assessment of National Road Schemes – A Practical Guide.

NRA (2009) Guidelines for Assessment of Ecological Impacts of National Roads Schemes.

Office of Public Works (OPW), (Accessed 2024). Flood database map viewer [Online] Available at: <u>http://www.floodinfo.ie/map/floodmaps/</u>

Tailte Éireann (Accessed 2024). Geohive Map Viewer [Online] Available at: <a href="http://map.geohive.ie/mapviewer.html">http://map.geohive.ie/mapviewer.html</a>

Working Group on Groundwater (2005). Approach to Delineation of Groundwater Bodies.

