7. LAND, SOILS AND GEOLOGY

7.1 Introduction

This Chapter of the EIAR comprised of an assessment of the likely impact of the proposed development on the soils and the geological environment as well as identifying proposed mitigation measures to minimise any impacts.

This chapter was prepared by Brendan Keogh (BA BAI PGradDip CEng MIEI) of DBFL Consulting Engineers. Brendan Keogh is a Chartered Professional Engineer with over 15 years experience in the design and construction of civil engineering projects. Projects have included works associated with the commercial, industrial, energy, residential and public infrastructure sectors.

7.2 Assessment Methodology

Assessment of the likely impact of the proposed development on soils and the geological environment includes the following activities:

- Preliminary Ground Investigation Study
- Review of information available on the Geological Survey of Ireland (GSI) online mapping service

Preliminary Ground Investigations for the proposed development were carried out by IGSL on October 2018 and included the following scope of work:

- 24 No. Trial Pits
- 25 No. Plate Bearing Tests
- 51 No. Dynamic Probes
- 8 No. Infiltration Tests

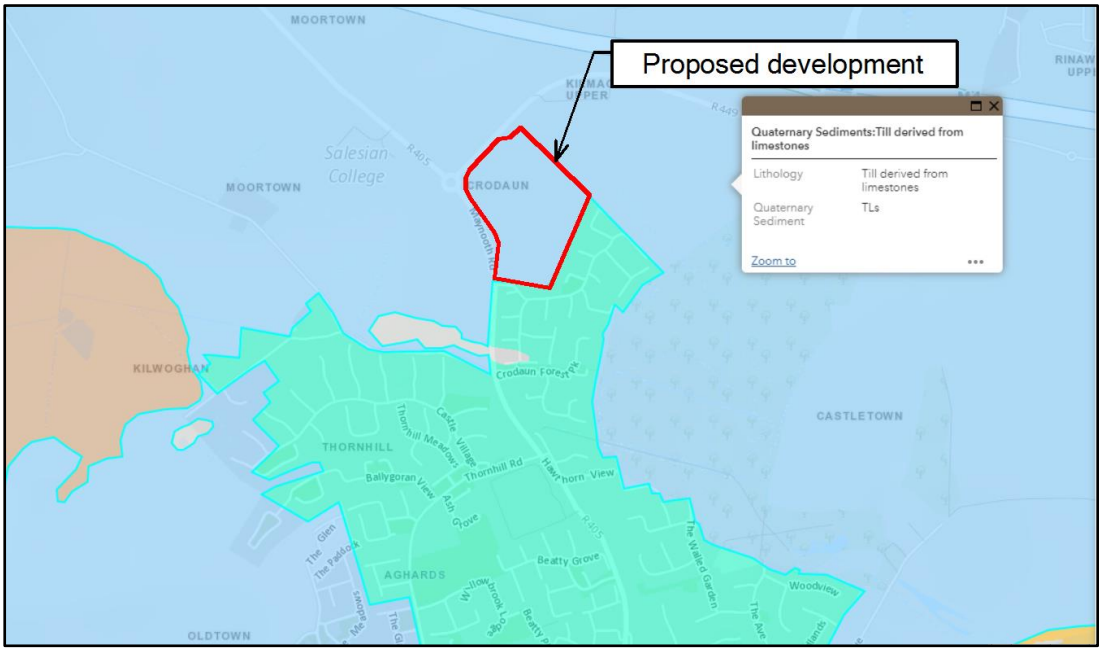
Refer to Appendix C Ground Investigation Report (IGSL, Issue Date November 2018, report no. 21281).

7.3 Receiving Environment

7.3.1 Soils

Review of information available on the GSI's online mapping service ("Quaternary Sediments") indicate that the site is underlain predominantly by a sediment type described as "TLs – Till derived from limestones". Refer to Figure 7.1 below.

Figure 7.1 Extract from Quaternary Sediments Map



Source: GSI Online Mapping Service

Ground conditions at the site, as observed during Preliminary Ground Investigations, are summarised as follows:

- 0.3m thick topsoil layer overlying;
- Stiff brown sandy gravelly clay with occasional cobbles
- Gravelly clay stratum becomes dark grey with increasing cobbles and boulders noted
- Excavations continued to approx. 2m BGL where excavator refusal was recorded (may be indicative of local limestone rock horizon).

All trial pits were dry, and excavations were stable (groundwater ingress was observed at only one trial pit location).

The dynamic probes indicate stiff to very stiff gravelly clay souls below softer surface topsoil. Boulders or shallow weathered limestone bedrock encountered 1.00 to 2.50 meters below ground level.

Infiltration tests were carried out at eight locations. Tests results indicated infiltration rates (f) ranged from 0.00018 m/min to 0.00091 m/min. These results reflect Low Permeability soils. Refer to Figure 7.2 below for table of results.

Geotechnical and environmental test were carried out in the IGSL laboratory and results were as follows:

- The soils have relatively high silt content and will be sensitive to moisture content variation
- The grading characteristics are typical of glacial till or boulder clay deposition.
- Low sulphate concentrations. No special precautions are necessary to protect foundation concrete from sulphate aggression.

- Environmental analysis indicates that the soils can be classified as inert with no elevated contaminant levels recorded. Material excavated from this site can be readily disposed of to a regular licensed landfill facility or utilised on site for non-engineering purposes.

Figure 7.2 Extract from IGSL Site Investigation Report – Infiltration Test Results

Test No.	Infiltration Rate (f) (metres / min)	Soil Type
IT01	0.00044	Sandy gravelly CLAY
IT02	0.00023	Sandy Gravelly CLAY
IT03	0.0007	Sandy gravelly CLAY
IT04	0.00018	Sandy gravelly CLAY
IT05	0.00073	Sandy gravelly CLAY
IT06	0.0004	Sandy gravelly CLAY
IT07	0.00031	Sandy gravelly CLAY
IT08	0.00091	Sandy gravelly CLAY

7.3.2 Geology

A review of GSI's online mapping service ("Bedrock Geology") describes geology in the vicinity of the site as "Visean limestone & calcareous shale".

GSI have classified the site's groundwater vulnerability as "moderate" to "high".

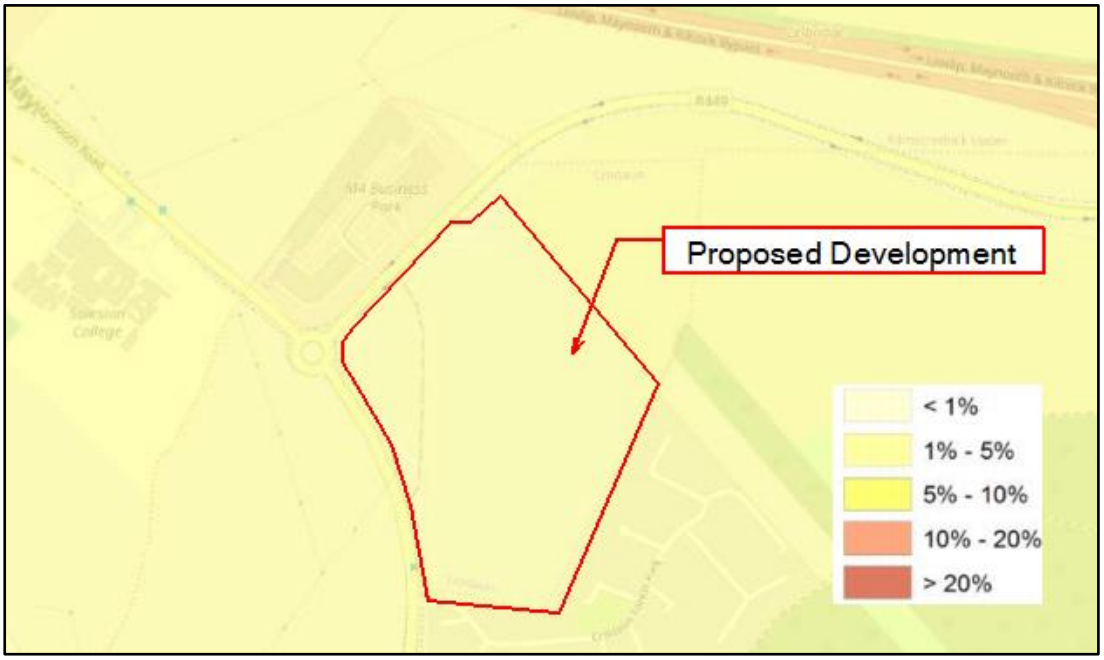
GSI also classified underlying bedrock aquifers as "locally important".

Refer to Chapter 8 of this EIAR for further commentary regarding Hydrogeology.

7.3.3 Radon

A review of the EPA's online mapping service ("Radon Map") shows that between one and five per cent of the homes in this 10km grid square are estimated to be above the reference level of 200 bequerel per cubic metre (Bq/m^3). Refer to Figure 7.3 below.

Figure 7.3 Extract from EPA Mapping Service (Radon Mapping)



7.4 Characteristics of the Proposed Development

Site development works will include stripping of the 300mm thick topsoil layer. It is expected that all stripped topsoil will be reused on site (incorporated into landscaping of back gardens and public open spaces).

Excavation of subsoil layers will be required in order to allow road construction, foundation excavation, drainage and utility installation and provision of underground attenuation of surface water. Underlying subsoil layers are also expected to be suitable for reuse as non-structural fill (e.g. build-up of back gardens areas or build-up of open spaces).

Importation of fill will be required beneath houses, driveways and to roadways (structural fill). Importation of fill will also be required to raise the ground levels along the eastern side of the site in order to achieve a gravity drainage solution (avoiding the need for a pumped drainage solution). Further information regarding importation of fill is included in Section 7.5.1.3 of this Chapter (quantity, type of material etc.)

7.5 Identification of Likely Significant Impacts

7.5.1 Construction Phase

7.5.1.1 Stripping of Topsoil

Removal of the existing topsoil layer will be required. As noted previously, it is expected that all stripped topsoil will be reused on site (incorporated into landscaping of back gardens and public open spaces).

Stripping of topsoil will result in exposure of the underlying subsoil layers to the effects of weather and construction traffic and may result in subsoil erosion and generation of sediment laden runoff.

Table 7.1 Preliminary Estimated Topsoil Volumes (+/- 10%)

	Volume (m^3)
Topsoil Strip (300mm thick layer)	30,000
Topsoil Reuse (landscaping of open spaces etc.)	30,000

7.5.1.2 Excavation of Subsoil Layers

Excavation of existing subsoil layers will be required in order to allow road construction, foundation excavation, drainage and utility installation and provision of underground attenuation of surface water.

Underlying subsoil layers are sandy gravelly clay with occasional cobbles and are expected to be generally suitable for reuse as non-structural fill (e.g. build-up of back gardens areas or build-up of open spaces).

Table 7.2 Excavation of Subsoil / Reuse of Excavated Material (+/- 10%)

	Volume (m^3)
Cut (excavation of subsoil layers as described in 7.5.1.2 above)	10,000
Reuse of Excavated Material as Non Structural Fill	10,000

7.5.1.3 Imported Fill

In the context of materials imported to site, these will be natural stones sourced from locally available quarries, greenfield / inert soil imported under a Waste Permit issued by the local authority; or materials that have been approved as by-products by the EPA in accordance with the EPA's criteria for determining a material is a by-product, per the provisions of article 27(1) of the European Communities (Waste Directive) Regulations, 2011.

Imported materials will be granular in nature and used in the construction of road pavement foundations, drainage and utility bedding and surrounds. Imported fill will also be required at the eastern side of the site to raise the development to the required level for drainage.

Materials will be brought to site and placed in their final position in the shortest possible time. Any imported material will be kept separate from the indigenous arisings from the site. All excavation to accommodate imported material will be precisely co-ordinated to ensure no surplus material is brought to site beyond the engineering requirement.

Table 7.3 Imported Fill (+/- 10%)

	Volume (m^3)
Fill (Total)	90,000
Reuse of Excavated Material (Non Structural Fill)	10,000
Topsoil Reuse (landscaping of open spaces etc.)	30,000
Imported Fill	50,000

7.5.1.4 Construction Traffic

Earthworks plant (e.g. dump trucks) and vehicles delivering construction materials to site (e.g. road aggregates, concrete deliveries etc.) have potential to cause rutting and deterioration of the topsoil layer and any exposed subsoil layers, resulting in erosion and generation of sediment laden runoff. This issue can be particularly noticeable at site access points (resulting in deposition of mud and soil on the surrounding road network). Dust generation can also occur during extended dry weather periods as a result of construction traffic.

7.5.1.5 Accidental Spills and Leaks

During the construction phase there is a risk of accidental pollution from the sources noted below. Accidental spills and leaks may result in contamination of the soils underlying the site.

- Storage of oils and fuels on site

- Oils and fuels leaking from construction machinery
- Spillage during refuelling and maintenance of construction machinery
- Use of cement and concrete during construction works

7.5.1.6 Geological Environment

Any excavations associated with development of the site are expected to be relatively shallow (e.g. no basement construction is proposed) and are not expected to impact on the underlying geology.

7.5.2 Operational Phase

On completion of the construction phase, there will be no further impact on soils and the geological environment.

7.5.3 'Do Nothing' Scenario

Should the development not proceed the site would remain in its current state with the only likely impact on the underlying soil and/or aquifer due to agricultural processes. The continued use of the site for agricultural purposes is likely to have a Neutral and Imperceptible effects on the environment.

7.6 Mitigation Measures

7.6.1 Construction Phase

7.6.1.1 Stripping of Topsoil

Stripping of topsoil will be carried out in a controlled and carefully managed way and coordinated with the proposed staging for the development. At any given time, the extent of topsoil strip (and consequent exposure of subsoil) will be limited to the immediate vicinity of active work areas.

Topsoil stockpiles will be protected for the duration of the works and not located in areas where sediment laden runoff may enter existing surface water drains.

Topsoil stockpiles will also be located so as not to necessitate double handling.

Surface water runoff from areas stripped of topsoil will be directed to on-site settlement ponds where measures will be implemented to capture and treat sediment laden runoff prior to discharge of surface water at a controlled rate.

On-site settlement ponds are to include geotextile liners and riprapped inlets and outlets to prevent scour and erosion.

7.6.1.2 Excavation of Subsoil Layers

Excavation of existing subsoil layers has been minimised. Cut type earthworks operations will not be required to achieve designed site levels.

Disturbed subsoil layers will be stabilised as soon as practicable (e.g. backfill of service trenches, construction of road capping layers, construction of building foundations and completion of landscaping). The duration that subsoil layers are exposed is to be minimised in order to mitigate against weather effects.

Similar to comments regarding stripped topsoil, stockpiles of excavated subsoil material will be protected for the duration of the works. Stockpiles of subsoil material will be located separately from topsoil stockpiles.

Measures will be implemented to capture and treat sediment laden surface water runoff (e.g. sediment retention ponds, surface water inlet protection and earth bunding adjacent to open drainage ditches).

7.6.1.3 Imported Fill

As noted in section 7.5.1.3 above, importation of fill to site will be required.

No large or long-term stockpiles of fill material will be held on the site. At any time, the extent of fill material held on site will be limited to that needed in the immediate vicinity of the active work area.

Smaller stockpiles of fill, where required, will be suitably protected to ensure no sediment laden runoff enters existing surface water drains. Such stockpiles are to be located in order to avoid double handling.

7.6.1.4 Construction Traffic

Earthworks plant and vehicles delivering construction materials to site will be confined to predetermined haul routes around the site.

Vehicle wheel wash facilities will be installed in the vicinity of any site entrances and road sweeping implemented as necessary in order to maintain the road network in the immediate vicinity of the site.

Dust suppression measures (e.g. dampening down) will be implemented as necessary during dry periods.

7.6.1.5 Accidental Spills and Leaks

In order to mitigate against spillages contaminating underlying soils, all oils, fuels, paints and other chemicals will be stored in a secure bunded hardstand area.

Refuelling and servicing of construction machinery will take place in a designated hardstand area which is also remote from any surface water inlets (when not possible to carry out such activities off site).

Oil, fuel etc. storage areas are to be decommissioned on completion of the construction phase. Any remaining liquids are to be removed from site and disposed of at an appropriate licenced facility.

7.6.1.6 Geological Environment

No mitigation measures are proposed in relation to the geological environment.

7.6.2 Operational Phase

On completion of the construction phase no further mitigation measures are proposed as there will be no further impact on soils and the geological environment.

7.7 Predicted Impact of the Proposed Development

7.7.1 Construction Phase

Implementation of the measures outlined in Section 7.6.1 will ensure that the potential impacts of the proposed development on soils and the geological environment do not occur during the construction phase and that any residual impacts will be short term / imperceptible.

7.7.2 Operational Phase

There are no predicted impacts arising from the operational phase. Accordingly, the predicted impact will be long-term-imperceptible- neutral.

7.8 Monitoring

Proposed monitoring during the construction phase in relation to the soil and geological environment are as follows:

- Adherence to Outline Construction Management Plan
- Construction monitoring of the works (e.g. inspection of existing ground conditions on completion of cut to road formation level in advance of placing capping material, stability of excavations etc.).
- Inspection of fuel / oil storage areas.
- Monitoring cleanliness of adjacent road network, implementation of dust suppression and provision vehicle wheel wash facilities.
- Monitoring of contractor's stockpile management (e.g. protection of excavated material to be reused as fill, protection of soils for removal from site from contamination)
- Monitoring sediment control measures (sediment retention ponds, surface water inlet protection etc.)

No ongoing monitoring is proposed on completion of the construction phase.

7.9 Reinstatement

All temporary construction compounds and site entrances are to be removed upon completion of the construction phase. Such areas are to be reinstated in accordance with the landscape architects plan and engineer's drawings.

All construction waste and / or scrapped building materials are to be removed from site on completion of the construction phase.

Oil, fuel etc. storage areas are to be decommissioned on completion of the construction phase. Any remaining liquids are to be removed from site and disposed of at an appropriate licenced facility.

All sediment control measures (e.g. sediment retention ponds) are to be decommissioned on completion of the construction phase. Such areas are to be reinstated in accordance with the landscape architects plan and engineer's drawings.

7.10 Interactions

7.10.1 Traffic and Transportation

Delivery of materials to site during the construction phase (e.g. aggregates for road construction, concrete for foundations, delivery of construction plant to site) will lead to potential impact on the

surrounding road network. In this way, the interaction between Soils, Land & Geology and Material Assets: Traffic and Transportation is considered to be short term.

7.10.2 Water and Hydrology

Stripping of topsoil will result in exposure of the underlying subsoil layers to the effects of weather

Surface water run-off may have the potential to infiltrate into underlying soils. Implementation of appropriate mitigation measures as outlined in the Preliminary Construction Management Plan (CMP) (Appendix A) and Chapter 8 of this EIAR will eliminate the potential for infiltration of surface contaminants into the underlying geology and hydrogeology. This way, the interaction between Soils, Land & Geology and Hydrology & Hydrogeology is considered to be imperceptible**.**

7.10.3 Noise and Vibration

Development of the site will result in a level of noise and vibration related effects on the environment during the construction phase. The interaction between Soils, Land & Geology and Noise and Vibration is considered to be moderate and temporary in nature.

7.10.4 Air Quality

There is a potential for soil excavation activity to impact on air quality in terms of dust generated. Dust generation can also occur during extended dry weather periods as a result of construction traffic. However, the implementation of suitable mitigation measures as outlined in Chapter 9 Air Quality and Climate and the CMP for the site will ensure a neutral impact. The interaction between Soils, Land & Geology and Air Quality is considered to be short term-imperceptible-neutral.

7.10.5 Biodiversity

Removal of the existing topsoil layer will be required across the site as well as removal of some trees, hedgerows etc. Chapter 6 (Biodiversity) identifies that the removal of hedgerow habitats will result in some mortality to species and that there will be a loss of ecological corridors and semi-natural habitats until such time as new planting becomes established. These interactions are not considered to be significant.

7.10.6 Potential Cumulative Impacts

Other developments currently under construction and other committed development in the vicinity of the site have been considered and are likely to have similar impacts during the construction phase in relation to soils and geology.

Should the construction phase of any developments coincide with development of the site, potential cumulative impacts are not anticipated provided similar mitigation measures are implemented.

7.11 Residual Impacts

Provided that appropriate mitigation measures have been implemented during the construction phase, the potential impact on land, soils and geology during construction is considered to have a short term, imperceptible significance.

There are no likely significant impacts on the land, soil or geological environment associated with the proposed operational development of the site. As such, the impact is considered to have a long term, imperceptible significance with a neutral impact on quality.

7.12 Risks to Human Health

The following risk to human health from soils and the geological environment can occur during construction:

- Dust generation can also occur during extended dry weather periods as a result of construction traffic.

With the implementation of the aforementioned mitigation measures, the likelihood of such events occurring would be local and not significant.

7.13 Unplanned Events

The following accidents & disasters involving soils during construction could potentially give rise to a serious incident putting people at risk:

- Collapse of trench during excavation works
- Accidental spills and leaks may result in contamination of the soils underlying the site.

With the implementation of the aforementioned mitigation measures, the likelihood of such events occurring would be local and not significant.

On completion of the construction phase, there will be no further unplanned events anticipated on soils and the geological environment.

7.14 References

Greater Dublin Strategic Drainage Study (2005) – Fingal County Council, Dublin City Council, Dún Laoghaire-Rathdown County Council, South Dublin County Council, Wicklow County Council, Kildare County Council, Meath County Council

The Greater Dublin Region Code of Practice for Drainage Works (2012) – Fingal County Council, Dublin City Council, Dún Laoghaire-Rathdown County Council, South Dublin County Council, Wicklow County Council, Kildare County Council, Meath County Council

Code of Practice for Water Infrastructure (2017) – Irish Water

Code of Practice for Wastewater Infrastructure (2017) – Irish Water

Ground Investigation Report (IGSL, Issue Date November 2018, report no. 21281).

Environmental Protection Agency (EPA) Online Mapping Service

Geological Survey of Ireland (GSI) online mapping service

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

Guidelines on the information to be contained in environmental impact assessment reports. Environmental Protection Agency (Draft 2017).

170099-rep-001 Infrastructure Design Report submitted by DBFL.

170099-rep-002 Site Specific Flood Risk Assessment submitted by DBFL