7 Land, Soils and Geology

7.1 Introduction

This chapter comprises an assessment of the land, soils and geology within the vicinity of the site and the surrounding environs. The potential effects posed by the construction and operational phases of the Proposed Development are investigated, and suitable mitigation measures are recommended to minimise effects on the local soil and geological receptors.

The objectives of this chapter are:

- To provide a baseline assessment of the receiving environment in terms of land, soils and geology.
- To identify any potential negative effects posed by the construction and operational phases of the Proposed Development.
- To propose suitable mitigation measures to prevent or reduce the significance of the negative effects identified.
- To consider any significant residual effects of cumulative effects posed by the Proposed Development.

7.2 Consultation

ORS have been commissioned to assess the potential effects of the Proposed Development in terms of Land, Soils, and Geology during the construction and operational phases.

The principal members of the ORS EIA team involved in this assessment include the following persons:

- **Project Scientist and Lead Author:**
  Jack Wilton – B.Sc. (Microbiology), M.Sc. (Environmental Sustainability).
  Current Role: Environmental Consultant. Experience *ca*. 3 years

- **Project Scientist and Reviewer:**
  Sarah Bergin - B.Sc. (Chemistry), PhD. (Engineering),
  Current Role: Senior Environmental Consultant. Experience ca. 14 years.

- **Project Coordinator and Reviewer:**
  Oisín Doherty – B.Sc. (Geography with Environmental Science), MSc. (Environmental Management), CEnv, MIEnvSc.
  Current Role: Chartered Environmental Consultant. Experience *ca.* 15 years.

Consultation between ORS and other members of the planning/design team was made in order to obtain information required to assess the potential construction and operational phase effects on local Land, Soils, and Geology.

7.3 Assessment Methodology and Significance Criteria

The methodology used to produce this chapter included a review of relevant legislation and guidance, a desk study, a site walkover, an intrusive investigation (in the form of trial pits, and laboratory tests), an evaluation of potential effects, an evaluation of significance of the effect and an identification of measures to avoid and mitigate effects.

This chapter was carried out in accordance with the following guidance documents:

- EPA, (2022). Guidelines on the Information to be Contained in Environmental Impact Assessment Reports.
- EPA, (2004). Landspreading of Organic Waste – Guidance on Groundwater Vulnerability Assessment of Land.
- EPA, (2004). Guidance Note on Storage and Transfer of Materials for Scheduled Activities.
- EPA, (2012). Guidance to Licensees on Surrender, Cessation and Closure of Licensed Sites.
- European Commission, (2017). Environmental Impact Assessment of Projects: Guidance on the preparation of the Environmental Impact Assessment Report.
- Institute of Geologists Ireland, (2013). Guidelines for Preparation of Soils, Geology and Hydrogeology Chapters in Environmental Impact Statements.
- National Road Authority, (2008). Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes.
- Transport Infrastructure Ireland, (2023). Cross Sections and Headroom, Design Standards (DN-GEO-03036)
- CIRIA, (2001). C532 - Control of Water Pollution from Construction Sites – Guidance for consultants and contractors.
- UK CIRIA Report C552 (2001). Contaminated Land Risk Assessment: A Guide to Good Practice
- IGI, (2013). Geology in Environmental Impact Statements – a Guide (Institute of Geologists of Ireland.
- Department of Agriculture, Food and the Marine; Department of Housing, Planning and Local Government (2017). Nitrates Explanatory Handbook for Good Agricultural Practice for The Protection Of Waters Regulations 2018
- DAFM, (2022). Code of Good Practice for Poultry Litter Hauliers - Legal Obligations and Good Practice Guidelines for Poultry Litter Hauliers in Relation to the Use and Disposal of Poultry Litter.

7.3.1 Desktop Study

A desktop study was undertaken in order to collate and review background information in advance of the site survey and to develop a baseline of the land, soil and geology. The following documents and sources were referenced:

- Geological Survey of Ireland (GSI) maps and datasets
- Environmental Protection Agency (EPA) maps and datasets
- National Parks and Wildlife Service (NPWS) maps and datasets
- Ordnance Survey of Ireland (OSI) maps and datasets
- Met Eireann meteorological data
- Office of Public Works (OPW) maps and datasets
- Kildare County Development Plan (CDP) 2023-2029
- Strategic Environmental Assessment CDP 2023-2029
- Review of the County Geology of Ireland: Kildare
- Aerial Photography from ESRI (ArcGIS).
- 1:50,000 Discovery Series Maps and 6” maps
- Water Action Plan 2024 - A River Basin Management Plan for Ireland

- Teagasc ISIS GIS maps
- General Soil Map of Ireland 2nd Edition, (1980), The National Soil Survey, An Fóras Taluntais
- An Foras Talúntais (1980). Soil associations of Ireland and their land use potential.
- County Kildare Groundwater Protection Scheme – Main Report (2002).

7.3.2 Field Survey

Fieldwork commissioned in January 2025 consisted of the following elements:

- Trial Pit Excavations
- BRE Digest 365 Percolation/Soakaway Testing

A site walk-over was conducted by ORS geotechnical consultants on the 31st of January 2025 to verify the finding of the desktop study and identify baseline features on the Proposed Development site including:

- Drainage patterns and distribution
- Exposures
- Drainage Infrastructure
- Identification of “Poached” ground.

7.3.3 Impact Assessment Methodology

Chapter 1: **Introduction**, **Section 1.7** and **1.8** outlines the impact assessment methodology and rationale applied to each chapter of the study. This section describes some further criteria applied to the assessment of land, soil and geological receptors.

Risk Appraisal Methodology

The Conceptual Site Model (CSM) identifies potential contaminants, receptors and exposure pathways that may be present based on the construction and operational phase of the Proposed Development. The identification of potential “contaminant linkages” is a key aspect of the evaluation of potentially contaminated land and in quantifying the potential risk associated with Proposed Developments. As such this assessment has been undertaken in line with the Source - Pathway - Receptor Model as per the “*Guidelines on the information to be contained in Environmental Impact Assessment Reports*” 2022 and IGI 2013 guidance notes. At the impact assessment stage, any potential beneficial or adverse effects associated with the development are identified and assessed with reference to the baseline environment. This requires consideration of:

- Quality of effects (sensitivity of receptor)
- Significance of effects (severity)
- Description of extent and context of effects (character/ magnitude)
- Probability of effects
- Duration and frequency of effects
- Type of effect (direct, indirect, residual, etc.)

Table 1.1 in **Chapter 1** presents the criteria for the description of effects, as outlined in the EPA guidance report 2022.

Evaluation of Geological Receptors

The 13-step approach to impact assessment proposed in the IGI guidelines (2013) is adopted for the evaluation of potential effects. The baseline environment is assessed by characterising the site topographical, geological and geomorphologic regimes from the data acquired. Following on from the identification of the baseline environment, the available data is utilised to identify and categorise potential effects on the soils and geological environment as a result of the Proposed Development.

These assessments include:

- Undertaking preliminary materials calculations in terms of volumetric soil and subsoil excavation and reuse associated with development design,
- Assessing ground stability risks,
- Assessing the combined data acquired and evaluating any likely effects on the soils, geology, and ground stability,
- Identifying effects and considering measures that would mitigate or reduce the identified effect.

The significance of effects of the Proposed Development has been assessed in accordance with the EPA Guidelines on the information to be contained in Environmental Impact Assessment Reports, 2022. The effects associated with the Proposed Development are described with respect to the EPA guidance in the relevant sections of this chapter.

Magnitude and Significance of Effects

An effect rating has been developed for each of the phases of the Proposed Development based on the Institute for Geologists Ireland (IGI) Guidance for the preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements. In line with the IGI Guidance the receiving environment (Geological Features) was first identified. Using the National Road Authority (NRA) (2008) rating criteria the importance of the geological features is rated in **Table 7.1** followed by an estimation of the magnitude of the effect (**Table 7.2**). This determines the significance of the effects prior to application of mitigation measures as set out in **Table 7.3**.

Table 7.1: Sensitivity/ Value of the Site's Geological Features (NRA, 2008)

Magnitude	Criteria	Example
Very High	Attribute has a high quality, significance, or value on a regional or national scale. Degree or extent of soil contamination is significant on a national or regional scale. Volume of peat and/or soft organic soil underlying the site is significant on a national or regional scale	• Geological feature 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 the site is significant on a local scale	• Contaminated soil on site with previous heavy industrial usage • Large recent landfill site for mixed wastes • Geological feature of high value on a local scale (County Geological Site) • Well drained and/or high fertility soils • Moderately sized existing quarry or pit • Marginally economic extractable mineral resource
Medium	Attribute has a medium quality, significance, or value on a local scale. Degree or extent of soil contamination is moderate on a local scale. Volume of peat and/or soft organic soil underlying the site 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 the site 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 • Uneconomic extractable mineral resource

The assessment of the severity/ magnitude of an effect incorporates the timing, scale, size, and duration of the potential effect. The magnitude criteria for geological effects are defined in **Table 7.2**.

Table 7.2: Severity/ Magnitude of effects on Geological Features (NRA, 2008)

Magnitude	Criteria	Description and 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 effect 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
Small Adverse	Results in minor effect 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 effect 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

Based on the determination of the findings from the above **Tables** (**7.1** and **7.2**) the following matrix is used to establish the significance of the effect.

Table 7.3: Rating the Significance of the Effect in Geology (NRA, 2008)

Importance of Attribute	Magnitude of Effect			
	Negligible	Small Adverse	Moderate Adverse	Large Adverse
Very High	Imperceptible	Significant/ Moderate	Profound/ Significant	Profound
High	Imperceptible	Moderate/ Slight	Significant/ Moderate	Profound/ Significant
Medium	Imperceptible	Slight	Moderate	Significant
Low	Imperceptible	Imperceptible	Slight	Slight/ Moderate

7.4 Description of the Receiving Environment

7.4.1 Background

This section of the chapter provides the baseline information in terms of geomorphology (landscape and topography), superficial and solid geology. The regional review of geological and hydrogeological conditions covers a zone of at least 2km from the Proposed Development site, as suggested in the IGI guidelines.

The Proposed Development occupies a total area of *ca.* 5.12 hectares and is situated in the townlands of Ballyvass, Castledermot, Co. Kildare. The Proposed Development is situated to the west of the M9 motorway with agricultural lands to the north, west and south of the site. The site's northern and eastern boundary is flanked by an unnamed local road which gives access to farmland and a quarry to the south of the site. The local road (L8050) is *ca.* 30m north of the site and *ca.* 30m west of the M9 Motorway. The Proposed Development will be accessed via this road and an entrance will be established to the north of the site along this road.

The site is located approximately 3.3km northwest of the town of Castledermot, Co. Kildare and approximately 11.3km northeast of Carlow town, Co. Carlow. The approximate grid reference location for the centre of the site is S 76846 88213, ITM: 676790, 688242.

The underlying geology has a major influence on topographical, hydrogeological and hydrological features within the Proposed Development vicinity, hence this chapter is closely linked to the following chapter (**Chapter 8 – Hydrology and Hydrogeology)**.

The receiving environment is described below for the Proposed Development under the following headings:

- Topography
- Drift (Quaternary) Geology
- Bedrock Geology
- Soils and Subsoils

7.4.2 Topography

The landscape of County Kildare comprises a central plain bound to the east by the Kildare uplands, which lie at the foothills of the Wicklow and Dublin Mountains. The Curragh, the boglands of north-west Kildare and the fertile lowlands of the south all comprise part of the central plain. The plain lands are interrupted by two groups of isolated hills, the Chair of Kildare and the Newtown Hills. The location of these hills within the central plain has a considerable effect on the landscape of Kildare. Inland waters comprise the River Liffey, River Barrow, River Slate, River Boyne, Royal Canal, Grand Canal and Rye Water River traverse the county, providing important landscape features.

The landscape of Co. Kildare reflects its varied underlying geology. The flattish-undulating low-lying region of the county occupying the middle and western parts of the county are underlain by the easily eroded and dissolved Carboniferous Limestones. The eastern hillier region is underlain by the more resistant and older Ordovician and Silurian rocks, as is the Chair of Kildare (hence its protrusion through the plains of Kildare). Occupying the most southern tip of the county there is a portion of the Leinster Granite, intruded into the sedimentary sequence

about 405 million years ago.

The landscape in County Kildare contains views and prospects worthy of protection. The natural diversity of the landscape, coupled with human interaction in the form of introduced features such as hedgerows, woodlands, archaeological monuments, settlements and buildings, all serve to give Kildare its distinctive characteristic landscape. The range of different landscapes found in Co. Kildare each have varying visual and amenity values, topography, exposure and contain a variety of habitats. Each landscape type also has varying capacity to absorb development relative to its overall sensitivity. Landscape sensitivity is a measure of the ability of the landscape to accommodate change or intervention without suffering unacceptable effects to its character and values. It is determined using the following factors: slope, ridgeline, water bodies, land use and prior development.

The Landscape Character Assessment undertaken to inform the review of the Kildare County Development Plan 2023-2029 has divided the county into 16 no. Landscape Character Areas based on the local landscape features which include:

1. Mouds Bog
2. Central Undulating Lands
3. Dun Ailinne
4. Chair of Kildare
5. Eastern Transition
6. Eastern Uplands
7. North-western Lowlands
8. Northern Hills
9. Northern Lowlands
10. Pollardstown Fen
11. River Barrow
12. River Liffey
13. South-eastern Uplands
14. Southern Lowlands
15. The Curragh
16. Western Boglands

The landscape character areas are further differentiated based on their landscape sensitivity as shown in **Table 7.4** overleaf. The proposed site is located in the Eastern Transition Landscape Character Area which falls under Class 2 – Medium Sensitivity (see **Figure 7.1**, **Figure 7.2** and **Figure 7.3** overleaf).

Table 7.4: Landscape Sensitivity Classification of County Kildare landscape Character Areas, adapted from Kildare County Development Plan 2023-2029.

Sensitivity	Landscape Character Area	Description
Class 1 Low Sensitivity	North-Western Lowlands	Areas with the capacity to generally accommodate a wide range of uses without significant adverse effects on the appearance or character of the area
	Northern Lowlands	
	Central Undulating Lands	
	Southern Lowlands	
Class 2 Medium Sensitivity	Eastern Transition Lands	Areas with the capacity to accommodate a range of uses without significant adverse effects on the appearance or character of the landscape having regards to localized sensitivity factors.
	South-Eastern Uplands	
Class 3 High Sensitivity	Western Boglands	Areas with reduced capacity to accommodate uses without significant adverse effects on the appearance or character of the landscape having regard to prevalent sensitivity factors.
	Eastern Uplands	
Class 4 Special	Chair of Kildare	Significant adverse effects on the appearance or character of the landscape having regard to prevalent sensitivity factors.
	Northern Hills	
	River Liffey	
	River Barrow	
	Mouds Bog	
Class 5 Unique	The Curragh	Areas with low capacity to accommodate uses without significant adverse effects on the appearance or character of the landscape having regard to special sensitivity factors.
	Pollardstown Fen	
	Dun Ailinne	

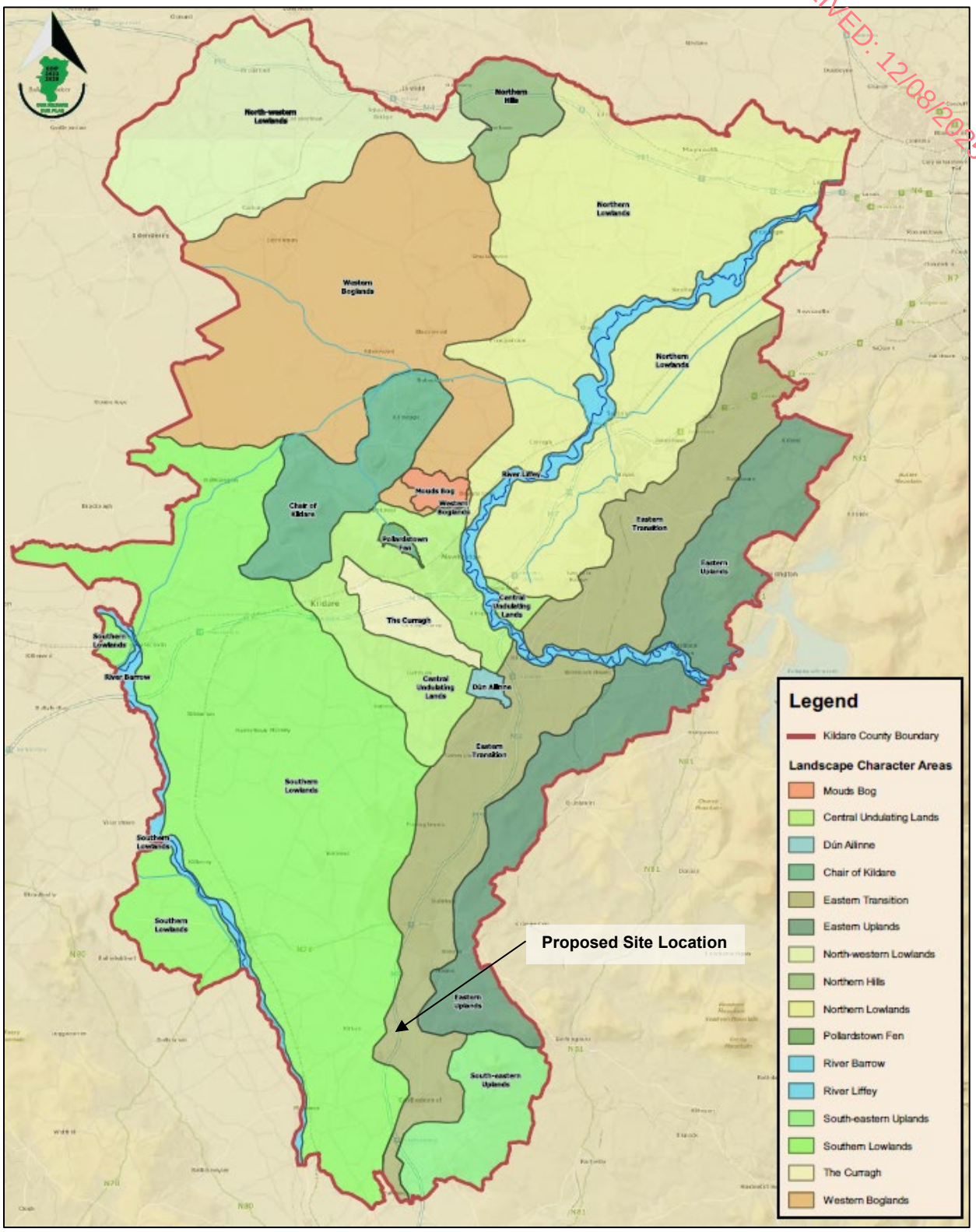

Figure 7.1: Landscape Character Areas (Map V1 – 13.1 of Chapter 13 of the Kildare County Development Plan 2023-2029)

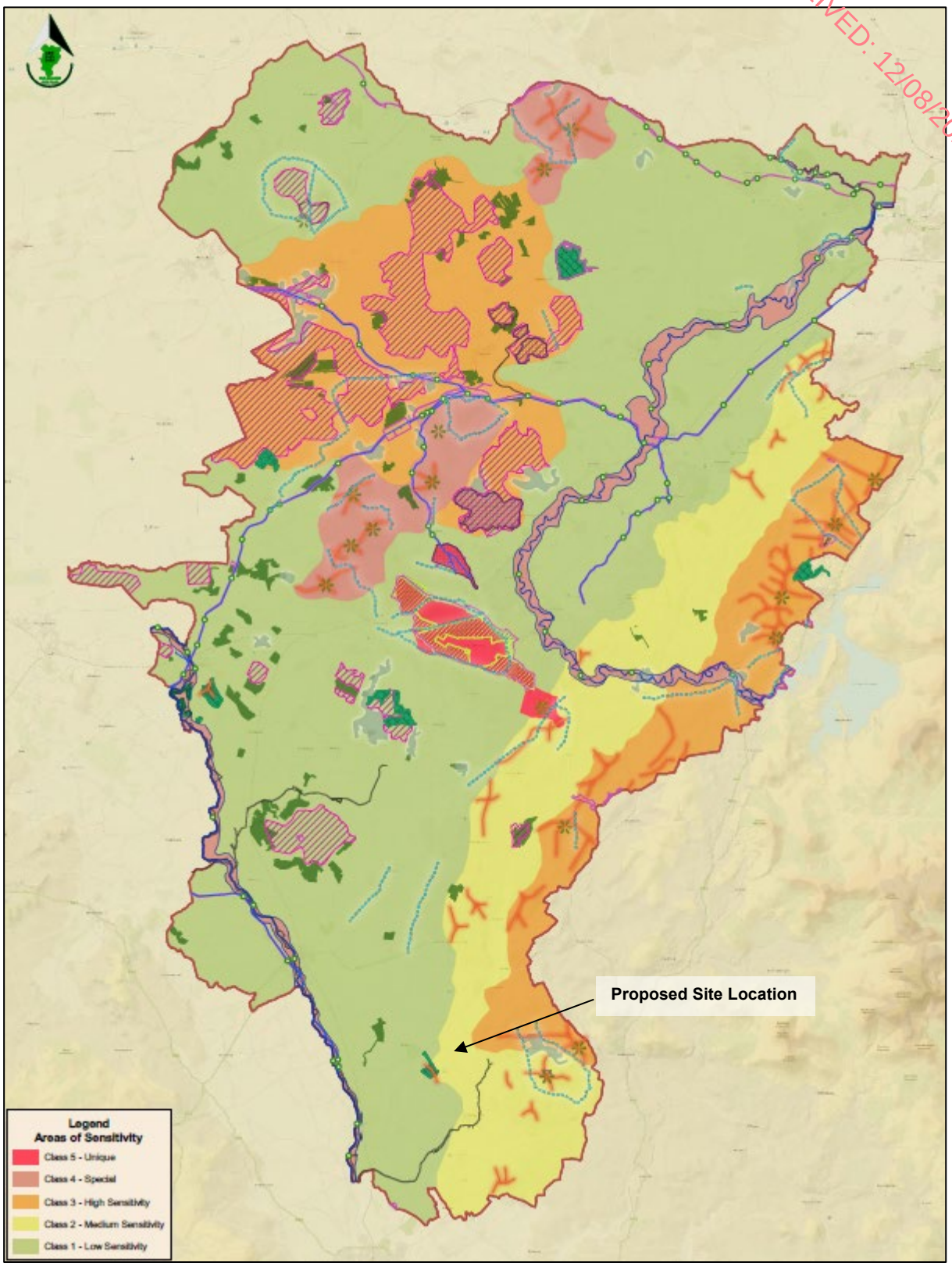

Figure 7.2: Landscape Character Area Sensitivity (Map V1 – 13.2 of Chapter 13 of the Kildare County Development Plan 2023-2029)

Based on the mapping of the Landscape Areas of Kildare, the Proposed Development is located entirely within the “Eastern Transition” character area, bordering the Southern Lowlands to the west, the Eastern Uplands to the northeast and the South-eastern Uplands to the east respectively. Considering a 2.0 km radius. According to the GSI Viewer the Proposed Development site is characterised as “Hummocky sediments”, in keeping with the Landscape Character Type description for the area.

A generalised description of each of the three landscape areas identified within 2.0km of the Proposed Development are presented below.

Eastern Transition Lands

This landscape character unit is located between the uplands and lowlands to the east of the County and is characterised by undulating topography. The River Liffey bisects the unit north and south. The terrain gently rises from the lowland areas to the hilltops of the Eastern Kildare Uplands. The land undulates through a series of hilltops. The elevated vantage points along the local roads provide long-distance views of the Kildare lowlands. The skyline to the east of this unit is defined by the Eastern Uplands, distant views including the neighbouring Wicklow Mountains, define the extent of visibility. The hilltops of the Chair of Kildare Hills partially define the skyline to the west.

Southern Lowlands

This landscape character unit comprises an extensive lowland area to the south-west of the County, the River Barrow and the Grand Canal running along its western quarter. This area is characterised by generally flat terrain and open lands with regularly shaped large field patterns. The generally flat topography and the low-lying vegetation allow long-distance and extensive visibility. Distant views include the skylines of the Eastern Kildare Uplands, the Newtown and Hughstown Hills and the Wicklow Mountains to the east, the Chair of Kildare hilltops to the north-east and the neighbouring hills of County Laois to the south-west.

Eastern Uplands

This Landscape Character Area is located in the northeast of the County and extends into the neighbouring County of Wicklow, as the Uplands are part of the Wicklow Mountain complex. The undulating hills situated within County Kildare lie to the east of the Liffey. The elevated nature of this area provides a defined skyline with scenic views over the central plains of Kildare and the neighbouring Wicklow mountains which further define the skyline and the extent of visibility.

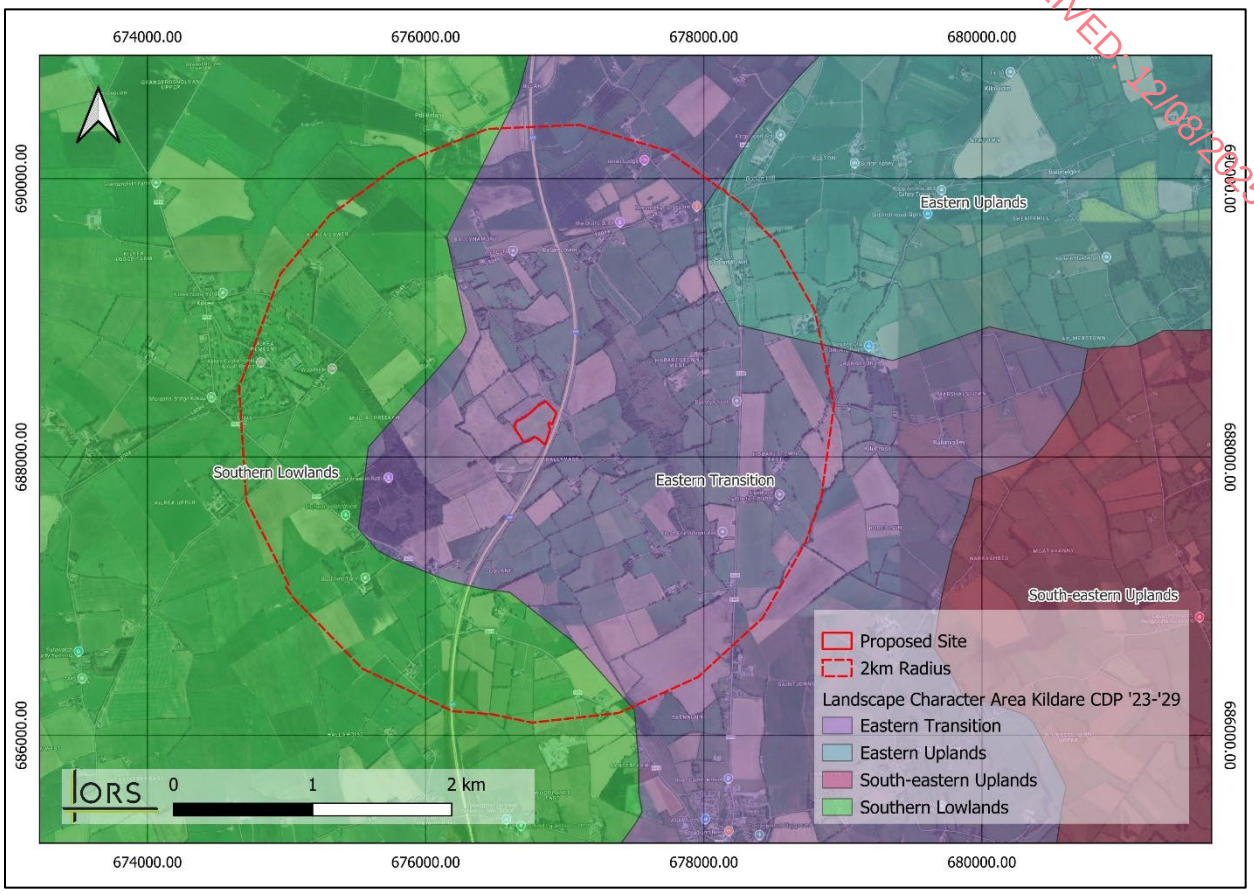

Figure 7.3: Overlay of the Proposed Development in relation to the Kildare CDP Landscape Area categories

The proposed site is located between two rivers, the Greese (*ca.* 1.6km north) and the Graney (*ca.* 3.5km south) which are distinct features within the landscape of southern Kildare. The topography of the site exhibits a gradual upwards slope from north to south. The site's topography peaks at 85.75m AOD along the southern boundary near, gradually sloping northwards to a low of 79.31m AOD. The elevation at the proposed entrance to the site is approx. 83m AOD. The site topography is illustrated in **Figure 7.4.**

The access roads e.g. L8050, the L8049 and an unnamed local road, remain relatively flat, ranging between 83m OD and 84m OD. To the west, a peak in the local topography reaches 140m OD, approximately 1 km from the site. Apart from this, the surrounding area does not show any considerable variation in terrain elevation. The site is bordered to the north by an existing watercourse that flows from west to east, the stream is not identified on EPA mapping but was noted during site visits and topographical surveying.

Figure 7.4: Topographical map of the landscape surrounding the site (topographic-map.com)

7.4.3 Receptors

Designated Sites

Figure 7.5 (overleaf) displays the spatial distribution of the Special Areas of Conservation (SAC), Special Protection Areas (SPA) and Natural Heritage Areas (NHA) within the wider region. SAC are prime wildlife conservation areas in the country which are considered to be important on a country and European scale. Sites are selected and designated under the EU Habitats Directive and have been transposed into Irish law under EC (Birds and Natural Habitats) Regulation 2011 (S.I. No. 477/ 2011). Likewise, an SPA is an area selected for conservation due to its importance in the protection of rare or vulnerable bird species, migratory species, and wetlands. Sites are selected and protected under the EU Birds Directive.

The closest designated sites to the Proposed Development include the River Barrow and River Nore SAC (Site Code: 002162) located *ca.* 1.9km southeast of the site. There are no additional designated sites within 2km of the site.

Table 7.5: Special Protection Areas (SPA) within a 2km study area of the site

Name	Site Code	Designation	Reason for Protection
River Nore and River Barrow SAC	002162	Special Area of Conservation (SAC)	• Estuaries [1130] • Mudflats and sandflats not covered by seawater at low tide [1140] • Reefs [1170] • Salicornia and other annuals colonising mud and sand [1310] • Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) [1330] • Mediterranean salt meadows (*Juncetalia maritimi*) [1410] • Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation [3260] • European dry heaths [4030] • Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels [6430] • Petrifying springs with tufa formation (*Cratoneurion*) [7220] • Old sessile oak woods with Ilex and Blechnum in the British Isles [91A0] • Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*) [91E0] • *Vertigo moulinsiana* (Desmoulin's Whorl Snail) [1016] • *Margaritifera margaritifera* (Freshwater Pearl Mussel) [1029] • *Austropotamobius pallipes* (White-clawed Crayfish) [1092] • *Petromyzon marinus* (Sea Lamprey) [1095] • *Lampetra planeri* (Brook Lamprey) [1096] • *Lampetra fluviatilis* (River Lamprey) [1099] • *Alosa fallax fallax* (Twaite Shad) [1103] • *Salmo salar* (Salmon) [1106] • *Lutra lutra* (Otter) [1355] • *Trichomanes speciosum* (Killarney Fern) [1421]

Taking into consideration the 'Source-Pathway-Receptor' model, the closest waterbody is the Ballynamoney stream located *ca.* 600m northeast of the Proposed Development. The stream runs from south to north, eventually crossing the M9 motorway and adjoining the River Greese *ca.* 2.3km downstream. The river Greese continues flowing to the west, eventually turning southwest and adjoins the River Barrow and River Nore SAC *ca.* 10.8km downstream. Thus, there is no direct hydrologic connectivity between the proposed development site and any European Designated sites.

An appraisal of the potential effects of the Proposed Development on the constitutive characteristics of European sites identified within 15km of the Proposed Development is set out in the Natura Impact Statement which accompanies the planning application for this project.

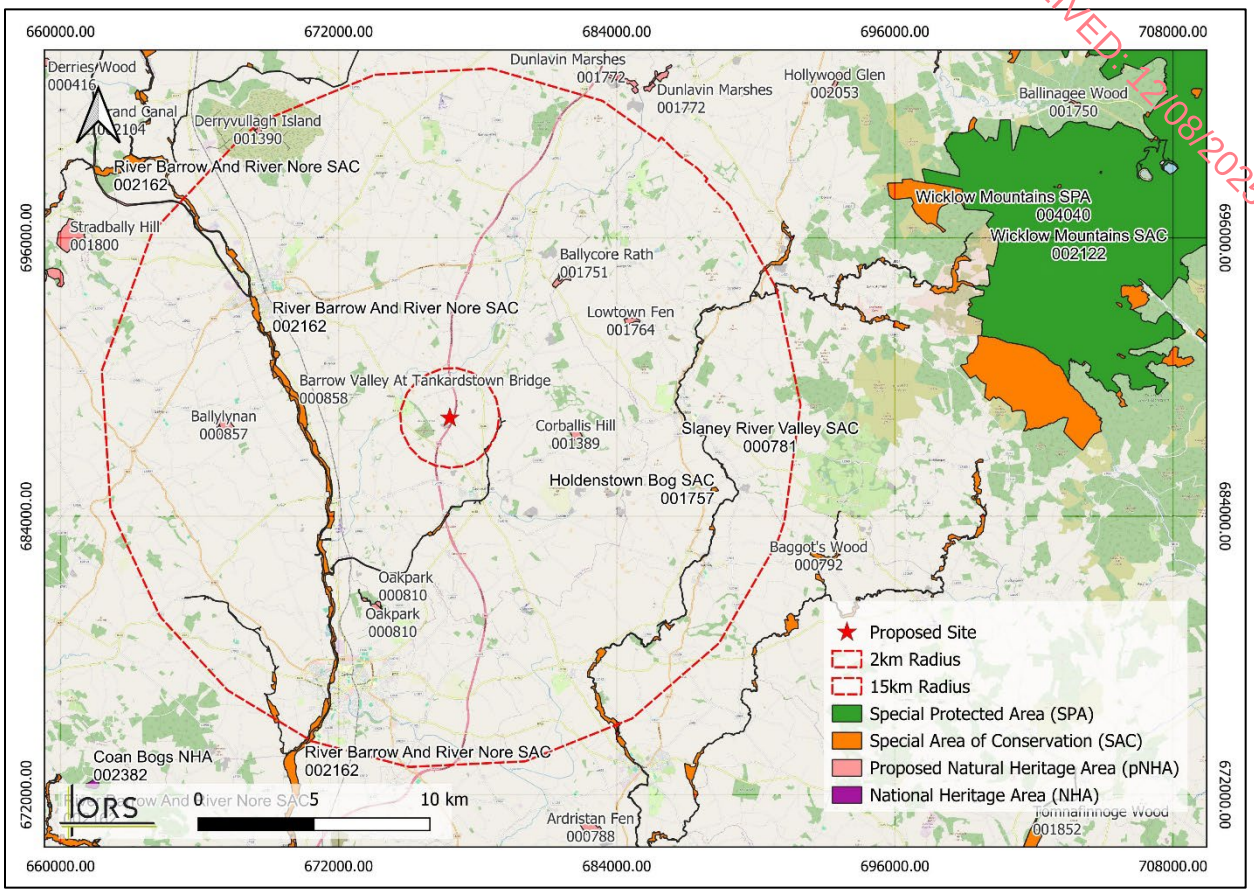

Figure 7.5: SPA, SAC and NHA sites within a 2km and 15km radius of site

Geological Heritage

The Irish Geological Heritage (IGH) Programme identifies and selects a complete range of sites that represent Ireland's geological heritage under sixteen themes ranging from karst features to hydrogeology. The IGH Programme is a partnership between the GSI and the National Parks and Wildlife Service (NPWS) and sites identified as important for conservation are conserved as Natural Heritage Areas (NHA).

Reference to the GSI online database confirms the proposed site is not within a geological heritage site and that there are no designated sites within the 2 km study area of the Proposed Development. The closest site is Hollymount, which is described as "*A number of fields where a borehole was drilled in the early 1970s*" and is located approximately 9.3km southeast of the site, outside the 2km study area. **Figure 7.6** overleaf indicates the Geological Heritage Site within the wider region.

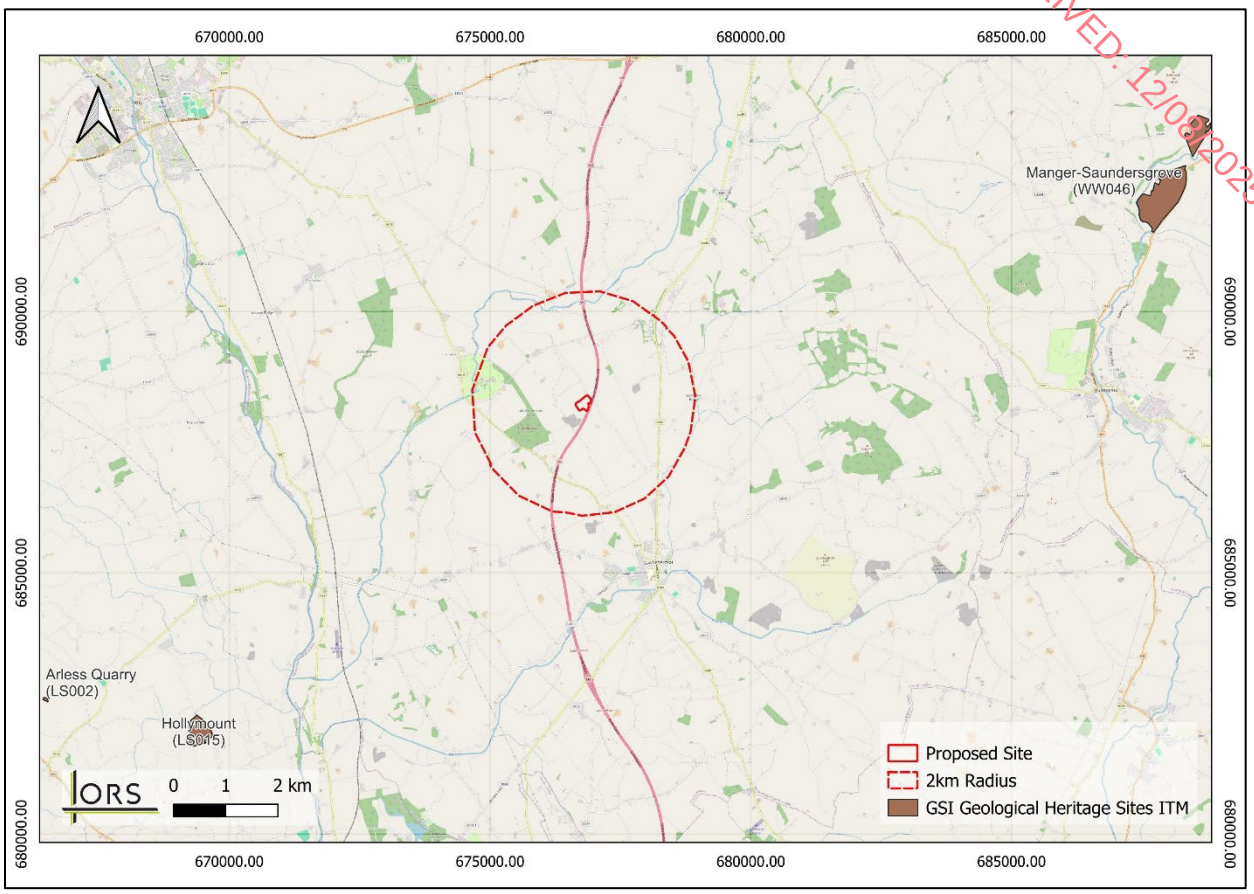

Figure 7.6: Geological Heritage Sites within the vicinity of the site

7.4.4 Drift (Quaternary) Geology

Drift is a general term applied to all mineral material (clay, silt, sand, gravel and boulders) transported by a glacier and deposited directly by or from the ice or as fluvioglacial deposits. It generally applies to deposits laid down during the Pleistocene (Quaternary) glaciations. Drift can also be included under Holocene (Quaternary) deposits. The drift geology of the area principally reflects the depositional process of the last glaciation. Typically, during the ice advance, boulder clays were deposited, sub-glacially as lodgement till over the eroded rock head surface, whilst moraine granular deposits were laid down at the glacier margins. Subsequently, with the progressive retreat of the ice sheet from the region, granular fluvio-glacial deposits were laid down in places by melt waters discharging from the front of the glacier.

The Proposed Development is located within a landscape of hummocky sediments which extends to the north and southeast. To the east, this landscape gives way to rolling to gently undulating sediments which gradually transition to mountains / hills. The landscape to the west of the Proposed Development site is a lowland region forming a flat to undulating plain which extends to the foot of a mountain plateau region beyond the banks of the River Barrow, to which the River Greese adjoins as shown in **Figure 7.7** overleaf.

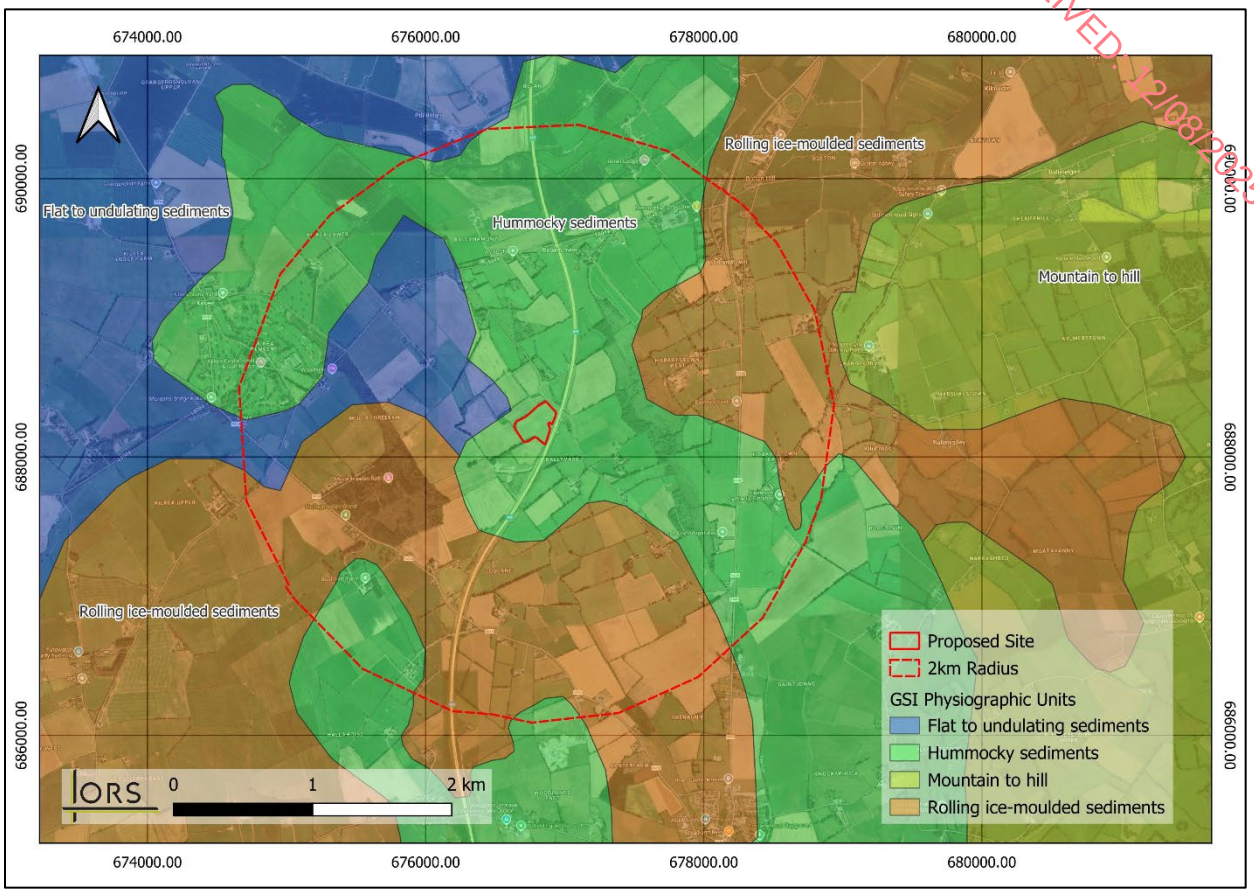

Figure 7.7: Physiographic Character of the site and surrounding landscape (GSI)

The Second Edition General Soil Map of Ireland describes this region as belonging to the "*flat to undulating lowland*" group of the broad physiographic divisions. The proposed site resides at the soil association denoted no. 35 which comprises grey brown podzolics (80%) with associated soils including Gleys (10%) and Brown Earths (10%). Parent material is proposed to consist of stony-limestone-glacial till. The majority of the proposed site overlays gravels derived from limestones. In view of the Proposed Development, the soils which are likely to be affected by the development are characteristic in the local and regional context and occur in abundance.

7.4.5 Bedrock Geology

Regional Bedrock Geology

Bedrock is defined as a consolidated aggregate of minerals underlying the ground surface and any soils present. Above the bedrock is usually an area of broken and weathered unconsolidated rock in the basal subsoil. Sedimentary rock lies in beds which may comprise different rock types and which may be horizontal or inclined, so that the rock encountered at the ground surface may change over a short distance.

The predominant rock types in Kildare are sedimentary rocks, limestone of Carboniferous age in particular. These sedimentary rocks have only been mildly affected by folding and retain many of their original sedimentary and depositional structures. Throughout the county there are also some minor igneous rocks and the larger Tullow Granite Pluton, which is a part of the

Leinster Granite.

The oldest rocks in Kildare are of Ordovician age (490-450 million years ago [Ma]) and occur within the Kildare Inlier (an area of older rocks surrounded by younger rocks). Silurian rocks (430 Ma) also occur there and in a wide belt in the southeast of the county. These rocks were formed under an ocean that separated two continents. At the Chair of Kildare and at the Hill of Allen there were two volcanic islands for a short time. The hard volcanic rocks that erupted are more resistant to erosion and have become isolated hills in the plains of Kildare. When the volcanoes were erupting, the shallow waters around them were populated by marine animals and some of the rocks formed then now contain fossils from that time.

Originally Ireland was composed of two 'halves' separated by a sea called the Iapetus Ocean, with the country split in a north-east to south-west direction from Clogher head to Dingle. The northwestern part of the island was located on the continent of Laurentia, with the southeastern part of the island located on Gondwana. Plate tectonic movement throughout the Ordovician period saw this Iapetus Ocean close and the two halves converge and eventually combine in Silurian times. The extreme pressures of the collision uplifted the rocks to produce a range of mountains, in an event known as the Caledonian Orogeny, resulting in the formation of the mountain ranges located throughout Ireland today, which run in a northeast to southwest axis.

The Caledonian Mountain belt was an area of erosion rather than deposition during most of the Devonian period, around 400Ma and few rocks of this age are present in the Kildare area. The prolonged erosion wore down the mountains, right down to the granite so that the next stage of deposition produced a major unconformity, or gap in the rock succession.

General subsidence permitted the sea to invade the lower ground from the south during the Carboniferous period. The depth of the sea and type of bottom varied from place to place, producing a variety of limestone (carbonate) sediments at any one time; for instance, oolites, which form in only very shallow water occur mainly around the present Kildare Inlier. After a time, carbonate mud banks or "reefs" (Waulsortian Limestones) developed as upstanding mounds on the sea floor across parts of the Kildare area (and much of the Midlands of Ireland). Growth of these mounds was probably due to the rapid accumulation of fine carbonate mud produced by unknown organisms. A rich fauna (including sea lilies (crinoids)) and varying micro-organisms lived on the mounds. Volcanic activity also occurred near Edenderry during a period of subsidence and faulting. The Carboniferous coalfield rocks (like those at Castlecomer) may once have covered Kildare but have since been eroded away.

The Proposed Development is located on a large terrane of Silurian metasediments and volcanics which terminates *ca.* 300m south of the Proposed Development and stretches from Belan Lower (N) to Kilkea (W) and Castleroe West (SW). The terrane expands and extends far to the northeast to Glencanon (E) and beyond towards Rathcoole and Naas East (NE). **Figure 7.8** overleaf indicates the regional hydrostratigraphic rock unit groups in the region of the Proposed Development.

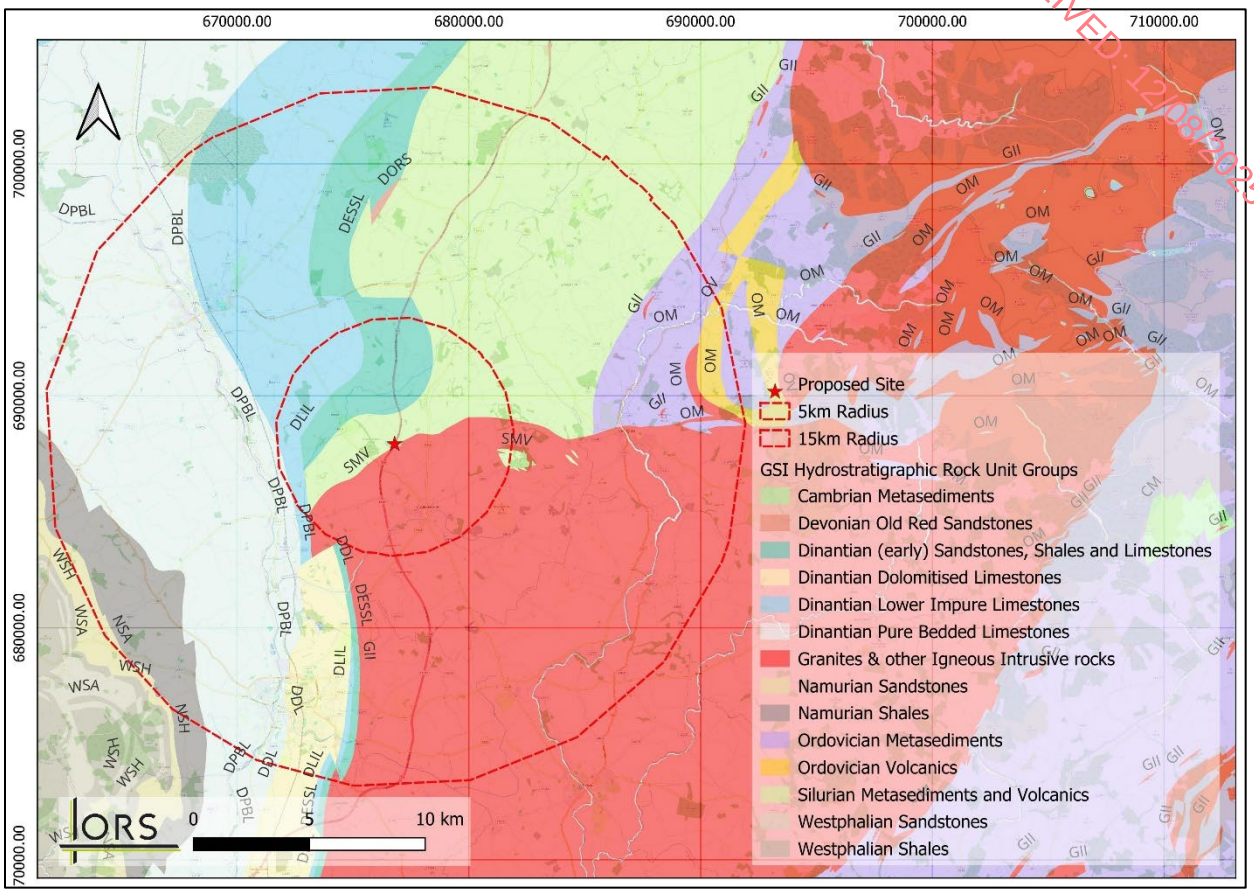

Figure 7.8: Hydrostratigraphic Rock Unit Groups Within Co. Kildare (GSI)

Local Bedrock Geology

According to the Geological Survey of Ireland and the National Draft Generalised Bedrock Map, the bedrock within the 2km study area of the Proposed Development, which extends to the southwest is comprised of Silurian metasediments and volcanics. The region within the 2km study area of the Proposed Development is comprised of a variety of formations which consist of granites and other igneous intrusive rocks, early Dinantian period rocks as well as additional areas underlain by Silurian metasediments and volcanics.

The formation underlying the Proposed Development is known as the Tipperkevin Formation. The 1:100,000 Bedrock Solid Geology Map indicates that the bedrock type in this formation is greywacke and shale. The lithological description of the formation is “medium to fine grained greywacke sandstones or shales”. Exposers of the formation can be found *ca.* 750m to the southwest of the Proposed Development site, extending towards Mullaghreelan Wood.

The Quinagh Formation lies *ca.* 860m to the north of the Proposed Development, beyond which is the Feighcullen Formation. The Quinagh Formation is classified by GSI as consisting of mudstone, sandstone and siltstone. The lithology comprises “lenticular, very thin beds and laminae of dark mudrock, interbedded with pale coarse siltstone or fine sandstone. Dolomitisation is common. Clasts of weathered granite are found commonly in the basal beds but are found throughout the formation.” The Feighcullen Formation is classified by GSI as consisting of skeletal, oolitic and micritic limestones. The lithology “consists mainly of varied

shallow-water limestones including oolites, skeletal calcarenites and micrites with minor shale and sandstone. The formation contains 4 informal units; Calcarenite D (*ca.* 28.5m), Micrite Unit (*ca.* 27.5m), Calcarenite C (*ca*. 33.5m) and Oolite Unit (*ca*. 40m)".

The Glen Ding Formation lies *ca.* 340m to the east of the Proposed Development lies. A fault occurs at the intersection of the Tipperkevin and Glen Ding Formations which runs from the northeast to the southwest. GSI have classified this as chloritic, feldspathic greywacke. The lithology is described as follows; "the greywackes of this formation are distinctly more chloritic and feldspathic than those of the other formations, probably accounting for a regional lithogeochemical contrast accross the Slate Quarries Formation-Glen Ding Formation contact".

To the southeast *ca.* 275m of the Proposed Development lies the Type 2 Equigranular Granite (Tullow Pluton) Formation, which is nestled between the Glen Ding and Type 1 Granite (Tullow Pluton) Formation and occurs beyond the aforementioned fault line along the northeast to southwest. GSI have classified this as granites and other igneous intrusive rocks. The lithology comprises "pale, fine to coarse grained granite". The Type 1 Granite (Tullow Pluton) Formation lies *ca.* 330m to the south of the Proposed Development. GSI have classified this as granites and other igneous intrusive rocks. The lithology comprises "fine grained granodiorite to granite".

To the west *ca.* 990m of the Proposed Development lies the Carrighill Formation. GSI have classified this as calcareous greywacke. The lithology is described as "the youngest and finest grained formation [of the Killcullen Group]. It consists of greywacke, siltstones and shales. Exceptionally, the bases of the graded beds can be up to coarse sand grade. Muscovite flakes are common on bedding surfaces. The greywackes are distinctive in having a calcareous matrix, principally iron-rich dolomite, with a higher proportion of matrix to clasts than the other formations". The local bedrock geology is illustrated in **Figure 7.9** overleaf.

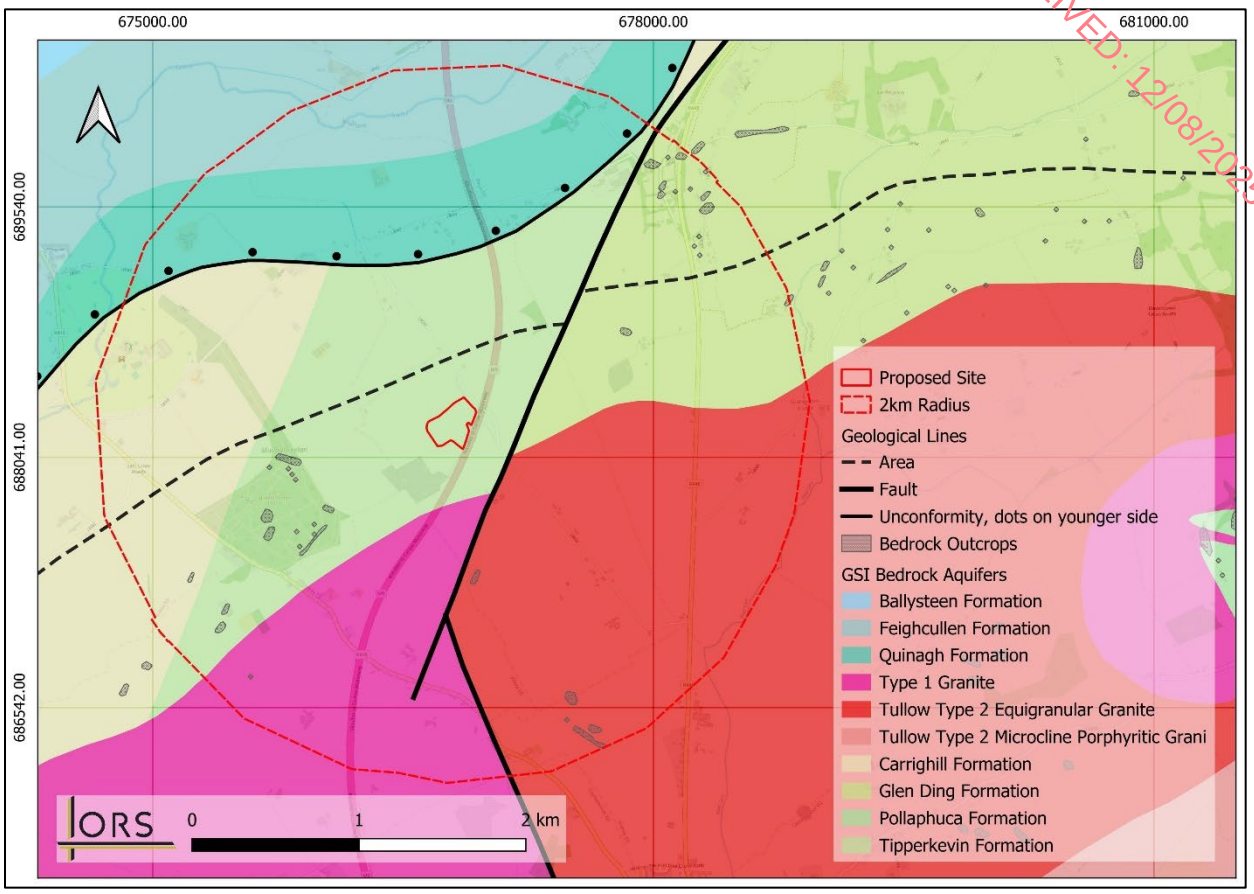

Figure 7.9 Local Bedrock Formations (GSI)

The bedrock geology and linework on the 1:100,000 scale mapping from the GSI indicates that there are a number of geological linework (e.g. unconformity, faults etc.) within the 2km study area. The closest unconformity, a fault, is located *ca.* 250m east of the site and runs from northeast to southwest. The fault line which runs marks the beginning of the Glen Ding and Type 2 Equigranular Granite (Tullow Pluton) Formations to the east of the Proposed Development. The fault line also encroaches upon the Type 1 Granite (Tullow Pluton) Formation.

Depth to Bedrock

According to the GSI database, there are approximately **64 no. groundwater wells within the 2km study area**. These groundwater wells are defined as a mix of dug wells and boreholes in addition to one spring recorded approximately 1.6 km southeast of the site. The details of groundwater wells within 2km of the Proposed Development are outlined in **Table 7.5** overleaf. **Figure 7.10** superimposes the approximate location of the groundwater wells listed in **Table 7.5** relative to the groundwater vulnerability rating of the area.

Groundwater wells within the wider area have a varying yield class from moderate to poor. The lands on which the site location has been proposed have been assigned a groundwater vulnerability rating of high. The recorded depth to bedrock encountered for the corresponding wells in the wider area is generally between 1.8 to 13.1 metres below ground level (mbgl). The western portion of the subject site is situated above a poor aquifer of bedrock which is

generally unproductive except for local zones (Pl). The eastern boundary of the Proposed Development is situated above the Coolane Sand and Gravel aquifer which is designated by the Geological Survey of Ireland (GSI) National Draft Bedrock Aquifer Map as a locally important gravel aquifer which is generally unproductive expective expect for local zones (Lg). The entirety of the site is located within the New Ross Groundwater body classified under the WFD. This ground waterbody extends throughout county Kildare towards New Ross, county Wexford to the south.

Table 7.5: Groundwater Wells with 2km of the site (GSI Well Database)

GSI Reference	Easting	Northing	Well Type	Depth (m)	DTB (m)	Well Use	Yield (m^3/d)	Location Accuracy	Proximity to site (km)
2617NEW258	278340	188410	Borehole	45.7	4.9	Domestic use only	31.6	to within 2km	1.49
2617NEW298	277870	187020	Borehole	12.8	DTB Unknown	Unknown	N/A	to within 50m	1.55
2617NEW299	275970	186470	Dug well	4.9	DTB Unknown	Unknown	N/A	to within 50m	1.95
2617NEW301	276580	186660	Dug well	4.1	DTB Unknown	Public supply	N/A	to within 50m	1.56
2617NEW212	276320	187150	Borehole	31.4	4.5	Unknown	21.82	to within 2km	1.18
2617NWW212	274780	189470	Dug well	9.8	0	Unknown	10.91	to within 1km	2.44
2617NWW213	273510	189300	Dug well	4.6	0	Unknown	N/A	to within 5km	3.53
2617NWW214	274890	188600	Dug well	9.1	0	Unknown	N/A	to within 1km	2.02
2617NEW266	275870	187310	Borehole	61	5.2	Domestic use only	16.4	to within 50m	1.33
2617NWW270	274900	188680	Dug well	9.1	DTB Unknown	Unknown	N/A	to within 50m	2.02
2617NWW271	274880	188580	Borehole	12.2	DTB Unknown	Unknown	54.6	to within 50m	2.02
2617NEW302	276760	186430	Borehole	18.3	DTB Unknown	Unknown	N/A	to within 50m	1.77
2617NEW303	277320	186210	Dug well	3.5	DTB Unknown	Unknown	N/A	to within 50m	2.04
2617NEW243	277010	185270	Borehole	20.7	12.2	Unknown	21.82	to within 2km	2.93
2617NEW252	275670	187350	Borehole	37.5	10.4	Domestic use only	65.5	to within 50m	1.47
2617NEW255	277320	186110	Borehole	91.4	9.1	Domestic use only	10.9	to within 100m	2.14
2617NEW386	275780	189100	Borehole	5	5	Other	N/A	to within 20m	1.41
2617NEW387	275100	188300	Borehole	14	Bedrock Not Met	Other	N/A	to within 20m	1.77
2617NEW285	276440	189620	Dug well	3.7	DTB Unknown	Unknown	N/A	to within 50m	1.48
2617NEW286	276210	189210	Dug well	4.9	DTB Unknown	Unknown	N/A	to within 50m	1.21

2617NEW287	276670	189360	Dug well	8.1	DTB Unknown	Unknown	N/A	to within 50m	1.18
2619SEW218	277130	190860	Borehole	24.1	12.2	Unknown	18.6	to within 2km	2.68
2617NEW289	276860	189070	Dug well	4.3	DTB Unknown	Unknown	N/A	to within 50m	0.87
2617NEW290	276090	188600	Dug well	4.1	DTB Unknown	Unknown	N/A	to within 50m	0.87
2617NEW291	278050	188660	Dug well	5.8	DTB Unknown	Unknown	N/A	to within 50m	1.27
2617NEW292	277460	187960	Dug well	8.8	DTB Unknown	Unknown	N/A	to within 50m	0.64
2617NEW293	276060	187180	Borehole	31.4	4.6	Unknown	21.8	to within 50m	1.30
2617NEW294	276340	187200	Borehole	17.7	DTB Unknown	Unknown	N/A	to within 50m	1.13
2617NEW229	275780	189510	Borehole	14	0	Unknown	27.28	to within 2km	1.70
2617NEW268	278320	188140	Borehole	38.1	0	Unknown	N/A	to within 2km	1.45
2619SEW219	277370	190860	Borehole	13.7	0	Unknown	54.6	to within 2km	2.71
2617NEW279	276540	184930	Borehole	25.3	DTB Unknown	Unknown	22.9	to within 5km	3.28
2617NEW205	278120	189710	Dug well	2.7	0	Unknown	N/A	to within 500m	1.96
2617NEW269	279100	186400	Borehole	6.2	Bedrock Not Met	Unknown	28	to within 2km	2.87
2617NEW318	278320	189200	Dug well	2.9	DTB Unknown	Unknown	N/A	to within 50m	1.77
2617NEW213	276090	185440	Dug well	7.3	0	Agricultural & domestic	12	to within 2km	2.86
2617NEW214	275960	186370	Dug well	7.6	0	Unknown	N/A	to within 2km	2.04
2617NEW215	275960	186290	Dug well	8.2	0	Unknown	N/A	to within 2km	2.11
2617NEW280	276600	184880	Borehole	37.5	0	Unknown	19.5	to within 5km	3.33
2617NEW314	278910	188940	Dug well	5	DTB Unknown	Unknown	N/A	to within 50m	2.17
2617NEW288	276790	189430	Dug well	3.2	DTB Unknown	Unknown	N/A	to within 50m	1.23
2617NEW281	277270	185240	Borehole	22.9	13.1	Unknown	57.5	to within 2km	2.98

2617NEW283	275420	188370	Borehole	21.6	Bedrock Not Met	Unknown	21.8	to within 50m	1.46
2617NEW226	276340	187070	Borehole	32	0	Unknown	18.55	to within 2km	1.24
2617NEW295	276740	186890	Dug well	5.5	DTB Unknown	Unknown	N/A	to within 50m	1.31
2617NEW296	277450	187970	Borehole	16.5	DTB Unknown	Public supply	N/A	to within 50m	0.63
2617NEW297	278020	187130	Spring	0	DTB Unknown	Unknown	N/A	to within 50m	1.57
2617NWW241	274520	189140	Borehole	49.7	0	Unknown	43.64	to within 2km	2.53
2617NWW242	274530	189050	Borehole	13.4	0	Unknown	87.3	to within 2km	2.49
2617NEW201	275470	187080	Dug well	3.7	0	Unknown	N/A	to within 500m	1.79
2619SEW221	278360	190910	Dug well	2.4	1.8	Unknown	21.8	to within 2km	3.10
2617NEW277	275760	188470	Borehole	21.6	0	Unknown	21.8	to within 1km	1.14
2617NEW278	275760	188400	Borehole	42.1	0	Unknown	40.8	to within 1km	1.12
2619SEW223	277090	190760	Dug well	6.4	6.4	Unknown	17.5	to within 2km	2.57
2617NEW220	276250	185260	Borehole	11.6	0	Agricultural & domestic	27.3	to within 2km	3.00
2617NEW224	276210	185310	Borehole	13.1	0	Agricultural & domestic	27.3	to within 2km	2.96
2617NEW307	277970	189730	Dug well	2.7	DTB Unknown	Unknown	N/A	to within 50m	1.89
2617NEW245	277070	187870	Borehole	37.5	7.6	Unknown	32.73	to within 2km	0.39
2617NEW246	278480	189900	Borehole	50	0	Unknown	38.19	to within 1km	2.35
2617NEW247	277440	187900	Borehole	49.7	0	Unknown	16.37	to within 2km	0.65
2617NEW216	276180	186390	Dug well	5.8	0	Unknown	N/A	to within 2km	1.93
2617NEW300	275990	186430	Dug well	5.2	DTB Unknown	Unknown	N/A	to within 50m	1.97
2617NEW211	278300	188260	Dug well	7	0	Unknown	N/A	to within 2km	1.43
2617NEW208	275870	188360	Borehole	17.1	12.2	Unknown	43.64	to within 2km	1.01

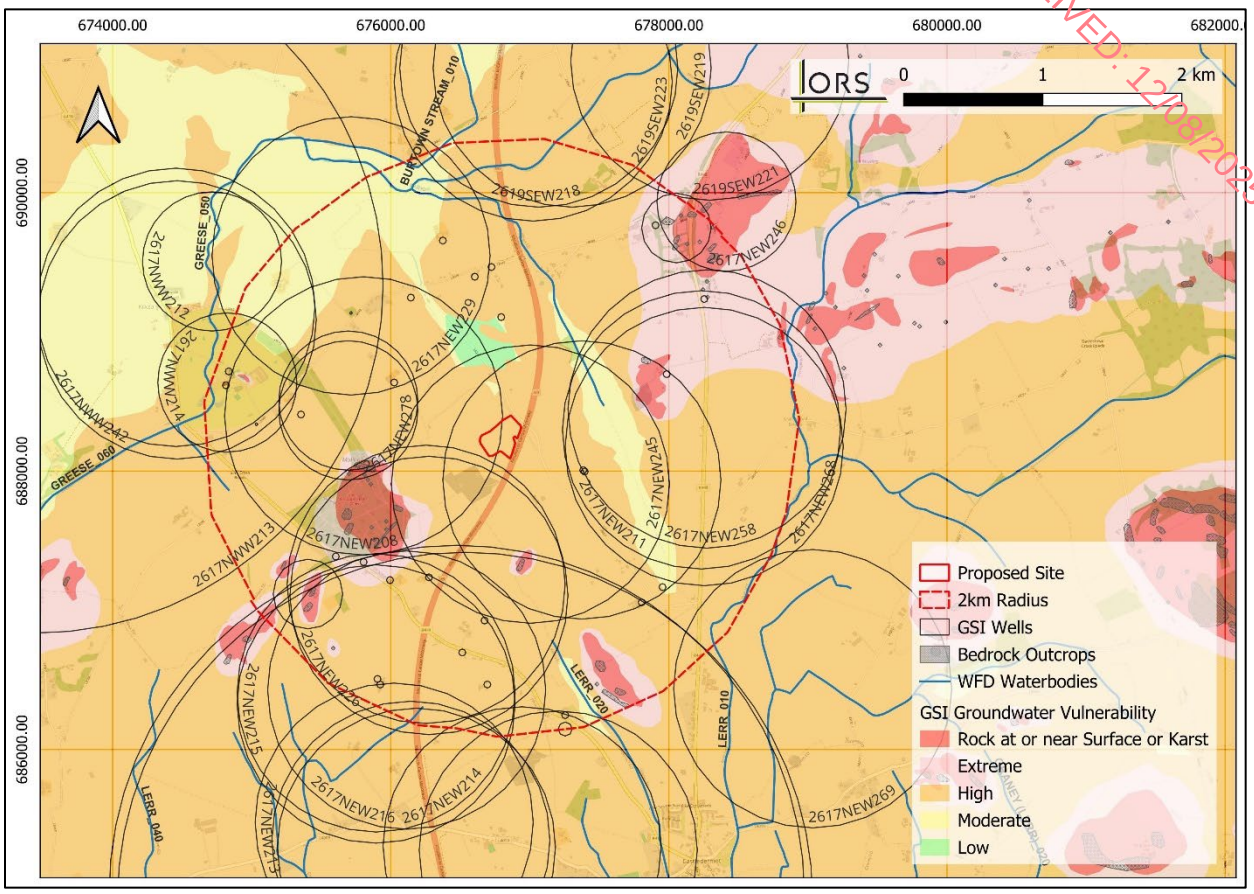

Figure 7.10: Groundwater Vulnerability and location of Groundwater Wells within the 2km study area (GSI Spatial Resources)

Karst Features

Examples of karst landforms are scarce throughout county Kildare. Karstic features are not common in this region due to the underlying igneous rocks, sandstones, greywacke and shale which occur throughout much of the county. A number of karstic features occur to *ca.* 13km west of the site, beyond the Kildare border in county Laois, where the underlying bedrock consists of Dinantian Pure Bedded Limestones, see **Figure 7.11** overleaf.

Karst areas are characterised by landforms of dissolution. Karst aquifers can be particularly vulnerable to pollution and karst features can also give rise to flooding. **Figure 7.11** depicts the approximate location of karstic features relative to the location of the proposed site. There are no karstic features located within the proposed boundaries of the Proposed Development or within the immediate vicinity of the site. There are no karstic features located within the 2km study area.

The closest Turlough can be found *ca.* 50.1km southwest of the proposed site. County Kildare contains no documented karst features. Tracing of underground flows from an enclosed depression to boreholes has been undertaken by GSI and indicates interconnectivity between karst features *ca.* 30km to the northwest of the study area. This flow occurs in a northwest direction, away from the Proposed Development. As shown in **Figure 7.11** overleaf, karst features and traced groundwater movements do not occur within the 2km study radius.

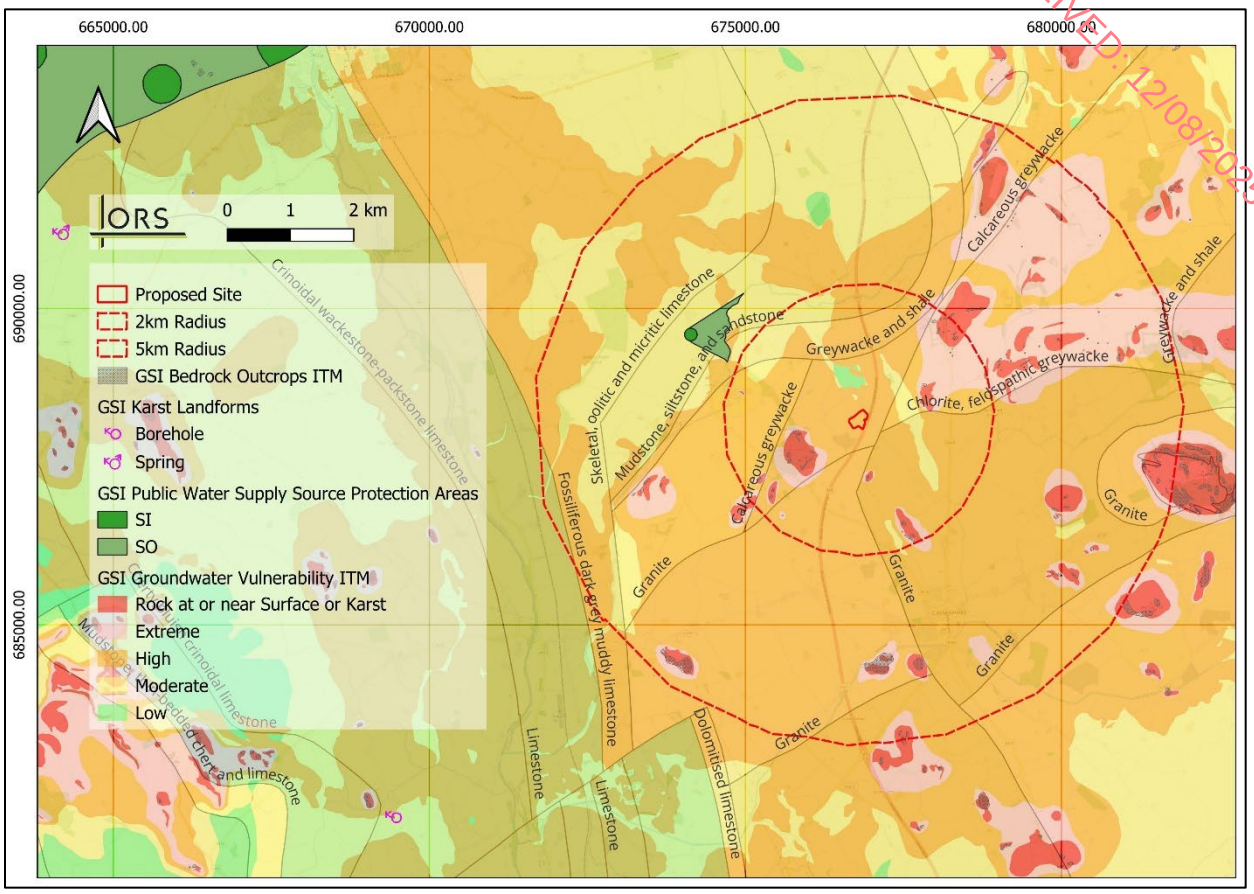

Figure 7.11: Groundwater Vulnerability, Bedrock Outcrops and Groundwater Source Protection Areas Overlaying (labelled) Regional Bedrock Formations and Outcrop Extents (GSI)

Mineral Aggregate Resources

There are no active quarries on or adjacent to the Proposed Development. An inactive quarry / pit is located *ca.* 785m south of the Proposed Development, which is currently not listed on the GSI database or the Irish Quarry Directory. The access road which bounds the site to the north and east also facilitates access to this aforementioned quarry / pit. The nearest active quarry recorded on the GSI's online database is Ballitore Pit (KE002) operated by KTK Sand and Gravel Ltd. located *ca.* 8km northeast of the site in Ballitore (Ballytore), Kildare where mortar sand, washed sand, washed drainage pebble, natural building stone are processed.

There are no active mineral localities within the 2km study area. Within the wider region several non-metallic mineral localities are identified. The closest of these localities is located *ca.* 3.8km to the south and granite is identified as the key mineral.

Radon

Radon is a naturally occurring radioactive gas formed by the radioactive decay of uranium and thorium which may be present in varying quantities in rocks, soils and groundwater. Classified by IARC (International agency for research on cancer) as Group 1 - carcinogenic to humans - Radon is second only to smoking as the leading cause of lung cancer. It is estimated that some 250 lung cancer cases each year in Ireland are linked to radon exposure and accounts for more than half of the total radiation dose received by the Irish population (EPA, 2016). The

acceptable level, or Reference Level, for homes and schools in Ireland is 200 becquerel per cubic metre (Bq/m^3). For workplaces the Reference Level is 400 Bq/m^3

Consultation with the EPA's online Radon Map (gis.epa.ie) shows a prediction of the number of homes in a given grid square that exceed the national Reference Level (200 bequerel per cubic metre (Bq/m^3)). Grid squares in which the predicted percentage of homes is greater than 10% are called High Radon Areas.

The EPA's Radon Map shows that the site is located across a Moderate Radon area, with approximately 10% of houses in the vicinity of the site estimated to have radon levels above the Reference Level respectively, pockets of High Radon (20%) and Low Radon (5%) areas also occur within this wider Moderate Radon region. As such all-office and canteen structures on site should be fitted with radon barriers to minimise staff exposure. Testing of radon in the workplace is a legal requirement in these zones.

Seismic Activity

No seismicity data is available from GSI online resources. Seismic activity is recorded by the Irish National Seismic Network. The Geophysics Section of the School of Cosmic Physics, Dublin Institute for Advanced Studies, has been recording seismic events in Ireland since 1978. **Figure 7.12** overleaf illustrates historical and recorded seismic events since 1980. Ireland is not considered an area to be of high seismic risk. As can be seen below, there is no significant seismic activity recorded within the vicinity of the Proposed Development.

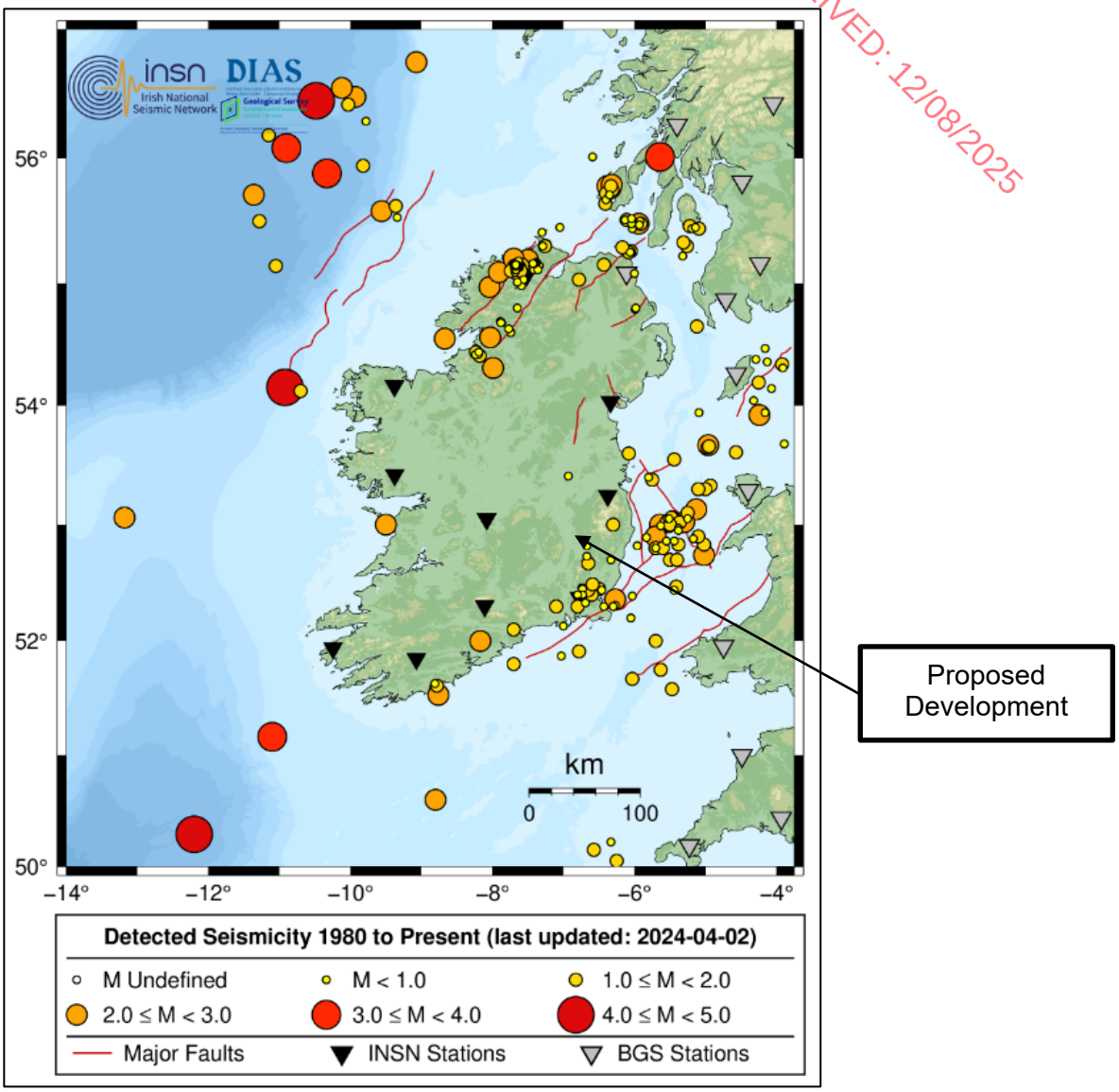

Figure 7.12: Recorded seismic activity in Ireland since 1980.

7.4.6 Soils and Subsoils

Soils can be referred to as topsoil or subsoil. Topsoil is the active layers at ground level where living organisms are found. Changes in soil characteristics are delineated in “horizons”. Topsoil is referred to as horizons ‘A’ and ‘B’. A typically refers to the uppermost layer in mineral soils and corresponds closely with the so-called 'surface soil’, whilst B lies immediately beneath the A and corresponds closely to the so-called 'sub-soil' (or C horizon), possessing some of the properties of both A and C horizons. The ‘C’ horizon, the subsoil, is the loose uncemented (unlithified) sediments present between the soil ‘B’ horizon and bedrock.

Regional Soil and Subsoil

The formation of soil is dependent upon geology, climate, vegetation, altitude, and landform shape. Soil landscapes found in Ireland are a consequence of the changing climatic conditions over the last 100,000 years (the last glacial age was *ca*.12,000 years ago) and the

management of land by farmers.

The soils in Co. Kildare are mainly derived from a mixture of non-calcareous and noncalcareous, materials. The soils range from deep well drained mineral (mainly basic) (BminDW); shallow well drained mineral (mainly basic) (BminSW); mineral poorly drained (mainly basic) (BminPD); shallow poorly drained mineral (mainly basic) BminSP; shallow well drained mineral (mainly acidic) (AminSW); alluvial (mineral) (AlluvMIN); deep well drained mineral (mainly acidic) (AminDW); mineral poorly drained (mainly acidic) (AminPD); shallow poorly drained mineral (mainly acidic) AminSP; shallow, rocky peaty/ non-peaty mineral complexes (mainly acidic) (AminSRPT); peaty poorly drained mineral (mainly basic) (BminPDPT); shallow poorly drained mineral (mainly basic) BminSP; made ground (made); fen peat (FenPt); cutaway/ cutover peat (Cut) as shown in **Figure 7.13**

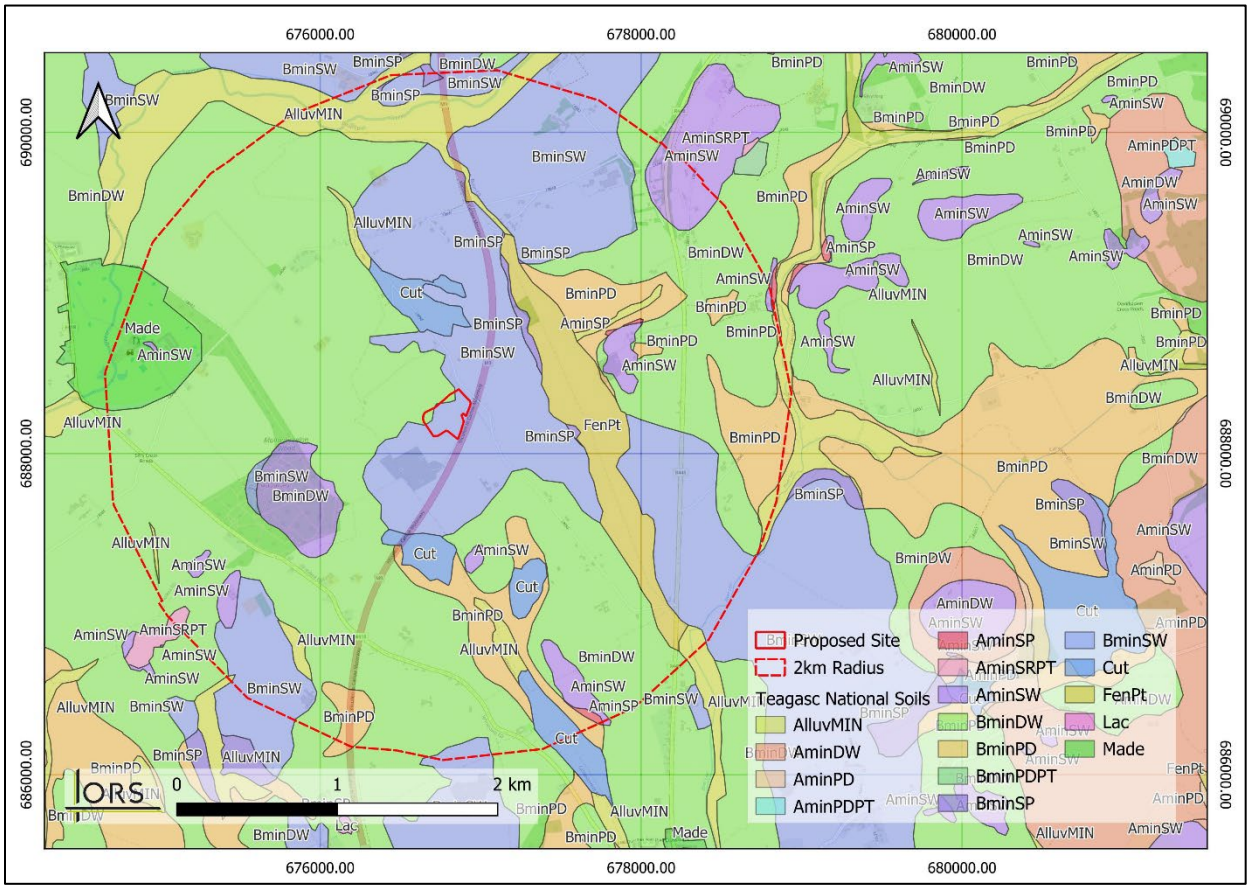

Figure 7.13: National Soils of South County Kildare (Teagasc)

Local Soil and Subsoil

GSI online mapping indicates that the majority of the site overlies shallow well drained mineral (mainly basic) (BminSW) soil derived mainly from calcareous parent materials. The soil groups associated with this category are renzinas and lithosols. A portion of the development located on the western and northern boundary is underlain by deep well drained mineral (mainly basic) (BminDW) soils derived from mainly calcareous parent materials. The soil groups associated with this category are grey brown podzolics and brown earths (medium-high base status).

A bedrock outcrop is noted *ca.* 750m southwest of the Proposed Development which occurs in

close proximity to a number of other bedrock outcrops. These outcrops occur in an area classified as belonging to the lithosols and regosols soil groups. A bedrock outcrop is also noted *ca.* 900m northeast of the Proposed Development in an area classified as belonging to the surface water gleys and groundwater gleys soil association.

The Irish Soil Information System (SIS) project has developed a national association soil map for Ireland at a scale of 1:250,000, together with an associated digital soil information system, providing both spatial and quantitative information on soil types and properties across the country. This resource groups similar soil groups together into 11 soil 'Great Groups' and associated 'Sub-Groups', allowing for the taxonomical classification of soil types throughout Ireland.

The entirety of the site overlies the Elton Series (1000c). Under the SIS classification system, this soil group is 'Luvisol' and the soil sub-group is classified as '1000 -Typical Luvisols'. **Figure 7.14** illustrates the soil associations in the study area and wider region as well as their drainage status, texture and approximate depth (mm).

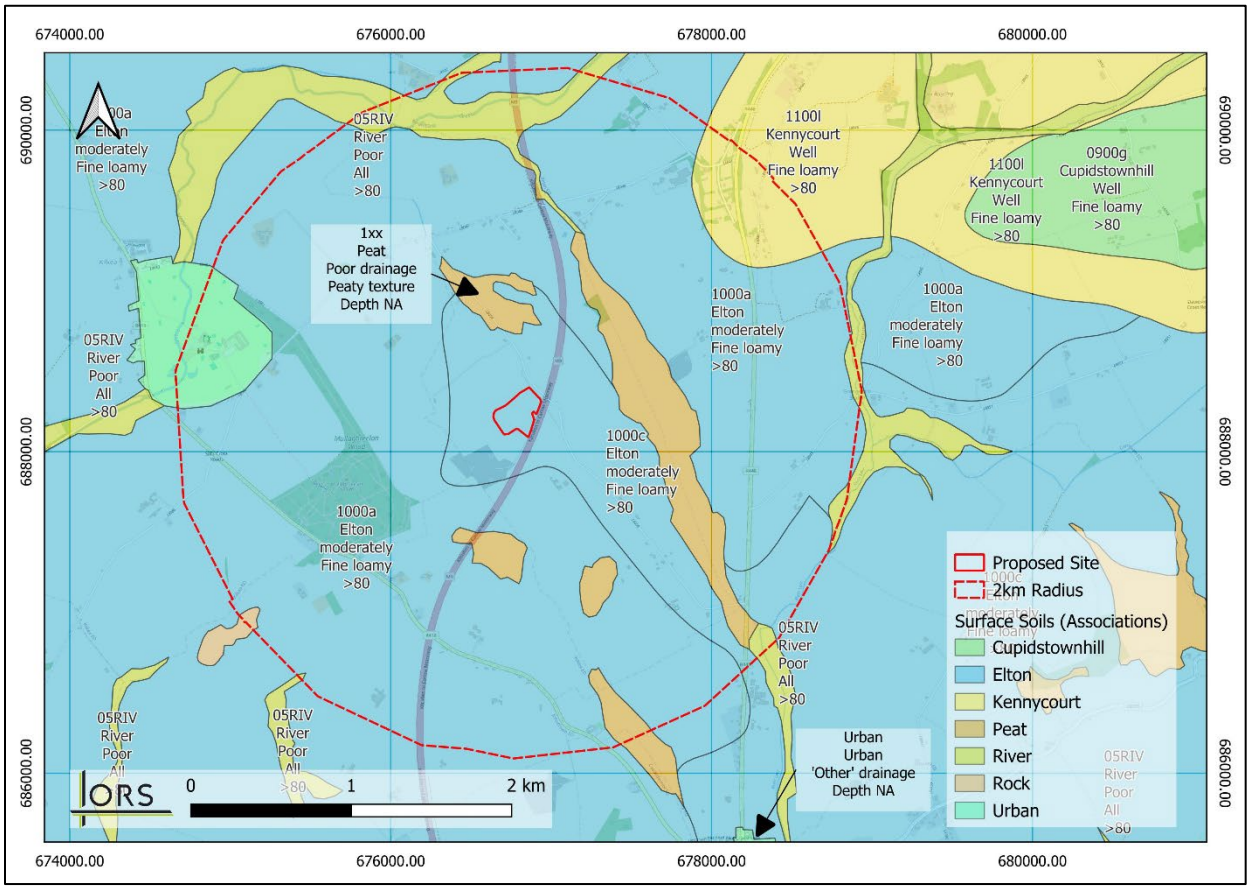

Figure 7.14: Soil Associations within proximity of the site (EPA and Teagasc)

The Teagasc representative soil profile description for the 'Elton (1000c)' series notes it as having a fine loamy texture. The modern definition is fine loamy drift with limestones.

The Ap horizon (0 – 25cm) is noted as containing few 2 – 6mm stones of sandstone and limestone with a loamy texture. Note: The "p" refers to a type of A horizon that has been disturbed by human activity, typically plowing or cultivation. It is non-cemented and non-

compacted with a firm consistency, is sticky and slightly plastic. An abrupt, smooth boundary distinguishes the Bt horizon (25 – 60cm) beneath. Note: The "t" stands for "translocated," indicating an accumulation of clay that has moved from other soil horizons. Lower horizons (Bt) and C (60 - 120cm) are noted as having an increasing proportion of stones, an increasing stickiness and packing density.

A detailed representative soil profile description from the Teagasc SIS database of the 'Elton' soil series is included in **Appendix 7.1**. This representative soil description available for the 'Elton' series is taken from a site in Kilkenny and so will differ somewhat from the soils at the proposed site in Ballyvass, Co. Kildare.

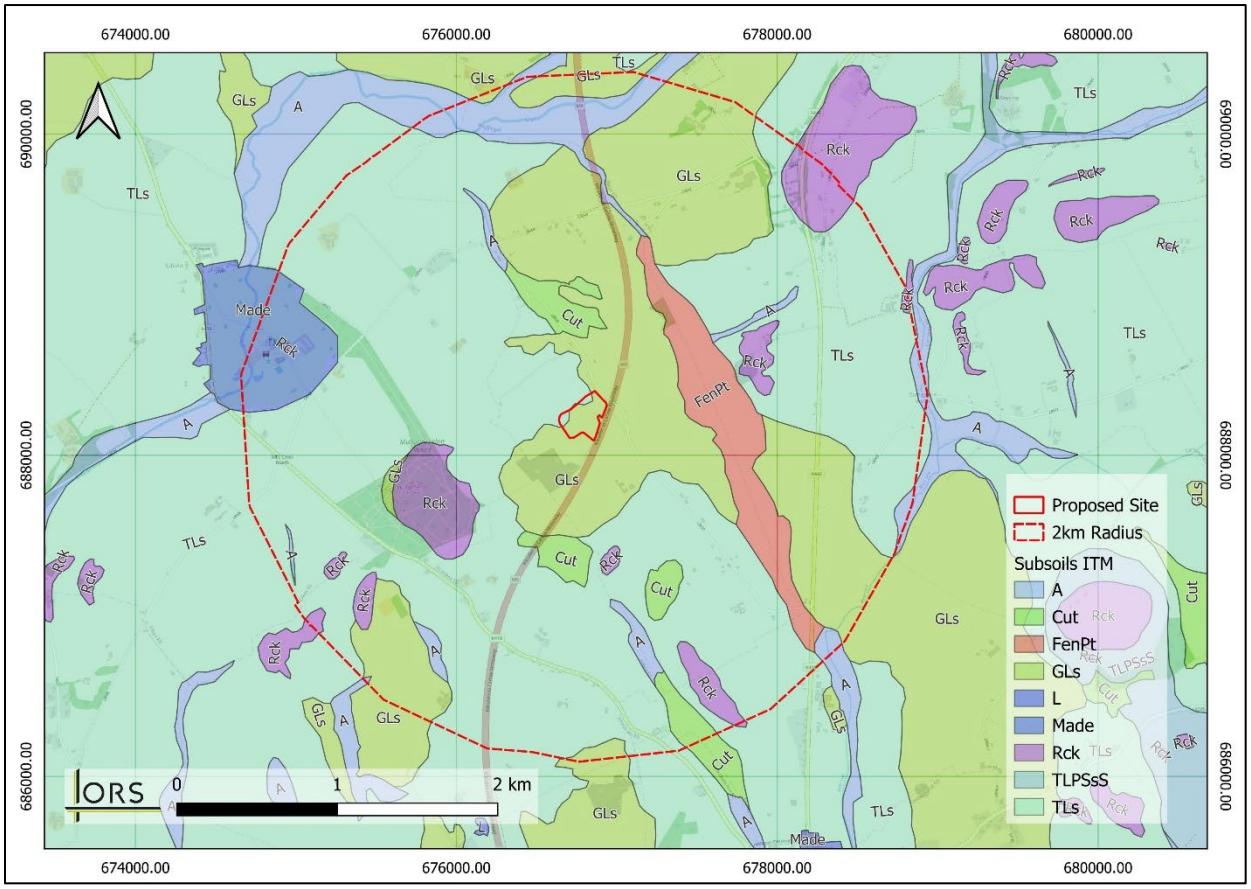

Figure 7.15 Teagasc Subsoil Map detailing subsoil types underlying the site (Teagasc)

The EPA databases indicate that the majority of the site overlies subsoils with parent material consisting of till derived chiefly of gravels derived from limestones (GLs). The till is described as diamicton, which relates to its terrigenous sediment that is unsorted to poorly sorted and contains particles ranging in size from clay to boulders, suspended in an unconsolidated matrix of mud or sand. This unsorted matrix is due to glaciation. A portion of the west and north of the site is underlain by subsoils with parent material consisting of till derived chiefly from limestone (TLs). The subsoil in the areas delineated as alluvium (A) are described as having undifferentiated alluvium subsoils.

The existing site is used for agricultural purposes and due to its topography is suited to pastural grazing and silage production.

Licensed Sites

A review of the Environmental Protection Agency (EPA) and Department of Communications, Climate Action and the Environment (DCCAE) website for existing and historic, licensed and illegal waste activities, mines and industries was carried out to identify any potential contamination sources present in the area and to identify any potential contaminating activities near the Proposed Development. The desk study indicated that no illegal waste activity sites were present within a 2km radius of the proposed area. A licensed Integrated Pollution Prevention Control (IPPC) facility is located *ca.* 8km southeast of the Proposed Development. Details of the facility are outlined in **Table 7.7** overleaf. Assessment of historic orthographic maps show that the site has historically been agricultural greenfield. Assessment of historic maps from the period of 2006 – 2012 show the establishment of the M9 motorway to the east of the proposed site and improvement of roads in the vicinity of the site. The site layout and environs have not changed significantly since this period.

No previous applications for permission on the site have been submitted. The details of significant licences granted in the area of the development are outlined in **Table 7.7**.

Table 7.7: Licensed Integrated Pollution Prevention Control (IPPC) Facilities and Industrial Emissions License applications (EPA Maps)

Licence Number	Major Class of Activity	Distance from site	Name	Licence Status
P0290-01	Industry	2.9km SE	Kelly Coachbuilders Limited	Surrendered
P1009-01	Industry	8km SE	Waddock Composting Facility Designated Activity Company	Licensed

There are no active IPPC licensed sites located within a 2km radius of the Proposed Development. To the southeast *ca.* 2.9 km is Kerry Coachbuilders Ltd. that is licensed under major class of activity 3.9: Metals. This license status is currently surrendered. Another facility is located *ca.* 8km to the southeast beyond Castledermot and a composting facility classified under the activity 11.4(b)(i): Waste. It is not foreseen that any these licensed facilities will have an effect on the Proposed Development.

There are no mapped current licensed/ unlicensed or historic waste facilities/ dump sites within the immediate vicinity of the Proposed Development. The closest facility is located *ca.* 7.8km northeast of the Proposed Development to the east of Ballitore. The site is a waste facility (W0310-01) with a current license status of “Applied” with the application date being 22/10/2021. According to EPA correspondence, permission for the facility has not yet been granted or refused as of 08/10/2024. A facility is located *ca.* 10.3km southwest of the site and is a licensed waste facility (W0158-01). A facility is located *ca* 10.9km west of the site and is a licensed landfill (W0046-01). Another facility is located *ca.* 9.2km northwest of the site and is a licensed waste facility (W0175-01). Due to the significant distance (>15km) of other waste facilities in Co. Kildare to the Proposed Development it is not foreseen that these facilities will have an effect on the Proposed Development.

Historic Land Use

The historic maps, as summarised in **Table 7.8,** indicate no obvious sources of contamination based on previous land use within the proposed site. The 25-inch historic maps (1863-1924) indicate that the area in the immediate vicinity of the Proposed Development site consists of

agricultural lands. In subsequent maps of the area, the character of the area has been changed due to the establishment of the M9 motorway located along the eastern boundary of the site. The site location and the surrounding environs have historically been greenfield.

Table 7.8: Historical Land Use (https://webapps.geohive.ie/)

Date	Description
1837-1842	The proposed site occupies a number of agricultural greenfield plots. A number of residential/ agricultural units occur in the surrounding area and in the vicinity of the proposed development.
1863-1924	The site remains agricultural greenfield and has been consolidated to consist of 3 no. separate plots.
1995	The proposed site is greenfield. A number of the fields in the surrounding area have been consolidated. Extensive development is underway *ca.*1.5km to the west.
2000-2003	The proposed site is greenfield. The golf course *ca.*1.5km to the west is established. Excavation / groundworks appear to be underway *ca*. 140m southwest, which is related to the establishment of a sand and gravel pit.
2013-2018	The proposed site is greenfield. The M9 motorway adjacent to the eastern site boundary has been established and runs from north to south. Additionally, the overpass and access road located between the eastern boundary and the M9 motorway is established. The site appears much as it does today.

Landslides

The GSI's online landslide database indicates there are no historic landslides recorded on the site or within a 2km radius of it. The nearest recorded landslide is *ca.* 12.4km southwest of the Proposed Development adjacent to the N80 national road.

7.4.7 Ground Investigations

Ground investigation works were carried out by an ORS environmental scientist for the Proposed Development at Ballyvass on the 31st of January 2025, with trial pits dug at various locations throughout the site as shown in **Figure 7.16**. These investigations revealed geology and subsoil conditions on site that were somewhat inconsistent with the conditions indicated in the geological mapping. This is evident by, for example, the presence of loamy soils (sand, clay) in some trial pits, which may be a result of infilling during the construction of the M9 motorway adjacent to the east of the site.

The water table on site was observed to be high, with visible drainage to the drainage ditch located at the northwest of the site. Rainfall was high preceding the site investigations, combined with variations in soil permeability (highly permeable in the southeast and less permeable in the northwest), likely contributed to high water table and consequently ponding along the northwestern boundary. The saturation of soils is evident in mottling (TP01, TP03, TP04, TP05, TP06) and gleying of soils (TP06). The location and depth of the trial pits is shown on **Figure 7.16** overleaf, and details of each investigation location is presented in **Table 7.9**.

The depths of trial pits varied slightly from 1.9m to 2.8m below ground level (bgl). Bedrock was not encountered in any of the trial pits on site. As stated in **Section 7.4.2**, the site's topography peaks at 85.75m AOD along the southern boundary near TP02, gradually sloping northwards to a low of 79.31m AOD at TP04. The overall site gradient runs from south to north, becoming slightly more pronounced towards the southern and central areas, particularly in the vicinity of

the gas pipeline..

There was variation in the soil profile across all six trial pits. Some similarities between profiles were also noted. Soil profiles on site generally consisted of loose, non-cohesive material such as find sand or silty sand. Unstable, collapsible soils which exhibited frequent sloughing and caving was encountered, particularly where groundwater was struck.

The topsoil across all trial pits were observed to consist of a dark brown layer to a depth between 0.2 – 0.4mbgl, overlaying horizons which were observed to differ amongst the trial pits. At lower horizons, profiles consisted of loamy soils with gravels present (TP01, TP02). Clay soils alongside gravels with minor mottling and a high cobble component towards the final pit depth was encountered in TP03 beneath the proposed bunded area. Impermeable clays with mottling and cobble content, albeit to a lesser degree, was also observed in TP02 at lower depths. Topsoil in TP04 was observed to consists of dark brown gravelly earths with extensive gley soils beneath, which was similarly observed in TP05. TP06 consisted of gravelly, silty loamy soils which exhibited signs of mottling and an extremely fragile structure. The findings of the trial pits are presented in **Table 7.9** overleaf.

The underlying bedrock across the site is a Silurian dark grey slate. No bedrock was encountered in any of the six trial pits on site. Groundwater infiltration was encountered at 1.5mbgl in TP01 and at 1.1mbgl in Trial Pit 6 located to the north and west of the site respectively. The depths at which groundwater was encountered suggest a connection to surface drainage flow, given the flow observed at the northwest drainage ditch.

A site characterisation assessment (percolation assessment) was conducted by Coyle Environmental. A trial hole to a depth of 2.4mbgl was excavated at the northern extent of the site on the 31st of January 2025, with an examination being performed on the 2nd of February 2025. Bedrock was not encountered during the assessment. Groundwater ingress was observed at 0.9mbgl, refer to **Appendix 7.2.**

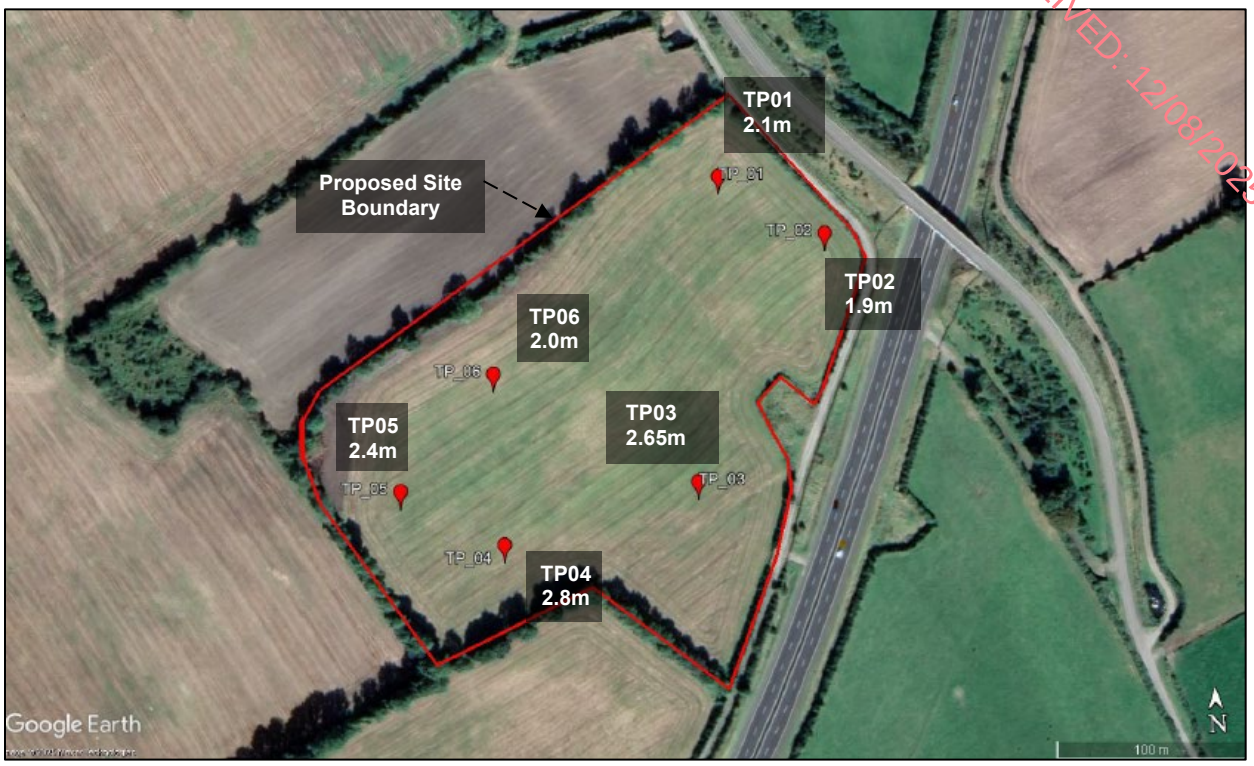

Figure 7.16: Location of Trial Pits (TP) and Site Characterisation Assessment

A summary of the soil profiles encountered during the ground investigation carried out as part of this report is given in **Table 7.9**.

Table 7.9: Ground profile for each Trial Pit

Location	Depth (m)	Ground Profile	Comments
TP-01	0.0 – 0.2 0.2 – 1.3 1.3 – 2.1 2.1	Topsoil – Dark Brown Earths. LOAMY/CLAY, gravel abundant, lighter brown colouring. – Site was likely infilled during construction of adjacent motorway. Dark LOAM mottling evident throughout layer, abundance of rounded large cobbles. GW observed @ 1.5mbgl, high recharge Unstable, collapsible soils. End of TP @ 2.1mbgl.	Trial Pit located at proposed entrance of the site, near to the suggested location for the WWTP. No Bedrock encountered. Groundwater encountered at 1.5mbgl.
TP-02	0.0 – 0.2 0.2 – 0.9 0.9 – 1.9 1.9	Topsoil – Dark brown, slightly aggregated silty SAND with some organic content. Dry, with no significant cohesion. Very thin transition layer of light brown to yellow/orange material, possibly iron oxidised. Light Grey Gravelly Silt. Light grey to darker grey SILTY GRAVEL with high gravel content and some small to medium cobbles. Slightly wet, with excavation walls collapsing due to low cohesion. End of TP @ 1.9mbgl.	No Bedrock encountered. No GW encountered. Highly permeable soil, consistent with desk study indicating a gravel aquifer above a poor bedrock aquifer. Wet conditions likely due to recent rainfall infiltration.

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TP-03	0.0 – 0.4 0.4 – 0.1 1.0 – 2.65 2.65	Topsoil - Dark Brown Earths, dry and loose silty SAND with some organic material. Light brown to grey compacted CLAY with sparse orange mottling, indicating some oxidation. Moist to wet conditions suggest reduced drainage and possible seasonal water table presence. Dark brown, moderately compacted silty GRAVEL with high gravel content and occasional cobbles. End of TP @ 2.6mbgl.	Trial Pit located at the bunded area. No Bedrock encountered. No GW encountered.
TP-04	0.0 – 0.3 0.3 – 0.55 0.55 – 1.55 1.55 – 2.8 2.8	Topsoil – Dark brown, dry and loose silty SAND with some organic matter. Transition layer – Light brown to grey, compacted GRAVEL with clayey matrix. Presence of fines suggests poor sorting. Light brown CLAY with high orange mottling throughout. Compacted and dry with collapsing walls, indicating low cohesion and possible evidence of seasonal wetting and drying. Dark brown, compacted and wet GRAVELLY material with fine content. Impermeable sticky Groundwater Gley (characterised by grey colour and upper layers are oxidised & typical brown) End of TP	No Bedrock encountered. High gravel presence and occasional small cobbles noted throughout all horizons. One side of the pit was noticeably drier than the other, suggesting variable drainage.
TP-05	0.0 – 0.2 0.2 – 1.0 1.0 – 2.4 2.4	Topsoil – Dark Brown Earths. Dry and loose silty SAND with some organic matter. Light brown, moderately compacted, wet GRAVEL with a mixed sand and clay matrix. Some orange mottling present, indicating minor oxidation and variable drainage. Dark brown to grey, compacted and wet GRAVELLY material with small to medium cobbles. End of TP.	No Bedrock encountered. No GW encountered.
TP-06	0.0 – 0.2 0.2 – 1.2 1.2 – 2.0 2.0	Topsoil – Dark brown, moderately dry and loose silty SAND with some organic matter. Unstable, collapsible gravelly lighter silty SAND, small signs of mottling. The sand matrix is poorly cohesive and saturated at depth, indicating groundwater influence. Groundwater strike @ 1.1mbgl. Unstable, collapsible darker brown soil, cobbles/ small boulders present. End of TP.	No Bedrock Encountered. GW encountered at 1.1mbgl Water accumulation observed at the base of the pit confirms high permeability and shallow groundwater conditions.

7.5 Likely Significant Effects

The assessment focuses on predicted effects in relation to soils and geology. The assessment relates to effects occurring during both the construction and operational phases of the development.

For a risk from ground contamination to exist, a contaminant source, pathway for migration and viable receptor must exist. The presence of all three of these elements is known as a 'pollutant linkage'.

Based on the dataset obtained during the desk study, intrusive site investigation, and anecdotal evidence collected, the following risk assessment has been carried out. This identifies the relevant sources, pathways and receptors (pollutant linkages) and assigns a qualitative risk classification of 'Positive, Neutral or Negative/ Adverse' risk to the identified Potential Pollutant Linkages (PPLs).

The likely potential pollutant linkages identified as a result of this assessment and specific for the site have been provided in the initial Conceptual Site Model (CSM). The model has been based upon the site setting at the time of the assessment, the land use (current and reasonably foreseen future use) of the surrounding area and the state of what the proposal is (i.e. development, ongoing use, etc.).

As well as identifying the potential pollutant linkages the model includes a preliminary assessment of risk based upon the probability of effect and the likely severity of effect in the context of the site setting and proposed future site use.

The criteria used for the risk assessment classifications in this report is detailed in the EPA guidance notes 2022, **Table 1.1** of **Chapter 1** in this report, and in the *CIRIA Report 552*.

7.5.1 Do-Nothing Scenario

If the Proposed Development does not proceed there would be no additional effect on the local soil, geology or geological heritage. The current rate of surface water percolation and runoff would continue to operate in its natural state.

Under the 'Do Nothing' scenario there would be no change to the current land use of the site which would remain as agricultural land.

In implementing this 'Do-Nothing' alternative, an Anaerobic Digestion Facility would not be developed and there would be no changes made to existing land-use practices. The site would likely continue to be used for agricultural grazing. Agricultural manures and slurries will be sourced from agricultural operators within a 15km radius of the Proposed Development. In the 'Do-Nothing Scenario' these agricultural wastes would not be treated locally through the AD process. Untreated and unpasteurised manures and slurries would continue to be applied direct to land at current volumes, with the continued addition of chemical fertiliser. Furthermore, the associated CH_4 emissions would not be captured within the AD process.

7.5.2 Receptor Sensitivity

The sensitivity of the receptors identified during the study of soil and geological features within the vicinity of the site are summarised in **Table 7.10** overleaf.

Table 7.10: Receptor Sensitivity

Receptor	Receptor Importance	Receptor Sensitivity	Rationale
Topsoil	Local Level	Low	The local topsoil is a dark brown earth which is in abundance within development site. The site topsoil contains no known pollutants. The soil is of poor agricultural quality, being a poorly-drained mineral soil and would not be a highly sought-after topsoil for any infill agricultural lands.
Underlying Deposits	Local Level	Low	The development has been designed to utilise the existing site topography as far as possible **(231239-ORS-ZZ-00-DR-CE-490),** minimising the disturbance to the subsoil to achieve the desired site levels. Where possible, to minimise quantities of excavated materials being removed from site, excavated materials will remain on site and be utilised for the provision of an earthen berm, for landscaping and as infill material. The deposits underlying the majority of the site are described as gravels. The portion to the west and north of the site is described as till. Both deposits are derived from limestone parent material which is in abundance within the wider area. The proposed development site is located across a GSI designated lowlands with a varying range in soil depth from shallow to deep. Site investigations revealed underlying deposits to consist of gley soils with a high-water table and the presence of some cobbles.
Bedrock Geology	Regional Level	Moderate	The underlying bedrock is characterised as medium and fine-grained greywackes and shales. Karst features have not been recorded within the site vicinity and are scarce throughout county Kildare. Bedrock was not encountered during trial pit investigations, up to depths of 2.8m bgl. The underlying aquifer is classified as being a locally important gravel aquifer.

7.5.3 Sources - Construction Phase

The Proposed Development will result in the establishment of the site across existing elevations ranging from 79.81m OD to 84.17m OD. Proposed finished floor levels range from 81.5m OD to 82.5m OD, with the Reception Hall and processing areas located at 81.6m OD and all Digesters and Pasteurisation Tanks at 81.5m OD, as shown in **Figure 7.17**. Given the sites current topography this will involve limited earthworks to both cut and fill the site to a level base upon which the development can be constructed.

The construction phase is likely to yield the most potential effects on the surrounding land, soil and geology. Potential construction phase effects are considered in detail below and summarised in **Table 7.11** overleaf.

Table 7.11 – Severity/ Magnitude of Effect during construction phase

Receptor	Potential Environmental Effects	Quality	Significance	Duration
Topsoil	Topsoil Removal	**Negative**	**Slight/ Moderate**	**Reversible**
	Site Entrance and Gas Injection Point	**Negative**	**Slight**	**Temporary**
Underlying Deposits/ Subsoil	Construction of Built Structures	**Negative**	**Moderate**	**Long-term**
	Excavation/ Subsoil Removal	**Negative**	**Moderate**	**Permanent**
	Geological Sensitivities and Harmful Substances	**Not Significant**		
	Attenuation Tanks	**Neutral**	**Moderate**	**Long-Term**
	Attenuation Pond	**Negative**	**Neutral**	**Permanent**
	Contaminated Soils	**Negative**	**Not Significant**	**Temporary**
	Site Entrance and Gas Injection Point	**Negative**	**Slight**	**Permanent**
Bed Rock Geology	Excavation of Bedrock	**Negative**	**Significant**	**Permanent**

Figure 7.17: Site layout with proposed and existing site levels (Drawing No: 231239-ORS-ZZ-00-DR-AR-200)

The following sections outline the potential effects to Land, Soil and Geology posed by the proposed excavation and infilling of the site.

Geological Sensitivities and Harmful Substances

Ground works at the site location will be necessary to facilitate the Proposed Development. Thus, the risk of activities which could contribute to increased levels of materials in groundwater sources which have deleterious effects on human health has been considered. This section considers geological sensitivities such as naturally occurring asbestos (NOA) and arsenic. Typically, incidences where naturally occurring asbestos (NOA) has been reported in Ireland relate to landfill or quarrying activities as in the case of Ballinclare Quarry, Kilbride, Co. Wicklow *ca.* 48km east of the site. However, neither of the aforementioned activities are relevant to the Proposed Development. No records of NOA were noted during the course of the investigations undertaken for the completion of this report or in available information relating to the closest quarry site which is located *ca.* 785m southwest of the site which is not listed on either the Irish Quarry Directory or the GSI Spatial Resources database. No records of NOA were noted for the closest listed quarry, being the Ballitore Pit *ca.* 7.9km to the northeast.

Regarding elevated levels of arsenic and heavy metals, pathways for human exposure have been proposed to have occurred due to excessive land disturbance activities such as quarrying or migration of liberated metals (potentially via reaction with existing ores) via groundwater pathways. It should be noted that the closest groundwater source protection zone is >2km from the Proposed Development.

Arsenic is not persistently elevated in groundwater throughout Ireland. However, regional studies have indicated that in several areas elevated arsenic concentrations in ground water are associated with Silurian and Ordovician metasedimentary formations, while a national study indicates that the Sandstone and Shale (Greywackes) rock units being primarily associated with elevated arsenic in groundwater (the metasedimentary formations belong to the Sandstone and Shale (Greywackes) group) of which the site Proposed Development overlies[1].

Regarding arsenic and heavy metals, there exist incidences where arsenic or heavy metals have been identified in public water supplies in County Kildare, such as in the Kilteel PWS, *ca*. 39.7km northeast of the site. Given the proximity of this incidence and a lack of evidence of similar occurrences in the vicinity of the proposed development, the risk of arsenic or heavy metals within the vicinity of the Proposed Development is considered to be ***not significant***.

As outlined throughout this EIAR, including **Chapter 8 – Hydrology & Hydrogeology**, the drainage report and CEMP, mitigation measures for protecting groundwater receptors during both the construction and operational stages of the Proposed Development have been presented. These measures include pre-construction trial pit investigations to ascertain soil depth throughout the site as well as backfilling and landscaping of any temporary excavation works as soon as possible. During the operational phase, the site will be bunded, with hardstanding established for offloading areas. No process water will be discharged off-site and ongoing monitoring of stormwater discharge to the Ballynamoney Stream will be undertaken. Thus, the risk of pathways which could exacerbate or contribute to increased levels of the aforementioned minerals and heavy metals in groundwater sources are minimised and the risk is considered to be ***not significant.***

Topsoil Removal

The initial phase of construction will involve the removal and stockpiling of the topsoil. The pre-

[1] https://www.sciencedirect.com/science/article/abs/pii/S0048969716326377?via%3Dihub

construction geotechnical site investigations conducted indicate a topsoil horizon of approximately 0.2m to 0.4m in depth of a dark brown, moderately dry silty and sandy topsoil underlain by loamy clay with evidence of mottling. This inert material will be stripped throughout the Proposed Development site and be stockpiled. The method of stripping will involve the use of a tracked excavator/ bulldozer along with the use of haul trucks.

Stockpiles in the absence of mitigation measures will be susceptible to erosion by climatic and hydraulic factors. Any excess topsoil will be removed from site and disposed of in accordance with current waste management regulations.

The most significant risk posed by the topsoil excavation is through the migration of silt, clay and other sediment off site through wind and water borne modes of transportation. If incorrectly stockpiled and under specific climatic conditions these sediments can find their way into nearby streams. In significant quantities they can pose a risk to aquatic life and result in degradation of water quality, as outlined in **Chapter 8: Hydrology and Hydrogeology**.

In the absence of mitigation, the removal and stockpile of topsoil would result in a ***negative, slight to moderate*** and ***reversible*** effect on soil.

Excavation/Subsoil Removal

Site investigations indicate a slight variation in the depth of the subsoil horizon which was observed to begin between 0.2m – 0.4m bgl. In Trial Pit 1 (TP01) the subsoil horizon was identified beginning at 0.2mbgl, with the topsoil overlaying a layer of loamy clay with abundant gravel and a comparatively lighter brown colour, before becoming darker at the lower horizon. Observations indicate that this portion of the site was likely infilled during construction of the adjacent M9 motorway. Groundwater with a high recharge was observed at 1.5mbgl.

Trial Pit 2 (TP02) demonstrated a similar composition of topsoil overlying a layer of loamy clay with a higher silt content and some grey/ orange mottling beginning at 0.2m bgl. Trial Pit 3 (TP03) was observed to consist of compacted gravelly clay beginning at 0.4m bgl, with comparatively less mottling and increasing cobble content at depth. In Trial Pit 4 (TP04) the subsoil horizon beginning at 0.3mbgl with a transition layer of compacted gravel with a clayey matrix. Subsoils consisting of mottled compacted, collapsible, dry clay was observed to overlie an impermeable groundwater gley soil, identified by the characteristic grey colouring and upper layer oxidisation. In Trial Pit 5 (TP05) similar mottling was observed beginning at 0.2mbgl although no groundwater ingress was observed. Trial Pit 6 (TP06) consisted of gravelly lighter silty sandy soils beginning at 0.2mbgl with some saturation at lower depths, indicating high permeability. Groundwater strike occurred at 1.1mbgl.

The development proposes retaining the general gradient of the existing topography. This will involve cutting into the existing topography, just to the west of the centre of site. It is hoped to utilise excavated onsite subsoil material where possible for infilling. Mechanical soil compaction will be undertaken to ensure soil stability throughout the site. Excess material will be transported off site for disposal.

The soils beyond *ca.* 0.4m below ground level have been found to be somewhat consistent throughout the trial pits, with presence of cobbles at increasing depth as well as showing signs of mottling and some gleying indicating a high-water table, particularly to the west of the site. The site contains a heterogeneous moderately sorted drift of primarily a dark brown loamy clay and gravels with sub-angular to round cobbles at greater depths. This till drift consists of silt

and clay-sized particles which respectively present a moderate and high susceptibility of becoming entrained in surface water run-off and/or to being blown out of a stockpile by moderate to strong breezes carrying a moderate to high risk of migrating into surface water receptors.

A site characterisation assessment (percolation assessment), **Appendix 7.2**, was conducted by Coyle Environmental from the 31st of January to the 2nd of February 2025 in order to establish the soil percolation rate on the site and thus to ensure an adequate wastewater treatment design for a discharge to groundwater system. The assessment indicated percolation rates of 33.00 min/25mm for Subsurface (depths greater than 400mm) and 36.00 min/25mm for Surface (ground level). Thus, the accompanying site suitability assessment concluded that the site is suitable to provide treatment for domestic sewage via discharge to groundwater which are suitable for development. The lower horizons of the subsoil (>0.4mbgl) were recorded as clay of a light brown colour, of medium compactness with a blocky structure. Further compaction of this layer during excavation and construction works is inevitable and may increase surface water run off due to reduced infiltration rates resulting in increased sediment erosion on site. The excavation of and exposure of the subsoil layer during the construction phase will result in an increased risk to the groundwater vulnerability, as outlined in **Chapter 8**.

The preliminary Cut and Fill calculations (refer to **Drawing No. 231239-ORS-ZZ-00-DR-CE-490**) for the Proposed Development indicate that a total of 26,372.90 cu. M of material is to be excavated, with 7,589.93 cu. M required to infill the site to the proposed final topography. This results in a net surplus of 18,782.97 cu. M which will be repurposed and redistributed on site in landscaping and earth berms within the site.

The importation of soil and stone increases the risk of introducing contaminated materials on site. Sourcing material from a licensed site that has undertaken ecological and environmental assessments and received all necessary permits/ licenses for the excavation of the material will be undertaken. All material will be transported to site using registered hauliers and records of material movements will be record in accordance with the waste legislation and guidance notes.

In the absence of mitigation, the extraction and reduction in the subsoil horizon / importation and alteration of the of subsoil horizons will have a ***negative, moderate*** and ***permanent*** effect on the subsoil.

Excavation of Bedrock

The GSI groundwater vulnerability maps have classed the entire site as overlaying an area of high vulnerability. Based off the groundwater vulnerability guidelines this would indicate a soil depth of *ca.* 1.5m to 8m towards the west and north of the site where subsoil permeability is described as moderate and a soil depth of *ca.* >2m across the majority of the site where subsoil permeability is described as high.

The site investigations did not encounter bedrock at depths ranging from 1.9m – 2.8m bgl Groundwater was encountered in three instances at 0.9m, 1.0m and 1.5m bgl in TP06, TP04 and TP01 located at the west, southwest and northwest of the site respectively. The findings of the site investigations indicate a high-water table across the site due to the presence of mottling and gleying in soils as well as groundwater strike.

A potential effect of the construction stage could be the exposure of the underlying bedrock.

Excavations of up to 2.49m bgl will be required to reach the finished floor level (FFL) of the Digesters (12, 13, 14, 15), Digestate Storage Tank (17). Excavations of up to 1.46m will be required to reach the FFL of the Reception Hall (06), west of bunded area (52). When excavation to FFL has been achieved, further earthworks will then follow to facilitate the construction of foundations and the installation of services/drainage infrastructure. Foundations of up to 2m below the FFL will be required along the structural outline of buildings.

It should be noted that the Digestion tanks (12, 13, 14, 15), Digestate Storage Tank (17), will all have a FFL of 81.5m OD. Foundations and hard core will be a further *ca.* 0.7m below the FFL. These structures are planned for the centre and south of the site which will require the most significant excavation works to achieve the desired FFL. Refer to the proposed Cut and Fill drawing in **Appendix 7.2** and relevant structural site layout drawings as referenced in **Section 2.2, Chapter 2 – Project Description**

In the absence of mitigation, encountering bed rock will have a ***negative, significant***, and ***permanent*** effect.

Site Access and Grid Injection Unit

A Grid Injection Unit (GIU) will be established on site which will facilitate the addition of upgraded biogas to the wider gas network, via the medium-pressure pipeline located within the site boundary of the Proposed Development. Thus, no excavations will be required to establish pipeline infrastructure on the proposed site. The GIU will be owned and operated by Gas Networks Ireland. Refer to **Section 2.2.20, Chapter 2 – Project Description** for a full description of the Grid Injection Unit.

During the initial stages of the construction phase, enabling works will consist of stripping and stockpiling of topsoil and subsoil at the proposed compound area, as outlined previously. Similarly, excavations are required for the construction the site entrance. Site access will be via the entrance located at the north of the site which will adjoin the local road which runs along the northern and eastern perimeter of the site.

Excavations of site may have an effect on the exposed soil and subsoil with implications for the soil surface with regard to stock piling and mobile plant. Any trenching along a road network will give rise to asphalt waste material. If unproperly managed these materials can pose a risk to the environment due to the presence of Polycyclic Aromatic Hydrocarbons (PAHs). PAHs are organic pollutants that persist in the environment and are considered potentially dangerous with side effects related to cancer development (A. Nagalli, 2015). Trenches will be backfilled shortly after excavation following the installation of each section.

At present a transmission pipe (high pressure) and a distribution pipe (medium pressure) is located beneath the proposed development and runs from the northwest to the southeast as indicated by GNI and shown in **Figure 7.18**. The route of the existing gas network within the site (indicated by the yellow hatched area in **Figure 7.17** in earlier section above) is proposed to have a minimum 14m buffer zone around the pipeline route where no construction is proposed on site, aside from formation of the yard area above.

During the design phase GNI were consulted with their Dial Before You Dig visiting the site to mark out the route of the pipeline and predict depth in advance of trial pit investigations. It was confirmed that pipeline is currently minimum 1.5mbgl. Prior to construction further consultation with GNI will be needed and pipeline/buffer areas clearly defined. Note, all works will be

undertaken in accordance with *Code of Practice for Working in the Vicinity of the Transmission Network. Procedure No: AO/PR/127 Rev 3 Date: May 2021.*

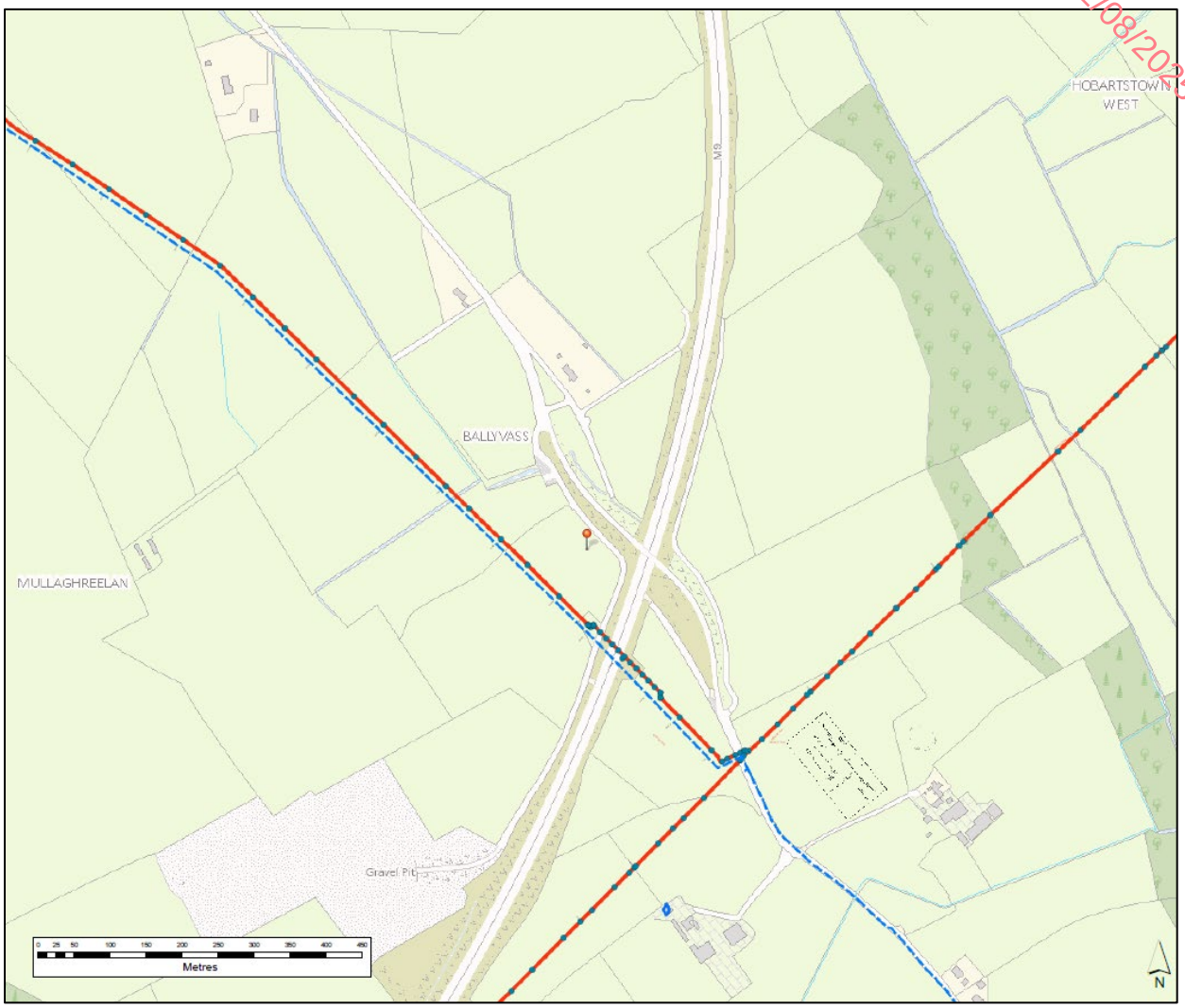

Figure 7.18: GNI gas transmission and distribution pipelines underlying the proposed development site.

In the absence of mitigation, excavations on site would have a ***negative, slight*** and ***temporary*** effect on the existing surface level materials and subsoil.

Construction of Built Structures

The construction of the Anaerobic Digestion Plant will result in the conversion of permeable soils to hard standing surfaces. This sealing/ capping of land has a long-term effect on the underlying soil's structure and function to the wider environment. It reduces the water infiltration to the underlying soil/ bedrock and alters the structure and functionality of the soil over time.

In total, the Proposed Development will result in the construction *ca.* 6,007 m^2 of hard standing, inclusive of built structures, internal plant areas and ancillary structures and concrete/ asphalt aprons. The construction of the built structures requires excavations of up to 2.49m below current ground levels. As is common practice with the construction of foundations a

compressed infill gravel base/ pad is required on top of which a concrete blinding is poured. Steel reinforcements will be installed, with shuttering erected around this to facilitate the final concrete pour. Infilling and compaction of excavations around structures is then conducted to ensure structural integrity. The infill material and concrete poses a risk of contaminating the subsoil and bedrock if installed in adverse weather conditions.

The use of plant and machinery during the construction stage will involve the use of hydrocarbon-based fuels and oils. There is a risk of contamination to soils and eventual percolation to the underlying bedrock. Hydrocarbons should be stored in bunded facilities, and the use of hydrocarbons should be contained to bunded areas with spills cleaned up immediately.

In the absence of mitigation, the effect of the construction of built structures would have a ***negative, moderate*** and ***long-term*** effect.

Attenuation Tanks

The Proposed Development includes the provision of two no. attenuation tanks designed to manage surface water runoff from roads, yards, roofs, and the impermeable bunded area. Two of the tanks are located centrally within the site, within the bunded area and near the silage clamps. Site investigations, which involved the excavation of trial pits to a depth of 2.8 mbgl, identified no presence of bedrock in these areas. The proposed design indicates that excavation for the installation of the tanks will not exceed a depth of 2.0 mbgl.

If inappropriately constructed, the attenuation tanks may pose a risk to the underlying aquifer. As such, it will be lined with an impermeable membrane to limit the risk of contaminants leaching into local subsoils and the underlying locally important gravel aquifer.

The attenuation tanks, if not properly constructed and in the absence of mitigation measures are foreseen to have potentially ***negative, moderate,*** and ***long-term*** effects on surface water bodies and on the underlying groundwater body.

Attenuation Pond

The Proposed Development includes the provision of one no. open attenuation pond designed to manage surface water runoff from the office and eastern service yard level. The attenuation pond is proposed to be located to the northeast of the site.

The soil on site comprises shallow, well-drained Podzolic and Brown Earth types. While naturally permeable, these soils may be suitable compacted or treated appropriately for forming a barrier to help retain water within the attenuation ponds. Using on-site material in this way could help mitigate the potential risk to the underlying bedrock aquifer, which may become more vulnerable due to the reduction in overlying protective cover during excavation.

No material will need to be imported to site in order to line the location of the proposed attenuation pond. Excavated material will be re-used on site and may be used in the construction of the proposed attenuation pond. As no importation of soil / clay material is required, the associated risk translocating invasive species and contaminated materials is **not significant**.

The construction of an attenuation pond will result in the degradation of the underlying soil

quality and ensure anaerobic conditions. On the contrary the wetlands will result in the addition of a new Fossitt designated habitat within the locality, FL8 “Other artificial lakes and ponds”. Its implied, if appropriately managed, wetlands will result in an increase in flora, fauna and biodiversity. It is proposed to install appropriate water tolerant planting on banks to promote biodiversity.

The constructing of the attenuation ponds is foreseen to have a ***negative-neutral*** and ***permanent*** effect.

Contaminated Soils

The excavation and construction activities will cause quantities of excavated materials to be reused on site or removed from site for disposal or recovery. The site is greenfield and has been so historically thus historical mapping data does not suggest any incidences of land use which might result in the contamination of soils. A geotechnical site investigation conducted at the site in December 2024 observed soils at the north to potentially consist of infill, arising from the construction of the adjacent M9 motorway. However, investigations did not detect any evidence of contaminated soils. It is not anticipated contaminated soils will be encountered during construction activities.

The construction management plan will include a set of procedures to be implemented in the incidence of contaminated soils encountered. Encountering contaminated soils would have a ***negative, not significant*** and ***temporary*** effect.

7.5.4 Sources - Operational Phase

The operational phase effects anticipated and considered throughout the lifetime of the operation of the facility are considered below and summarised in **Table 7.12** overleaf.

Table 7.12 – Severity/ Magnitude of Effect during operational phase

Receptor	Potential Environmental Effects	Quality	Significance	Duration
Topsoil	Nutrient Leaks	**Negative**	**Slight**	**Short-term**
	Land Spreading of Biobased Fertiliser	**Positive**	**Slight**	**Long-term**
Bed Rock Geology	Hydrocarbon Contamination	**Negative**	**Moderate/ Significant**	**Long-term**

It is not envisaged that there will be many potential sources of effects to soil, land or geology during the operation of the facility.

Nutrient Leaks

Accidental discharge, spills or leaks of digestate, sewage, nutrient rich liquids or solid wastes from the reception hall, digesters or wastewater treatment system could pose a risk to the local soil. Such nutrient rich substances have a high Biological Oxygen Demand (BOD) and would pose a risk to groundwater and bedrock aquifers by potential introducing microbial

contaminants and threatening aquatic life by consuming available dissolved oxygen in watercourses. The long-term threat to soil is considered to be less than hydrocarbons as such nutrient rich substances will be biodegraded in the soil and absorbed by flora. However, excessive volumes can be detrimental to soils by killing off the microbial and microorganism populations and stunting or killing plant growth by inhibiting the absorption of micro-nutrients. The overall effect is dependent on the volume and duration of such nutrient leaks.

In the absence of mitigation, nutrient leaks to the surrounding soil would have a ***negative***, ***slight*** and ***short-term*** effect.

Land Spreading of Biobased Fertiliser

Utilising biobased fertiliser (digestate) offers several scientific benefits over the continued use of raw manures, slurries, and chemical fertilisers. These include balanced nutrient availability, slow-release nutrients, improved soil health and a reduction in pathogens and weeds when compared to slurries and manures. These advantages support sustainable agricultural practices whilst simultaneously improving soil conditioning.

Balanced Nutrient Availability: Biobased fertiliser typically contains a balanced mix of essential nutrients, including nitrogen (N), phosphorus (P), potassium (K), and micronutrients crucial for plant growth. This balanced nutrient profile contrasts with chemical fertilisers, which often supply only specific nutrients. Studies have shown that the diverse nutrient composition of digestate supports comprehensive plant nutrition, contributing to improved crop yields and overall plant health (Möller and Müller, 2012). Digestate is particularly rich in ammonium nitrogen (NH4-N), a form of N that is readily available for uptake by plants (Doyeni et al, 2021).

Slow-Release Nutrients: Biobased fertiliser releases nutrients gradually over time as it decomposes in the soil. This gradual release mechanism ensures a sustained supply of nutrients to plants, contrasting with untreated manures, slurries, and chemical fertilisers, which can be prone to leaching or volatilisation. The slow-release nature of digestate reduces the risk of nutrient loss and enhances nutrient uptake efficiency by plants (Yao et al., 2011). Digestion of livestock slurry has also been shown to increase the plant availability of nitrogen in slurry by ca. 10%.

Enhanced Soil Health: Rich in organic matter, Biobased Fertiliser improves soil structure, promotes water retention and stimulates microbial activity. These soil health benefits contribute to improved nutrient cycling, root development, and overall soil fertility (De Vries et al., 2015).

Pathogen and Weed Reduction: Manure and slurry may contain a range of bacterial, viral, and parasitic pathogens and land application of these organic fertilisers typically occurs without prior treatment. In contrast, Anaerobic Digestion, and subsequent pasteurisation of digestate significantly reduces the presence of pathogens and weed seeds, making it safer for agricultural use compared to untreated manures and slurries (Vinnerås et al., 2006).

With an annual feedstock processing capacity of 90,000 tonnes, approximately 78,000 tonnes of whole digestate will be generated. Following treatment and separation, around 53,500 tonnes of liquid digestate (bio-based fertiliser) and 24,500 tonnes of solid digestate fibre will be produced

Post pasteurisation, the biobased fertiliser will meet the standard of an EU fertilising product

under Regulation (EC) No 2019/1009 under the criteria outlined for Product Function Category (PFC) 3 B: Inorganic Soil Improver. The proposed operator will apply for End of Waste Criteria.

All biobased fertilisers will be used in accordance with S.I. 113 of 2022 European Communities (Good Agricultural Practice for Protection of Waters) Regulations, 2022).

The spreading of the biobased fertiliser on the customer farms will be done in accordance with the specific Nutrient Management Plan for that farm.

If appropriately managed land spreading of biobased fertiliser has the potential to have a ***positive, slight*** and ***long-term*** effect on nutrient management and soil quality.

Hydrocarbon Contamination

It is proposed that the site will be frequented by numerous hauliers and farmers transporting both liquid and solid feedstocks for production of biomethane. There is a possible risk of vehicular accidents on the site which could result in the accidental release of hydrocarbons.

Mobile plant and fixed machinery are a potential source of contamination on site. Accidental leaks or spills of fuels and oils from hydraulics would be the source of such contaminants.

The 1,000L fuel tank is an obvious source of such contaminants and as such it will be bunded to comply with EPA guidelines.

Strict enforcement of traffic management measures, adherence to standard operating procedures (SOP's) for refuelling and regular inspection of bunds should eliminate the potential for such sources of contamination. On top of this the process area will be bunded which will further reduce the possibility of such chemicals making contact with the local soil and geology.

In the absence of mitigation, hydrocarbon leaks and spills would have a ***negative, moderate*** **to** ***significant*** and ***long-term*** effect.

7.6 Mitigation Measures and Monitoring

This section highlights the mitigation measures proposed for the operation and construction stages of the Proposed Development to mitigate potential effects to the near and wider environment.

7.6.1 Construction Phase

General Mitigation Measures

A Construction Environmental Management Plan (CEMP) will be prepared and implemented by the main contractor during the construction phase. This is a practical document which will include detailed procedures to address the main potential environmental effects on site, encompassing soil, geology, noise, dust, air quality, surface and ground water, and highlights the proposed construction methods, activities and procedures. Refer to the preliminary CEMP report submitted in conjunction with this EIAR (**Document No.: 231239-ORS-XX-XX-RP-EN-13d-010**). The implementation and compliance with the conditions of the CEMP will be overseen by the Project Supervisor Construction Stage (PSCS) and/or onsite Environmental or

Ecological Clerk of Works (ECoW) where necessary. Proposed mitigation measures include;

- Site preparation and construction must be confined to the Proposed Development only and it must adhere to all the mitigation measures outlined in this Chapter. Work areas should be kept to the minimum area required to carry out the proposed works and this area should be clearly marked out in advance of the proposed works.
- Prior to the commencement of developments on site, the PSCS/ ECoW will ensure that contractors will be made aware of the sensitive receptors identified in this chapter and the associated mitigation factors. A signed statement saying that they have taken on board the mitigation measures contained herein should be presented to the local authority along with the Notice of Commencement.
- A wheel wash/ power wash facility will be established at the site-setup stage of construction to limit the translocation of sediment onto the local road network.
- A best practice measure in reducing the risk of the translocation of invasive species all machinery initially arriving to site will be inspected. Any dirty equipment will be refused entry to site.
- All construction waste will be removed from site by a registered contractor to a registered site. Evidence of the movement and safe disposal of the construction waste will be retained and presented to the Local Authority upon request. Removal of the construction waste will occur as soon as possible after construction works.
- The following Guideline documents should be adhered to:
    - Construction Industry Research and Information Association (CIRIA) (2005) Environmental Good Practice on Site (C692).
    - Construction Industry Research and Information Association (2001) Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors (C532).
    - Construction Industry Research and Information Association (2000) Environmental Handbook for Building and Civil Engineering Projects (C512).
    - Environmental Protection Agency (2015) List of Waste and Determining if Waste is Hazardous or Non-Hazardous.
    - Environment Agency et al. (2015) Guidance on the Classification and Assessment of Waste, Technical Guidance WM3.

Topsoil Removal

The removal of topsoil is part of the first stage of the construction process. As mentioned above the initial phase will involve the stripping and stockpiling of the topsoil layer. This material will be reused on site as far as possible during the landscaping stage to remediate slopes and soils within the vicinity of the site, including the buffer zone.

Stockpiles in the absence of mitigation measures will be susceptible to erosion by climatic and hydraulic factors. Mitigation measures include:

- Excavated topsoil will be stockpiled in an area abounded by silt fencing to contain/ reduce any sediment run-off during times of inclement weather.
- Driving machinery on topsoil stockpiles is not advised as it damages the soil structure, reduces porosity, and subsequent percolation rates, and can result in ‘smearing’ of the soil surface, which prevents water infiltration into the soil.
- Any excess topsoil will be removed from site and disposed of appropriately.
- Stockpiling and slight compaction of stockpiles to minimise both hydraulic and climatic erosion.

- Running stockpiles in the direction of prevailing wind to minimise windborne erosion rates, SW-NE. (EPA, 2013).
- Construction of silt fences around topsoil stockpiles to contain sediment run-off.
- Minimise the export of topsoil off site by incorporating in the final landscape design.
- Minimise handling and tracking of material to maintain optimum soil structure.
- Landscaping to take place as soon as possible to reduce exposure of subsoil and topsoil stockpiles.
- Works will be avoided during periods of extended rainfall.
- All topsoil generated from site works should be stored within the Proposed Development until it is required for landscaping. It must not be stored outside the Proposed Development boundaries and it must not be used for the infilling of any area outside of the Proposed Development. If there is more topsoil than is needed for landscaping, it must be removed from site by a registered contractor for appropriate use elsewhere. The end location of the topsoil must be identified and records presented to the local authority if requested.

Excavation

As with all greenfield site construction projects, civil earthworks are the first stage of the construction process. Excavation work to set the site levels, foundation, drainage and buried utilities is essential in facilitating the construction of the built structures. Excavation work will be conducted in stages to minimise the exposure of unprotected soil, subsoil and bedrock.

The development is proposed to be constructed within the range of the existing contours on site. This will limit the extent of significant earth works and greatly reduce the risk of encountering bedrock. Where possible excavated subsoil material will be reworked and used on site. A geotechnical investigation of the site will be required in order to assess the potential of the underlying soil, subsoil and bedrock for reuse.

Temporary excavations which are required for the installation of drainage, gas and buried networks will be excavated and backfilled within as short a timeframe as possible to minimise exposure of surfaces to erosion. Excavation stability is important, and deep excavations will employ the use of appropriate excavation techniques (e.g. temporary shoring) to ensure excavation wall stability.

The following measures will help mitigate the effects during excavation:

- Excavation work will be conducted in stages to minimise the exposure of unprotected soil, subsoil and bedrock.
- Where possible excavated subsoil material will be reworked and used on site.
- A geotechnical investigation of the site will be required in order to assess the potential of the underlying soil, subsoil and bedrock for reuse.
- Stockpiling material in appropriate locations, away from water sources, with a silt fence surrounding it to reduce the rate of run-off from hydraulic conditions.
- Light compaction of stockpiles to minimise the rate of erosion from climatic methods.
- Stockpile heights should be kept to a minimum to ensure stockpile stability and minimise wind borne erosion.
- Excavations will be postponed in high rainfall conditions to reduce the risk of excavation collapse and erosion to soil and subsoil profiles.
- If extreme weather conditions are forecast high sediment stockpiles will be covered to minimise erosion.

- Excavations to be backfilled as soon as possible to prevent any infiltration of contaminants to the subsurface and bedrock.
- All temporary excavations will be conducted in a safe manner to ensure sidewall stability and prevent collapse of excavations. Mobile shoring equipment will be utilised to this end where required.
- All long-term soil stockpiles are to be planted with a vegetative cover to bind the soil and improve slope stability.
- Engineered retaining walls are to be installed where required to ensure stability of contiguous and Proposed Development topography.
- “Mole Plough” installation method will be utilised to install the discharge pipe to the drainage ditch to the West of the site. This will limit trenching requirements and reduce the risk of sediment laden run-off.

Geological Sensitivities and Harmful Substances

Mitigation measures include pre-construction trial pit investigations to ascertain soil depth throughout the site, a desktop study to determine environmental sensitivities in the vicinity of the site as well as backfilling and landscaping of any temporary excavation works as soon as possible.

Soil Compaction

Heavy tracked and wheeled construction vehicles will be in use throughout varies stages of the construction process. The soil on site is noted as being compacted in parts with high water content, of clay loam texture and a fragile structure to investigated depths of 1.9m – 2.9m bgl. Beyond this greywacke and shale, bedrock is expected as no bedrock was encountered in site investigations. To reduce compaction during construction the following mitigation measures will be undertaken:

- Construction of a hardcore gravel access road on and around the site.
- Confine site traffic to designated routes.
- Minimise traffic flows on site and establish a construction stage parking compound.
- Avoid the use of oversized machinery when and where possible.
- Prevent movement of vehicles on site during and after periods of rainfall.
- Driving machinery on topsoil stockpiles will be avoided as it damages the soil structure, reduces porosity, and subsequent percolation rates, and can result in ‘smearing’ of the soil surface, which prevents water infiltration.

Run-Off

Sediment laden run-off from exposed soil and stockpiles poses a risk to waterways and aquatic life. The main pollutants of site water are silt, fuel/oil, concrete and chemicals. There are a number of steps outlined below to eliminate contamination of site surface water runoff.

- As a standard best practice measure silt fencing will be erected along the western extents of the Proposed Development site to limit accidental discharge of sediments into the adjacent drainage ditch located to the west and southwest. The fencing is to be made of a permeable filter fabric (Hy-Tex Terrastop Premium silt fence, or similar), with the footing of the fencing to be buried into the ground and the visible fencing to be *ca*. 0.5m high.
- An interceptor trench will be installed in front of the silt fence.

- The silt fence will be visually inspected daily to ensure that they remain functional throughout the construction of the Proposed Development. Maintenance of the fences will be carried out regularly. Fences will be inspected thoroughly after periods of heavy rainfall.
- Excavated and/or imported material will be stockpiled and silt fencing will be constructed around stockpile locations to contain/ reduce any sediment run-off during times of inclement weather.
- Compacting of stockpiles will reduce the rate of airborne and hydraulic erosion.
- Stockpile areas for sands and gravel should be kept to minimum size, well away from storm water drains and gullies leading off-site.
- Silt Fences to be erected where excavation works are required in close proximity to water features and along depressions in land where there's increased surface water flow rates.
- Harmful materials such as fuels, oils, greases, paints and hydraulic fluids must be stored in bunded compounds well away from storm water drains and gullies. Refuelling of machinery should be carried out using drip trays.
- A temporary drainage system will be established complete with a settlement pond to remove contaminants from run-off, prior to discharge.
- Temporary staff welfare facilities will be installed on site at the pre-commencement stage. These will include toilet facilities. All foul discharges from welfare facilities will be collected in a septic storage tank. This tank will be regularly emptied, and the contents disposed of at a registered facility.

Concrete

The underlying bedrock contains a locally important gravel groundwater body. Subsoil permeability across the majority of the site is described as "high" with a portion of the east/ northeastern boundary described as "moderate". The entirety of the site has a groundwater vulnerability rating of "high" with the overlying burden/ soil being between 1.5-8m in areas with subsoil of moderate permeability and >2m in areas of high subsoil permeability. The site is also located adjacent to a waterbody which is suspected to be the reason for the high-water table across the site.

Due to its elevated pH, unset concrete possesses a risk to adjacent soil, surface waters and the underlying groundwater body. The following mitigation measures are proposed to limit the accidental discharge of concrete and to minimise waste.

- **Concrete Washout Skip**: Chutes of concrete trucks are only to be washed out into an impermeable lined (polythene) skip. The washout water is to be treated prior to discharge.
- Excavations lined with an impermeable liner are not permitted as concrete washout bays.
- Large excess loads of concrete are to be returned to the supplier or poured into concrete block moulds (Betonblock or similar design) in order to minimise waste and reduce the risk of contaminants leaching into the surrounding environment.
- Best practice in bulk-liquid concrete management should be employed on site addressing pouring and handling, secure shuttering, adequate curing times etc.
- Where concrete shuttering is used, measures will be put in place to prevent against shutter failure and control storage, handling and disposal of shutter oils.
- Activities which result in the creation of cement dust will be controlled by dampening down the areas.
- Raw and uncured waste concrete will be disposed of by removal from the site.

Construction Contaminants

A wide array of chemicals and materials will be used during the construction of the development. This includes hydrocarbons which can persist in the wider environment for decades. To mitigate the exposure of the surrounding soil and geology to these substances it is proposed to undertake the following:

- Fuels, oils and other environmental deleterious chemicals are to be stored in a bunded well-ventilated chemical stores.
- Use of such chemicals and fuels is to be contained to bunded areas, where possible.
- Fuel bowsers to be located in bunded areas which can cater for 110% of the primary vessel capacity.
- Any spills or leaks to the soil is to be immediately contained and the soil in question is to be removed by a licensed contractor and disposed of in a registered facility.
- Oil spill containment kits are to be situated near areas of potential spills.
- Regular inspections carried out on plant and machinery for leaks and general condition.
- Use of ready-mixed supply of wet cement products.
- Scheduling cement pours for dry days.
- Maintenance and repair works will be carried out at least 10m from any collection of surface water.
- No refuelling will be undertaken within 50m of the drainage channel adjacent to the west of the site.
- Ancillary machinery equipment such as hoses, pipes and fittings which contain hydrocarbons will be stored within a bund or drip tray.
- Any repair works required on machinery involving fuel and oil control will be carried out offsite where practical, if not possible then repairs will be undertaken on a clean hardcore area of site. Unless unavoidable, repair works carried out in the field where machinery is operational will use spill trays and absorbent materials to prevent release of contaminants to the ground.
- Daily checks prior to start-up of plant and machinery will minimise the risk of breakdown and associated contamination risks for on-site repairs. Daily pre-start checks will be undertaken and records maintained. A clean site policy and diligent housekeeping will also reduce the potential of hydrocarbon release on-site.

Importation of Materials, including if found to be contaminated

The Proposed Development will involve the importation of gravel and concrete.

- All material will be sourced and transported by registered suppliers.
- All materials will be inspected prior to acceptance on site.
- Any deliveries found to be contaminated will be refused access to deposit on site. Any contaminated materials accidentally deposited on site will be removed immediately from site. If this is not possible then it will be stored in a “quarantine zone”.
- The quarantine zone is to be lined with an impermeable liner which the material will be stored on. A cover will be placed over the liner to avoid hydraulic run-off of contaminated materials. The quarantine zone is to be fenced off and surrounded by silt fencing, as a secondary containment measure.

Excavation of Contaminated Soils

The existing site consists of open pastures. At no point in the site’s history was there any

development present, hence excavation of contaminated soils is unlikely. Nonetheless, during construction:

- All excavated materials will be visually assessed for contamination.
- Any contaminated material detected will be sent for analysis to a suitable environmental laboratory and subsequently quantified, segregated and transported for disposal by a licenced contractor.

7.6.2 Operational Phase

The disturbance to soil and geology at the Proposed Development during the operational phase of the Anaerobic Digestion Facility is not foreseen to result in any significant effects. The most significant threat to the underlying soil and geology is posed by the uncontrolled release of digestate or manure.

General Mitigation Measures

An Environmental Operating Plan (EOP) will be prepared and implemented by the plant management company during the operational phase. This is a practical document which will include detailed procedures to address the main potential effects on surface water and groundwater.

The proposed facility will operate under an Industrial Emissions Licence (IEL) issued by the Environmental Protection Agency (EPA). The licence will contain several conditions which the operator must remain in compliance with for the entire duration of the facility's lifespan. Typical conditions relating to the protection of water receptors include:

- Emissions Limit Values for all emissions including surface water
- Monitoring requirements for surface waters
- Resource use and energy efficiency
- Waste management control and documentation
- Storage and transfer of substances
- Facility management
- Accident prevention and emergency response including fire water retention
- Operational Controls

Geological Sensitivities and Harmful Substances

During the operational phase, the site will be bunded, with hardstanding established for offloading areas. No process water will be discharged off-site and storm water will be monitored. Thus, the risk of pathways which could exacerbate or contribute to increased levels of the aforementioned minerals and heavy metals in groundwater sources are minimised.

Attenuation Tanks

The attenuation tanks should be lined with an impermeable membrane to limit the risk of contaminants leaching into local subsoils and the underlying poor aquifer and locally important gravel aquifer.

Attenuation Pond

Mitigation of relevance to the management of the Attenuation Pond will include:

- No soils will be imported to site.
- Any contaminated materials will be refused entry to site
- Quarantine zone will be available to isolate any contaminated soils identified. The area will have an impermeable linear, cover and surrounded by silt fencing.
- The pond will be lined with an impermeable geotextile liner to limit percolation of the contents into the underlying groundwater.

Uncontrolled Releases and Spillage

Mitigation of relevance to the management of uncontrolled releases will include:

- Dedicated hard standing for off-loading areas, with a minimum separation distance from adjacent water courses.
- Use of spill kits, bunded pallets and secondary containment units, as appropriate.
- All bunds sized to contain 110% of the volume of the primary storage vessel.
- Environmental Management Plan (EMP) to include site specific standard operating procedures pertaining to waste management and emergency response.
- There will be no intentional discharge of untreated storm water to surface or ground waters during the operational phase. All stormwater discharges from site will be directed to rainwater harvesting tanks to be reused on site. Discharge rates will be controlled with implementation of a combined below ground (Pluvial Cube) and above ground attenuation (detention basin) solution. Class 1 petrol/oil interceptors will also be installed in the various collection areas on the site as illustrated in the civils report and drawing.
- The Digestion Tanks and Digestate Storage tanks will be located within a bunded location to the south of the site, this will act as a secondary containment in the event of loss of tank contents.
- All primary pipelines and bunded structures will be inspected and integrity tested prior to handover from the appointed construction contractor. All works will be installed to Construction Quality Assurance (CQA) plan.

Land Spreading of Biobased Fertiliser

To mitigate the risk to soil, groundwater and surface water features the following measures will be complied with:

- In order to avoid any reductions in water quality within the catchment as a whole, all biobased fertilisers must be used in accordance with S.I. 113 of 2022 European Communities (Good Agricultural Practice for Protection of Waters) Regulations, 2022).
- The spreading of the biobased fertiliser on the customer farms must be done in accordance with the specific Nutrient Management Plan for that farm.
- Application of biobased fertiliser to be conducted in compliance with the Nitrates Action Programme (e.g. prohibited periods and nitrogen application rates).
- All biobased fertiliser is to be pasteurised prior to removal from the Proposed Development to comply with Regulation (EU) 142/2011 on Animal By-Products in Organic Fertilisers.

7.6.3 Decommissioning Phase

The decommissioning phase will entail similar activities to the construction phase. The construction stage mitigation measures outlined in **Section 7.6.1** above will be undertaken to limit and avoid effects to the underlying soil from compaction and contamination. The goal of the decommissioning phases is to render the site safe both physically and environmentally so that it no longer poses a risk to the surrounding population and environment. A Closure, Restoration and Aftercare Management Plan (CRAMP) will be developed as a condition of the industrial emission licences and in compliance with the Guidance to Licensees on Surrender, Cessation and Closure of Licensed Sites set by the EPA (2012).

7.7 Cumulative Effects

Within the European Commission - Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions, dated May 1999, cumulative effects are described as "impacts that result from incremental changes caused by other development, plans or projects together with the Proposed Development or developments".

The cumulative effects of the proposed construction and operation of an Anaerobic Digestion Facility at Ballyvass, Castledermot, Co. Kildare with other developments in the area is reviewed in this section with specific regard to the local and regional Land, Soil and Geology.

Excavated soils will be reused and repurposed for landscaping purposes and for the construction of earth berms on site. There will be no disposal of excess soil and subsoil from site to licensed facilities and so the Proposed Development will not have an effect on capacity at such sites. This will result in a **neutral** effect on such sites.

7.8 Residual Effects

According to Environmental Protection Agency guidelines, Residual Effect is described as ‘the degree of environmental change that will occur after the proposed mitigation measures have taken place.’ The mitigation strategy above recommends actions which can be taken to reduce or offset the scale, significance and duration of the effects on the surrounding land, soil and geology.

The purpose of this assessment is to specify mitigation measures where appropriate to minimise the ‘risk factor’ to all aspects of the soil and geological environment such as to minimise the potential for contamination effects to soil, groundwater or aquifers and reduce the risk of erosion and sediment run-off, etc. This ‘risk factor’ is reduced or offset by recommending the implementation of a mitigation strategy in each area of the study. On the implementation of this mitigation strategy, the potential for effect will be lessened.

A site-specific Construction Environmental Management Plan (CEMP) will be devised and implemented throughout the duration of the construction phase. This document will contain all the necessary procedures required to prevent and minimise any environmental risks posed by the project on the surrounding environment.

7.8.1 Construction Phase

A summary of the predicted effects associated with the construction phase in terms of quality,

significance, and duration, along with the proposed mitigation measures and resulting residual effects are summarised in **Table 7.13**.

The overall effects anticipated by the construction phase of the project following the implementation of suitable mitigation measures is considered to be ***neutral to negative***, ***slight to significant*** and ***temporary to permanen*t**.

7.8.2 Operational Phase

A summary of the predicted effects associated with the operational phase in terms of quality, significance, and duration, along with the proposed mitigation measures and resulting residual effects are summarised in **Table 7.14**.

The overall effects anticipated by the operational phase of the project following the implementation of suitable mitigation measures is considered to be ***positive to neutral***, ***imperceptible to slight***, and ***temporary to long-term***.

Table 7.13: Summary of predicted construction phase effects, mitigation measures and residual effect

Potential Source	Environmental Receptor	Effect Description	Quality	Significance	Duration	Mitigation	Residual Effect
Topsoil Removal	**Topsoil** Soil structure, soil microorganism population, adjacent waterways	Erosion of stockpiles of exposed soils leading to migration of silt into surface water receptors via dust and run-off. Damage to soil structure	***Negative***	***Slight to Moderate***	***Reversible***	• Silt fencing and interceptor trench to be installed along the western extents of the site • Stockpiles of topsoil to be used in landscaping works as soon as is practicable • Silt fence erected along catchment lines • Silt fences to be installed around stockpile locations to reduce run-off rates and to prevent vehicles driving on stockpiles, damaging soil structure • Slight compaction of stockpiles to minimise run-off and airborne erosion • Running stockpiles in direction of prevailing wind, to reduce windborne erosion • Minimise handling of material • Keep stockpile heights low to minimise compaction and windborne erosion • Topsoil is to remain within the Proposed Development site • Wheel wash/ Power hose facility will be available on site to limit the migration of sediment off-site via vehicles • Machinery will be clean on arrival to site, and will undergo inspection • Site welfare facilities will be established prior to removal of topsoil	***Neutral, Slight, Reversible***

Potential Source	Environmental Receptor	Effect Description	Quality	Significance	Duration	Mitigation	Residual Effect
Excavations/ Subsoil Removal	**Subsoil** Adjacent waterways, Underlying Poor Aquifer and Locally Important Gravel Aquifer	Reduction in subsoil horizon by up to 4m will increase groundwater vulnerability and threaten Aquifer. Migration of silt into adjacent lands and waterways via dust and run-off	***Negative***	***Moderate***	***Permanent***	• Stockpiling material in appropriate locations, away from water sources, with silt fencing surrounding it to retard the rate of erosion from hydraulic conditions. • Light compaction of stockpiles to minimise the rate of erosion from airborne and hydrological methods. • Stockpile heights should be kept to a minimum to ensure stockpile stability and minimise wind borne erosion. • Excavations will be postponed in high rainfall conditions to reduce the risk of excavation collapse and erosion to soil and subsoil profiles. • If extreme weather conditions are forecast high sediment stockpiles will be covered/ dampened to minimise erosion. • Excavations to be backfilled as soon as possible to prevent any infiltration of contaminants to the subsurface and bedrock. • Excavate and backfill temporary excavations within a short timeframe to minimise exposure to erosion and contamination • Installation of silt fencing to capture hydraulic erosion • Risk of contaminating underlying exposed material 'naturally' mitigated by the presence of the of the low permeability subsoil throughout the site • "Mole Plough" installation method for piping proposed where applicable.	***Neutral, Slight, Permanent***
	Bedrock Underlying Poor Aquifer and Locally Important Gravel Aquifer	Exposure of bedrock, and/or excavation of bedrock	***Negative***	***Significant***	***Permanent***		***Neutral, Moderate, Temporary***
Geological Sensitivities	**Subsoil** Adjacent waterways, Underlying Poor Aquifer and Locally Important Gravel Aquifer	Mobilization of naturally occurring materials or contaminants which are deleterious to environmental health	***Not Significant***			• A desktop investigation was undertaken examining instances of deleterious material contamination with respect to local quarries, public water supply and local schemes. • Pre-construction trial pit investigations to ascertain soil depth throughout the site. • Backfilling and landscaping of any temporary excavation works as soon as possible.	***Not Significant***
	Bedrock Underlying Poor Aquifer and Locally Important	Mobilization of naturally occurring materials or contaminants which are deleterious to environmental					

Potential Source	Environmental Receptor	Effect Description	Quality	Significance	Duration	Mitigation	Residual Effect
	Gravel Aquifer	health					
Attenuation Tanks	**Subsoil and Bedrock** Underlying Poor Aquifer and Locally Important Gravel Aquifer	Exposure and removal of soil and subsoil. Stockpiling of excavated material. Percolation of contaminants into the underlying aquifer	***Neutral***	***Moderate***	***Long-Term***	• Excavations to be backfilled as soon as possible to prevent any infiltration of contaminants to the subsoil and underlying aquifer	***Neutral, Slight, Long-Term***
Attenuation Pond	**Subsoil and Bedrock** Underlying Poor Aquifer and Locally Important Gravel Aquifer	Anaerobic soils. Percolation of contaminants into the underlying locally important aquifer	***Negative/ Neutral***	***Significant***	***Permanent***	• No soils will be imported to site. • Any contaminated materials will be refused entry to site • Quarantine zone will be available to isolate any contaminated soils identified. The area will have an impermeable linear, cover and surrounded by silt fencing • The pond will be lined with an impermeable geotextile liner to limit percolation of the contents into the underlying groundwater	***Neutral, Slight, Permanent***
Site Entrance and Grid Injection Point	**Topsoil and Subsoil** Underlying Geology Poor Aquifer and Locally Important Gravel Aquifer	Exposure and removal of soil and subsoil. Stockpiling of excavated and imported material. Migration of silt into adjacent lands Contamination of subsoil and underlying geology	***Negative***	***Slight***	***Permanent***	• "Mole Plough" installation method for piping proposed where applicable. • Excavations to be backfilled as soon as possible to prevent any infiltration of contaminants to the subsoil • Landscaping to take place as soon as possible to reduce weathering • Installation of drainage headwall to be undertaken outside of the closed season for instream works (October 1st to June 30th)	***Neutral, Slight, Long-term***
Construction of Built Structures	**Topsoil, Subsoil and Bedrock**	Conversion of permeable soil into hard standing. Compaction of soil and subsoil from plant machinery Contamination of subsoil and bedrock from hydrocarbons, concrete, etc.	***Negative***	***Moderate***	***Long-term***	• Construction of site access to confine plant machinery to designated routes • Construction of site car park to reduce traffic and compaction on site • Chemicals/ hydrocarbons to be stored and used in bunded areas. • Spill kits to be located throughout site • Scheduling and use of ready mixed concrete on site • Chutes of concrete trucks are only to be washed out into an impermeable lined (polythene) skip which will be located in the east of the site • Excess concrete is to be returned to the supplier here possible. If not possible it will be poured into	***Neutral, Slight, Long-term***

Potential Source	Environmental Receptor	Effect Description	Quality	Significance	Duration	Mitigation	Residual Effect
						concrete block moulds (Betonblock or similar) to minimise waste and reduce the risk of contaminants leaching into the surrounding environment • Best practice concrete handling measures will be employed • Temporary site welfare facilities will be established • All foul effluent from welfare facilities will be collected in a septic tank prior to disposal at a register waste facility	
Excavation of Contaminated Soils	**Topsoil, Subsoil and Bedrock**	Excavated materials, intended to be reused on-site for landscaping purposes and establishment of earth berms. Potential for soils to contain contaminants from accidental spillages or legacy contamination and leach into surface water receptors	***Negative***	***Not Significant***	***Permanent***	• Greenfield site with no previous industrial activities noted at the site meaning incidences of contaminated land unlikely • No contaminants identified during Site investigations • Procedure in place for incidence of contaminated land within CEMP • Contaminated soils encountered to be tested, quantified, segregated and transported for disposal by a licenced contractor • Quarantine zone will be available to isolate any contaminated soils identified. The area will have an impermeable linear, cover and surrounded by silt fencing	***Positive, Slight, Short-term***

Table 7.14: Summary of predicted operational phase effects, mitigation measures and residual effect

Potential Source	Environmental Receptor	Effect Description	Quality	Significance	Duration	Mitigation	Residual Effect
Hydrocarbon Contamination	**Topsoil**	Accidental release from vehicular crash, leaks from hydraulics, fuel tanks, fuel stores, bunds into the surrounding soil	***Negative***	***Moderate to Significant***	***Long-term***	• Drainage systems will be designed to attenuate excess surface water runoff with suitable storage volumes • Reduction of outflow rate to below the existing greenfield runoff rate before discharging • Installation of Sustainable Urban Drainage Systems (SuDS) features such as Sumps in gullies and catchpits collect silts in run-off from roads, filter drains, discharge bypass separator, attenuation tanks and an attenuation pond. • Environmental Management System • Bunded production area • Regular inspection of bunds • TOC monitors and automated valve shut offs to avoid contamination accidentally being discharged from site.	***Neutral, Imperceptible, Long-term***
	Subsoil and Bedrock Poor Aquifer / Locally Important Aquifer	Accidental releases outlined above percolating downwards into lower soil horizon and bedrock aquifer	***Negative***	***Moderate to Significant***	***Long-term***		***Neutral, Imperceptible, Long-term***
Nutrient Leaks	**Topsoil**	Accidental discharges of high BOD demanding digestate/ feedstock/ sewage into soil. Poses threat to adjacent surface water	***Negative***	***Moderate***	***Short-term***	• All sewage/ pipe/ tank infrastructure to be installed in accordance with the relevant industry standards and pressure tested/CCTV surveyed prior to commissioning to ensure absence of defects • Programme of inspection and maintenance to ensure any defects in tanks or bunds are repaired	***Neutral, Imperceptible to slight, Short-term***
	Subsoil and Bedrock Poor Aquifer / Locally Important Aquifer	Leakage of high BOD sources outlined above into lower soil horizon and bedrock aquifer	***Negative***	***Slight to Moderate***	***Short-term***	• The process area on site will be completely bunded. This will catch and retain and spills preventing percolation into the lower horizons • TOC monitors and automated valve shut offs to avoid contamination accidentally being discharged from site	***Neutral, Imperceptible to Slight, Short-term***

Potential Source	Environmental Receptor	Effect Description	Quality	Significance	Duration	Mitigation	Residual Effect
Land Spreading of Digestate	Topsoil, Watercourses Animal welfare	Application of processed digestate to agricultural land Transmissible diseases	***Negative***	***Significant***	***Temporary***	• Biobased fertilisers will be used in accordance with S.I. 113 of 2022 European Communities (Good Agricultural Practice for Protection of Waters) Regulations, 2022). • Nutrient management plans to avoid excess fertiliser application • Farmers to comply with the Nitrates Action Plan • "Lay-off" period of 21 days for grazing or harvesting following application • Biobased fertiliser will be pasteurised in accordance with Regulation (EU) 142/2011 on use of animal by products as organic fertiliser	***Positive, Imperceptible, Temporary***

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7.9 Monitoring

The Construction Environmental Management Plan (CEMP) and Environmental Operating Plan (EOP) will include provision for the monitoring of construction and operational related activities including the following:

- Water Quality Monitoring of the surface water receptors adjacent to the site boundary and discharge point
- Daily inspections for housekeeping and site cleanliness
- Continuous noise, vibration and dust monitoring
- Dust Suppression on dry days or during concrete cutting
- Risk assessment for the prevention of fuel spillages
- Monitoring of stockpiles to determine if further measures are required to prevent erosion
- Daily inspection of concrete washout and waste management facilities

Daily site inspections to ensure procedures outlined within the CEMP are adhered through throughout the site.

7.10 Summary of Significant Effects

The receptors for this assessment are considered to be shallow soils, the underlying drift, bedrock geology and waters. Whilst the development proposals have the potential to cause detriment to the sensitive receptors identified, the recommended mitigation measures will ensure that the risk of potential effects are reduced to ***slight to moderate***.

7.11 Statement of Significance

The significance of effect upon shallow soils, drift deposits, and bedrock geology have been assessed for both during the construction and operational phases. The results of the assessment are presented on **Table 7.11** and **Table 7.12**.

Where a potential effect has been identified, the significance of effect upon these receptors ranges from ***not significant to significant***.

Where a potential effect has been identified, mitigation measures have been provided which if implemented, reduces the effect of significance to ***imperceptible to moderate.*** The mitigation steps are presented in **Section 7.6** and summarised in **Table 7.13** and **Table 7.14**.