CHAPTER 7

LAND AND SOILS

7.0 LAND AND SOILS

7.1 INTRODUCTION

This chapter was prepared by Jorge Castrillo (BSc, MSc in Civil Engineering by the University of Burgos, Spain, and the Silesian University of Technology, Poland) of Roughan and O'Donovan Consulting Engineers Limited.

Jorge is a design geotechnical engineer with 10 years of experience post graduate and 8 years of experience working in the field of geotechnics. During this time, he has developed competencies on detail design aspects of the projects such as the completion of geotechnical designs reports, interpretative reports, design specifications and ground investigation scopes as well as competencies on preliminary phases of the projects including Land and Soils chapters for environmental impact assessment reports, option selection reports and constraints, risk and opportunities reports. Jorge also has experience in the supervision of ground investigation works on site.

This chapter of the Environmental Impact Assessment Report (EIAR) presents the land and soils assessment of the proposed construction of the Railpark Maynooth development. It also identifies the characteristics, predicted potential impacts, mitigation measures and residual impacts arising from the proposed development in both the construction and operational phases. This chapter should be read in conjunction with the following chapters, and their appendices, which outline related impacts arising from the proposed development, and proposed measures to mitigate the predicted impacts:

- Chapter 8 – Hydrogeology
- Chapter 9 – Water (Hydrology)

7.2 STUDY METHODOLOGY

7.2.1 Guidelines

The assessment of the potential impact of the proposed development on land and soils was undertaken with reference to the methodology and criteria set out in the following documents:

- EIA Directive 2014/EU/52
- National Roads Authority (TII, 2008), *Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes*;
- Environmental Protection Agency (EPA) (2022), *Guidelines on the Information to be contained in Environmental Impact Assessment Reports.*
- Institute of Geologists of Ireland (IGI) (2013), *Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements.*
- Advice Notes on Current Practice (in preparation of Environmental Impact Statements) (EPA 2003),
- EPA Draft EIAR Guidelines 2017

Impacts are characterised using Table 3.3 of the EPA Guidelines on Information to be contained in an Environmental Impact Assessment (May 2022).

7.2.2 Consultation

The following information sources were consulted:

- Geological Survey of Ireland (GSI) interactive mapping.
- Environmental Protection Agency (EPA) interactive mapping.
- Ordnance Survey Ireland (OSI) mapping.
- Topographical survey website (en-ie.topographic-map.com)
- Teagasc – Agriculture and Food Development Authority website (teagasc.ie)
- Opensource technologies such as Google Earth and Bing Maps

The following investigative surveys / reports were consulted:

- Maynooth Eastern Ring Road Project: Detailed Ground Investigation Contract – Factual Report, July 2019 (ref. P18247). A geophysical survey report was included (REPORT No. P18247_Gp_Rp_D02).

The aforementioned ground investigation was conducted in 2019 as part of the Maynooth Eastern Ring Road project, which is to bisect the proposed development. A combination of cable percussive boreholes, rotary cores, trial pits, dynamic probes and slit trenches were conducted within and adjacent to the Railpark Maynooth site boundary. The following is a list of those exploratory holes recorded in the factual report considered relevant to the area of study:

- BH101, 102, 103, 104, 105
- RC104, 105
- TP103, 104, 105, 106, 107, 108, 109
- DP106, 107
- ST104, 105, 106, 107, 117, 118, 119

7.2.3 Desktop Study

A desktop study for the site was completed and the relevant bodies and information sources referenced above used as information sources.

7.2.4 Study Area

The proposed development is a 15.27-hectare area located at Railpark, Maynooth, Co. Kildare on a greenfield site adjacent to Maynooth town southeastern side. The area is currently bounded by existing hedgerows and vegetation on all sides. An existing residential area is located immediately to the west of the site. The Royal Canal and a railway line are located approximately 450m north of the site, whilst the R405 and M4 are located several hundred metres to the south of the site.

The site will also be occupied by a proposed road to be built as part of another project called Maynooth Eastern Ring Road (MERR). This road is to bisect the site in a north-south direction. Construction of the MERR is expected to commence in 2025.

7.3 THE EXISTING RECEIVING ENVIRONMENT (BASELINE SITUATION)

Details of the existing land and soils are described in the following sections which were compiled based on the information sources listed above.

7.3.1 Topography and Land Use

Available topographical maps online (en-ie.topographic-map.com) show that the lands within the proposed development are predominantly flat between 63 and 64m OD, but also show a small mound at the northeast of the site which reaches 67m OD in elevation. The area to the west of the development is a residential area, whilst the rest of the areas are greenfields. There are no watercourses within the site boundary.

7.3.2 Topsoil & Soil

GSI's Geotechnical map identifies the quaternary sediment type at the site as 'till' derived from limestones. The residential area directly to the west of the proposed site is classified as 'urban' (see Figure 7.1). There are no other quaternary sediment types in the immediate surrounding area.

Based on the ground investigation findings, the topsoil layer within the site boundary is estimated to range between 0.25-0.6m but is typically around 0.35m thick. The subsoil is predominantly glacial till, which is generally regarded as competent ground for civil engineering purposes. Most of the available data received from this ground investigation suggests that the soil deeper than 1m below ground level has sufficient strength and stiffness values to serve as foundation level for this type of development. It is noted that TPs 104 and 105 contained 'soft silt/clay' up to a depth of 2.2m, although these trial pits are located at the southeastern corner of the proposed site. A summary of the soil profile is provided in Table 7.1.

Figure 7.1: GSI Quaternary Sediments Map (Site boundaries indicatively shown in red)

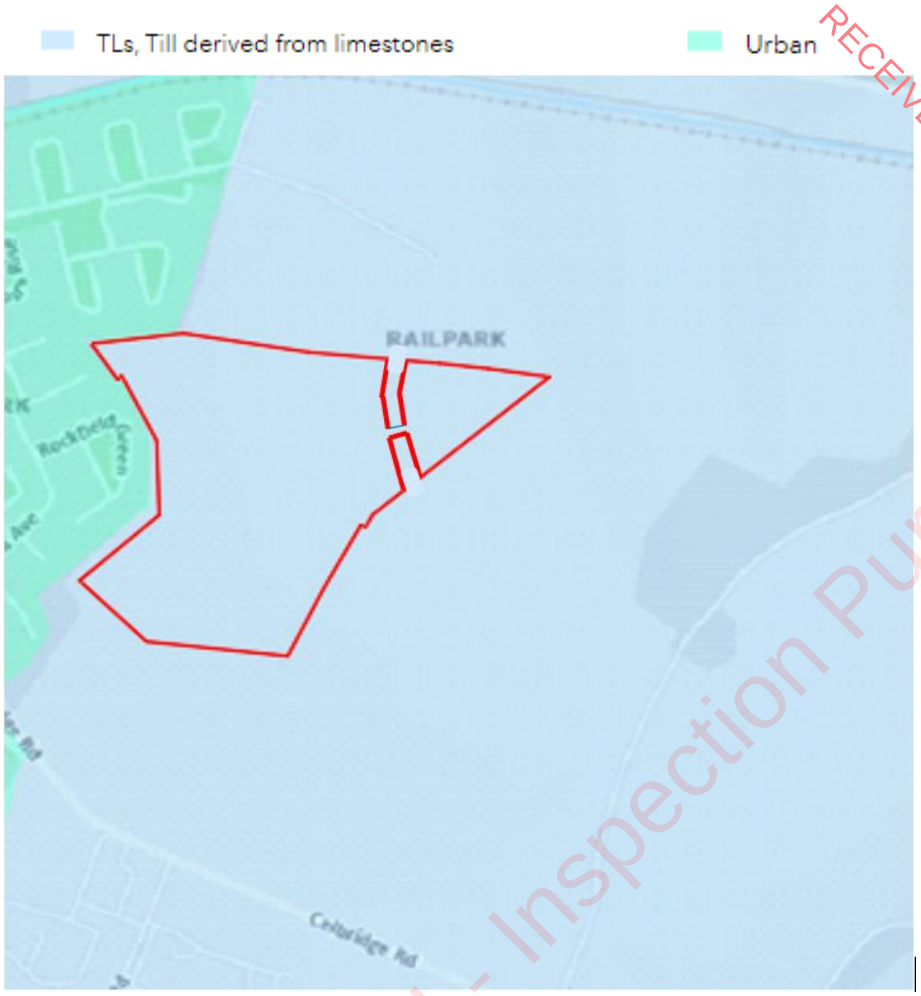


Table 7.1: Summary of Soil Profile

Soil Layer	Layer Thickness	Description
Topsoil	0.25-0.6m	Typically described as 'soft, brown, slightly sandy, gravelly silt'. Layer is typically thinner towards the north of the site. Teagasc County Soil map for Co. Kildare classifies the topsoil within the site as 'suitable to moderately suitable for tillage, pasture, meadow and forestry'.
Glacial Till	1.8-2.7m	Combination of gravel, sand and clay. Typically described as 'clayey sandy gravel' with some form of cobble and boulder content. Some localised areas of 'soft clay' (TP104, 105/ Southeast of the site).
Bedrock	N/A	Typically Waulsortian Limestones (massive, unbedded lime-mudstone), as per GSI Mapping.

7.3.3 Bedrock Geology

The bedrock geology mostly consists of Waulsortian Limestones (massive, unbedded lime-mudstone) in the development area, and Tober Colleen Formation (calcareous shales and limestone conglomerate) at the northwestern side of the site according to GSI's 1:100,000 Bedrock Geology map (see Figure 7.2).

Rotary cores were carried out in 2019 as part of the Ground Investigation for the MERR project.

Although these rotary cores were conducted to the north of the proposed Railpark Maynooth site, they provide an indication of the depth and type of rock present. Bedrock was observed in the rotary cores conducted closest to the proposed site (RC104, 105) at depths of 2.7m and 4.0m, respectively, and it was described as strong grey Limestone, slightly weathered to fresh. Competent rock (less fractured) was found at 2.7 and 5.3m respectively in both boreholes.

Figure 7.2: GSI Bedrock Geology Map (Site boundaries indicatively shown in red)

7.3.4 Hydrogeological Aspects

EPA maps indicate that the proposed development area is classified as having 'High' groundwater vulnerability. Beyond the site boundaries, there are localised areas with 'Extreme' groundwater vulnerability near to the M4 motorway, and two karst features (caves) are present to the northeast of the site, approximately 2-3km away. GSI Mapping also confirms that there are no geological heritage areas, quarries, or mineral extraction points within the site or in the surrounding areas. For further information on Hydrogeological aspects, refer to Chapter 8.

7.3.5 Contaminated Land

EPA maps show no sources of possible contamination within the proposed development's boundaries. There is no indication of any previous mining activity, industrial works or waste disposal facilities within

the site area, however, EPA maps indicate that there was a 'non-hazardous waste transfer station' to the north of the study area, on the northern side of the Royal Canal, which was operational until the facility's licence was surrendered in 2009.

The Ground Investigation Factual Report from the MERR Project, July 2019 (ref. P18247) provides no indication of contamination present on the site.

7.4 CHARACTERISTICS OF THE PROPOSED DEVELOPMENT

The proposed Maynooth Railpark site is a residential development that will include the construction of 581 units, playground, multi-use game areas, grass playing field, SuDS basins, neighbourhood centre, creche play area, multiple public open spaces, car parking spaces, internal roads, a greenway route, and vehicular access to the site via the Maynooth Eastern Ring Road. Public open space comprises an estimated 2.9 hectares of the development area. A full description of the proposed development is provided in Chapter 2 of this EIAR. A ten year permission is sought for this development.

The proposed schedule of accommodation for the development is as follows:

- 59 no. 2 bed houses;
- 275 no. 3 bed houses;
- 62 no. 4 bed houses;
- 53 no. 1 bed units (duplex and apartments);
- 92 no. 2 bed units (duplex and apartments);
- 40 no. 3 bed duplex.

It is anticipated that the main development characteristics impacting soils and geology comprise the following:

- General construction activities across the majority of the site.
- Alterations to the ground levels across the site to facilitate the specified final levels of the development.
- Excavations to facilitate the construction of foundations for housing units, road construction, landscaping and installation of services including drainage and the SuDS basin at the north of the site.
- Removal and disposal of excavated soils off-site to facilitate the proposed infrastructure.
- Importation of construction materials to the site to be used as backfill over the constructed foundations and services and also to be used as fill material to reach final design levels over existing levels, where applicable.

7.5 POTENTIAL IMPACT OF THE PROPOSED DEVELOPMENT

7.5.1 Construction Phase

This part of the chapter identifies potential and significant impacts to the soil and geology of the site as a result of the construction of the proposed development.

7.5.1.1 Excavation of Topsoil

Removal of the existing topsoil layer will be necessary practically across the entire area of study to facilitate construction of the development and to meet the final ground levels. Stripping of topsoil exposes the underlying subsoil layers to the effects of weathering and construction traffic, which could result in deterioration / erosion of the subsoil and / or produce sediment laden runoff. Some of the excavated topsoil will be incorporated into the works, and the remainder shall be removed from the site to be disposed of.

Table 7.2 below estimates the volume of topsoil required to be excavated on the site, assuming a uniform topsoil layer of 0.35m, and a total site area of 15.98Ha (159,800m^2). Table 7.2 also estimates the volumes of topsoil to be reused on site and to be disposed of. Reuse of topsoil will apply to public open spaces, private dwelling lawns and general landscaping areas.

Table 7.2: Estimated Topsoil Values

	Area (m2)	Thickness (m)	Approximate Volume (m^3)
Total topsoil within the site (0.35m thick topsoil layer)	159,800	0.35	55,930
Total topsoil to be excavated	159,800	0.35	55,930
Topsoil to be reused on site at Grasslands / Meadows	33,561	0.3	10,068
Topsoil to be reused on site at private dwelling lawns	26,218	0.3	7,865
Topsoil to be reused on site for Groundcover Planting	9,666	0.5	4,833
Total topsoil to be reused on site	-	-	22,766
Remaining topsoil to be disposed of	n/a	n/a	33,164

The total volume of topsoil to be excavated is significant partially because its thickness (0.35m) is slightly greater than the usual (0.1 to 0.2m) and because it will be removed from the entire site area.

It is considered that the removal of the existing topsoil layer will only have a temporary slight negative effect.

7.5.1.2 Excavation of Subsoil Layers, Reusability and Imported Fill Material

The excavation of subsoil layers will be required to facilitate the construction of foundations for the housing and apartments, landscaping, and installation of services on the site including drainage and the SuDS basins. Further excavations will be required for changing / modifying existing ground levels to meet final finish ground levels.

The largest part of the subsoil excavations will be related to the foundations for the housing and apartment units. As the housing on the proposed site do not have basements and the majority of the ground

investigation results show competent soils those deeper than 1m below ground level, the volume of excavated subsoil material is anticipated to be limited. However, some of the trial pits conducted as part of the MERR ground investigation indicate that 'soft clay' is present up to 2.2m depth below ground level in some areas. These trial pits are located to the Southeast of the site, however their findings are still relevant to our general assessment. It has therefore been assumed that the excavation depth required for 80% of all the proposed building's footprint area on the site is 1.25m, and for the remaining 20%, the required excavation depth has been assumed to be 2m, to allow for the presence of deeper soft clay soils in some areas. In the latter case, a 1m thick suitable backfill material shall be placed to reach a foundation level at 1m depth.

More excavations will be also undertaken at different parts throughout the site to achieve the design levels where these are below the existing ones. This will enable a suitable final topography to achieve required water lines slopes for the relevant utilities. This volume of excavation was estimated from the differences observed between existing and proposed ground levels discounting previously assessed volumes derived from topsoil excavation and subsoil excavation below the footprint areas from housing units and utility trenches.

Additional amounts of excavation will be generated from the trenches excavation for the purpose of providing relevant services and utilities across the study area. In the lack of a detailed design a preliminary assumption has been adopted considering a 1m wide by 1m deep trench for a length equal to the sum of the lengths of all the proposed residential roads within the development (approximately 3700m).

No excavations have been considered under the proposed residential roads on the basis that these will be built at grade/below topsoil base.

Based on available ground investigation information, the following reusability values have been assumed for the subsoil:

- 50% of all excavated subsoil material at trenches are deemed to be suitable for reuse.
- 50% of all excavated subsoil material from the 1.25m deep foundation excavations are deemed to be suitable for reuse.
- 70% of all excavated subsoil material from the 2m deep foundation excavations are deemed to be suitable for reuse. (This excavated material is likely to be more competent compared to that closer to ground level).
- 70% of all excavated subsoil material from the construction of the SuDS basin are deemed to be suitable for reuse. (As above, since the material is from a deeper excavation, it is likely to be more suitable for reuse.)
- 50% of all excavated subsoil material from the excavation works (estimating an average excavation depth of 0.8m) aimed to reach design levels are deemed to be suitable for reuse.

Any subsoil which is unsuitable for reuse will be removed from the site to be disposed of and will be subject to EPA licensing, except in the case where it is deemed to be suitable for landscaping purposes.

The requirements for fill material have been estimated based on the following assumptions:

- The volume required to backfill a service trench will be 90% of the volume excavated, to allow for such services/utilities volume within it.
- The volume required to backfill a 1.25m deep foundation excavation will be 90% of the volume excavated, to allow for such structural foundation.
- The volume required to backfill a 2m deep foundation excavation will be:
  - 100% of the volume excavated from 1m to 2m depth;
  - 90% of the volume excavated from ground level to 1m depth, to allow for the structural foundation.
- The volume required to reach design levels throughout the scheme has been estimated from the differences observed between the proposed ground levels and the existing ones. This fill will enable a suitable final topography to achieve required water lines slopes for the relevant utilities.
- The volume of fill material required to provide a suitable formation layer for the residential roads was estimated considering a width of 6.5m, a thickness of 300mm and a measured length of 3700m.
- No fill material was assumed to be required to provide a suitable formation layer for the cycle paths.

Approximate cut and fill values for the proposed development are shown in Table 7.3. Excavated subsoil unsuitable for reuse will require off-site disposal as it cannot be incorporated into the works, except in cases where the subsoil is deemed suitable for landscaping purposes.

Table 7.3: Estimated excavation of subsoils and fill volumes

Subsoil	Volume (m^3)
Foundations cut for housing (1.25m excavation)	24,150m^3
Foundations cut for housing (2m excavation)	11,050m^3
Subsoil excavated for trenches	2,400m^3
Subsoil excavated for SuDS basin	300m^3
Subsoil excavated for reaching design ground levels	18,000m^3
Total excavation of sub soil material	55,900m^3
Reuseable excavated material	30,200m^3
Non reusable excavated material	25,700m^3
Fill required to foundations	34,450m^3
Fill required to trenches	2,150m^3
Fill required under roads	7,200m^3
Fill required for reaching design ground levels	59,400 m^3
Total fill material required	103,250m^3
Disposal of unsuitable excavated material	25,700m^3 (*)
Fill material to be imported	73,050m^3 (*)

(*) It is noted that the disposal of unsuitable excavated material and the amount of fill material to be imported are subjected to the suitability of any excavated material for landscaping purposes, and therefore these amounts could be reduced.

The majority of the required fill material should be used for reaching the correct design ground levels. The amount of earthworks generated from subsoil excavations and placement of fill materials is not substantial relative to the scale of the scheme and it will have a slight negative effect.

7.5.1.3 Excavation of Bedrock

Rotary core logs from Report P18247_Rp_F01 suggest rock is typically found at least 3m below ground level. Rotary cores RC104 and 105 are located to the immediate north of the site and show that limestone layers were observed starting at 2.7m and 4.0m, respectively. Rotary cores RC106 – 109, which are located on the southern side of the Royal Canal, show rock commencing at a depth of at least 3m, although these rotary cores are further from the site boundary. Based on this and based on the small depths likely to be excavated it is improbable that excavation of rock will be necessary as part of the construction of the proposed development.

7.5.1.4 Construction Traffic

As per section 7.5.1.1, following topsoil stripping, there is a risk of rutting and deterioration of the exposed subsoil layers by construction vehicles and plant over the course of the construction period. This could cause erosion and generation of sediment laden run-off and mud may be deposited onto nearby roads used for access.

It will be necessary to import fill materials to site for the construction of roads, foundations and services, in addition to large quantities of bricks, concrete, steel, pipes etc. These materials will be delivered by lorry and generate a large amount of construction vehicle trips on the nearby road network during the construction phase.

It is not envisaged that there would be any adverse impacts on the existing strength and / or quality of the subsoil upon completion of the works. The impact of vehicles and plant associated with construction on the subsoil is likely to be short term, slightly negative effect on subsoil surfaces.

7.5.1.5 Accidental Spills / Leaks

During the construction phase, there is a risk of accidental pollution on the site relating to some construction activities, including:

- the storage of oils and fuels on site.
- oils and fuels leaking from construction plant / machinery.
- spillage during the refuelling and / or maintenance of construction plant / machinery.
- the use of cement and concrete during construction works.

Any potential accidental spills and leaks may cause contamination of the topsoil, subsoil, bedrock or groundwater underlying the site. The presence of firm-stiff cohesive glacial till soils at the site may limit the potential for contamination to infiltrate into the underlying groundwater.

7.5.2 Geological Environment

It is not envisaged that the proposed development will have any impact on the geological environment. The excavations associated with the construction of the development are shallow, in the order of 1-2m depth, as no basements are proposed as part of the housing units. The bedrock is typically found at 3-4m depth and therefore it is not anticipated to be exposed during excavations.

7.5.3 Human Health

Potential risks to human health due to the development could arise during construction activities which may result in direct contact, ingestion or inhalation by construction workers/personnel on site with the soils (e.g. construction workers exposed to dust generated by the construction activities within the site which may expose soils in dry weather to wind). Further risks to human health include accidental spills / leaks of hydrocarbons / oils relating to construction activities.

7.5.4 Operational Phase

It is not envisaged that there would be further direct impact on the existing soils or geology on the site following completion of construction. Landscaping and road surface areas within the development will protect the soils from exposure and erosion. Stormwater collection will prevent concentrated run-off from eroding existing soils or causing contamination.

The development when constructed will create additional impermeable surface areas. Run-off from the development's impermeable areas is designed to be collected via a new stormwater network which incorporates the on-site SuDS basins. Previous ground investigation results in nearby areas indicate that the existing subsoil has relatively low permeability and as such only a small quantity of the run-off collected from impermeable areas during the operational phase will be dissipated via infiltration into the soils. As a result, the day-to-day operational activities of the completed development are unlikely to have any direct impact on the groundwater environment or water quality.

Accidental spills or leaks of fuels and oils from vehicles on the site may be collected via run-off and directed into the stormwater network / SUDS features which could lead to a risk of impacting existing soils where infiltration occurs.

EIAR Chapter 8 provides further information in relation the strategy for the development's stormwater management.

7.6 POTENTIAL CUMULATIVE IMPACTS

Projects currently permitted or under construction are subject to EIA and/or planning conditions which include appropriate mitigation measures to minimize impacts on the land, geological and hydrogeological environment. Any cumulative impacts will be limited to the construction stage and will therefore be temporary and short-term in duration. If mitigation measures for the development are carried out as permitted, cumulative impacts on the land, geological and hydrogeological environment are not envisaged.

In addition to the MERR project, which will bisect the site in a north-south direction, a future development adjacent to the Railpark site (Celbridge Road) has been granted planning permission, however potential cumulative impacts are not anticipated, provided similar mitigation measures are implemented in both projects. There are no predicted cumulative impacts arising from the construction or operational phase.

7.7 'DO NOTHING' IMPACT

If the proposed housing development at Railpark Maynooth did not proceed, there would be no impacts on existing land, soils or geology within the development area from this project if the existing land use continued. However, as the MERR project is likely to commence construction in the near future and passes through this location, some areas of the site's land and soils will be disturbed.

7.8 AVOIDANCE, REMEDIAL & MITIGATION MEASURES

7.8.1 Incorporated Design Mitigation

- The proposed development's levels are designed to minimise cut/fill type earthworks and volume of material to be disposed off-site where possible.
- Design of site services / drainage works are in accordance with the relevant design guidance.
- Excavated material to be removed off-site to be undertaken to the relevant EPA licensing requirements.
- Landscaping works designed for the development are to protect the soils on the site from weathering and erosion.
- Information from a previous ground investigation is available. If during the construction phase should any excavated material differ significantly in nature from the soils assessed before then separate stockpiling and analysis of that material will be undertaken.

7.8.2 Construction Phase Mitigation

The Outline Construction & Environmental Management Plan (OCEMP) will be developed further by the contractor into a Construction and Environment Management Plan for the construction phase. The OCEMP includes a range of site specific measures including the following mitigation measures in relation to soils, and these should be reflected in the CEMP at construction stage:

L&S CONST 1: Construction Environmental Management Plan (CEMP)
A Construction Environmental Management Plan (CEMP) shall be prepared and agreed with the Planning Authority prior to commencement of development, and include the following mitigation measures:

- Stripping of topsoil layer is to be controlled, carefully managed, and coordinated with the proposed staging for the development.
- Topsoil stockpiles to be protected for the duration of the works and not located in areas where sediment laden runoff may enter watercourses.
- Topsoil to be re-used throughout the development in landscaping and public open spaces
- The duration that subsoil layers are exposed to the effects of weather and construction vehicles is to be kept to a minimum. This involves disturbed subsoil layers being stabilised as soon as practical. Backfilling of services trenches, construction of road capping layers, completion of landscaping, and construction of building foundations are to be conducted promptly to limit subsoil exposure.
- Any stockpiles of excavated subsoil material are to be protected for the duration of the construction works and are to be located separate to the topsoil stockpiles and any other stockpiles.
- Site mitigation measures including wheel washing and dust suppression measures to be implemented.

- Measures to be implemented to capture and treat sediment laden surface water runoff especially from foundation excavations and stripped land (e.g. sediment tanks, surface water inlet protection and earth bunding adjacent to open drainage ditches).
- Where possible, excavated subsoil material is to be reused on the site as part of the works (e.g. for landscaping works, for backfill to foundation excavations and for backfill to trenches under non-trafficked areas). It might be also reused in the construction of a suitable formation layer under the proposed residential roads.
- Plant and other construction vehicles delivering materials to site during the works will be restricted to pre-determined haul routes on and entering the site.
- All fuels, oils, paints and any other chemicals are to be stored in a secure hardstanding area.
- Servicing and re-fuelling of construction machinery to be conducted in a designated, hardstanding area if it is not possible to carry out these activities off site.
- Good housekeeping throughout the works, including use of disposal bins and site clean-ups.
- Any hazardous materials to be stored within secondary containment to prevent accidental release.
- All materials removed from site are to be classified prior to removal to ensure correct and appropriate disposal to either a licenced landfill or recovery facility in accordance with The Waste Management Regulations 1998. Any materials that are unable to be reused on site are to be disposed of off-site under licence
- Where bedrock / boulders are encountered in excavations, option to crush and reuse to be considered depending on quantity of material excavated. Screened material may be reused as a fill material e.g. in road construction and backfill to service trenches.
- Where feasible, excavated material is to be reused on the site as part of the works. Any unsuitable excavated subsoil will have to be removed to an approved landfill for disposal.

7.8.3 Operational Phase

Mitigation measures envisaged during the operational phase include:

L&S OPERA 1: Sustainable Urban Drainage

- Ensuring regular maintenance of site services, SuDS features, such as the SuDS basin, and attenuation systems, such that they operate as designed.

7.9 RESIDUAL EFFECTS OF THE PROPOSED DEVELOPMENT

The proposed development will alter the current land use from greenfield to residential development with public open space and landscaped areas. The impact on land, soil, geology, and hydrogeology from accidental spillages of fuel and lubricants used during the construction phase of the development is predicted to be minimal when stored and used in a responsible manner. After implementation of the mitigation measures recommended above for the construction phase, the proposed development will not give rise to any significant long term adverse impact.

Implementation of the measures outlined in Section 7.8 will ensure that the potential impacts of the development on soils and the geological environment are minimised during the construction phase and that any predicted impacts will be short term, and imperceptible.

Predicted Impacts from earthworks haulage and the risk of contamination of groundwater are deemed to be of minor risk. The residual impacts for a residential housing development and associated open spaces are deemed to be imperceptible post construction (during the operational phase).

Implementation of the mitigation measures outlined above will ensure that potential significant effects of the proposed development on land, soils and geology do not occur during the construction phase and that any residual effects will be short term and not significant.

7.10 MONITORING

Construction phase monitoring relates to the good maintenance of mitigation measures outlined above in section 7.8 including the Outline Construction and Environmental Management Plan (OCEMP). Soil removed during the construction phase is to be monitored to maximise potential for re-use on site. Monitoring of any hazardous material stored on-site will form part of the proposed Construction Waste Management Plan. A dust management/monitoring programme should be implemented in accordance with the mitigation measures in section 7.8 and the OCEMP.

7.10.1 Monitoring measures – construction

Proposed monitoring during the construction phase concerning the soil and geological environment are as follows:

- Contractors will be recommended to adhere to the CEMP.
- Construction monitoring of the works (e.g. inspection of existing ground conditions on completion of cut to road sub-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 of vehicle wheel wash facilities.
- Monitoring of contractor's stockpile management (e.g. protection of excavated material to be reused as fill; protection of soils from contamination for removal from site)
- Monitoring sediment control measures (sediment retention ponds, surface water inlet protection etc.)
- Soil removed during the construction phase will be monitored to maximise potential for re-use on site. Any contaminated soil encountered to be analysed and disposed of at a suitable licensed facility.
- The quantities of topsoil and subsoil removed off site will be recorded.

7.10.2 Monitoring measures – operational phase

No ongoing monitoring will be necessary during the operational phase.

7.11 REINSTATEMENT

There is no requirement to assess if these lands can be fully reinstated to green field in the future scenario.

7.12 INTERACTIONS

Land, soils and geology closely interact with hydrogeology and hydrology. The potential impacts of which are discussed in Chapters 8 and 9, respectively. The mitigation measures to be implemented at the proposed development will ensure that the proposed development's impact complies with all legislative limits regarding surface and groundwater. Any potential impacts in relation to the construction phase shall be short-term slightly negative.

7.13 DIFFICULTIES ENCOUNTERED IN COMPILING

No particular difficulties were encountered in completing this chapter. It is noted that all soil volumes calculated are estimated volumes based on similar schemes and a review of the available information for this proposal. Actual volumes or amounts may change based on final detailed design and the condition of soils when exposed / excavated.

7.14 REFERENCES

- Geological Survey Ireland (GSI) online mapping.
- EPA (2025) EPA maps
- Maynooth Eastern Ring Road Ground Investigation Report

CHAPTER 8

HYDROGEOLOGY

8.0 HYDROGEOLOGY

8.1 INTRODUCTION

This chapter of the Environmental Impact Assessment Report (EIAR) evaluates the proposed development in relation to hydrogeology. This section assesses and evaluates the impact of the proposed development on the underlying groundwater body/ aquifer during the construction and operational phases. All natural water bodies including groundwater (till deposit and bedrock) and where applicable downgradient groundwater receptors (boreholes, wells, springs and water supplies), groundwater dependent habitats and groundwater flood areas that may be impacted by the proposed development are assessed. Interactions between the proposed development and other developments in the vicinity are assessed in terms of the cumulative impact.

This report has been prepared in accordance with the European Commission, 2017, Environmental Impact Assessment of Projects Guidance on the preparation of the Environmental Impact Assessment Report[1] and Environment Protection Agency (EPA, 2022) Guidelines on the information to be contained in Environmental Impact Assessment Reports[2], Irish Geological Institute (IGI, 2013) Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements[3] as outlined in the following sections.

A Flood Risk Assessment (SSFRA) has been completed by Roughan and O' Donovan Consulting Limited and is included as a standalone report with this application. This report has contributed to the contents of the EIAR, and the assessment below.

This chapter was prepared by Maryann Nwankwo BSc (Hons) MSc hydrogeology, CWEM, MCIWEM, CENV, FGS of Roughan and O'Donovan Consulting Engineers Limited.

Maryann is a Senior Hydrogeologist with over 16 years' experience in consultancy. She has worked on varieties of projects in water and environment for UK, Ireland and internationally. Leveraging on her strong communication skills, Maryann has completed several projects relating to environmental impact assessment and in particular, aspects relating to water. Her principal area of expertise is ground investigation, water quality monitoring and assessment, contaminated land studies, water resources, Environmental Impact Assessment (EIA), dewatering impact assessment, water resource estimation, flood risk assessment, and modelling. She is a chartered member of CIWEM, a Chartered Environmentalist and a fellow of the Geological Society of London.

8.1.1 Legislation, Policy and Guidance

8.1.1.1 Introduction

This study complies with the Environmental Impact Assessment (EIA) defined in Directive 2011/92/EU (as amended by Directive 2014/52/EU) for certain types of major development before development

[1] European Union (EU), 2017. Environmental Impact Assessment of Projects Guidance on the preparation of the Environmental Impact Assessment Report (Directive 2011/92/EU as amended by 2014/52/EU). Available at Contact support (europa.eu) [Accessed on 12th July 2024]
[2] EPA (2022) Guidelines on the information to be contained in Environmental Impact Assessment Reports. Available at https://www.epa.ie/publications/monitoring--assessment/assessment/EIAR_Guidelines_2022_Web.pdf [Accessed on 12th November 2024]
[3] IGI (2013. Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements https://igi.ie/assets/files/Codes%20and%20Guidelines/IGI%20Enviro%20Impact%202013.pdf [Accessed on 18th November 2024]

consent is granted. This study was undertaken in accordance with the Irish legislation (transposition of the aforementioned directive):SI No. 296 of 2018: European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018.

8.1.1.2 European Legislation

The Water Framework Directive (WFD), which was passed by the European Union (EU) in 2000, and came into legal effect in December 2015, is a wide-reaching legislation which replaces a number of the other water quality directives. The WFD 2000/60/EC establishes a framework for community action in the field of water policy. The WFD seeks to enhance the status of aquatic ecosystems, promotes sustainable water use and contributes to mitigating the effects of flood and drought.

The Council Directive (80/68/EEC) of 17 December 1970 on the protection of groundwater against pollution caused by certain dangerous substances is no longer in force and is repealed by Directive 2006/118/EC of the European Parliament and of the Council of 12 December 2006 on the protection of groundwater against pollution and deterioration. This Directive establishes specific measures as provided for in Article 17(1) and (2) of Directive 2000/60/EC in order to prevent and control groundwater pollution. These measures include in particular:

(a) criteria for the assessment of good groundwater chemical status; and

(b) criteria for the identification and reversal of significant and sustained upward trends and for the definition of starting points for trend reversals.

This Directive also complements the provisions preventing or limiting inputs of pollutants into groundwater already contained in Directive 2000/60/EC and aims to prevent the deterioration of the status of all bodies of groundwater.

The requirements of these directives have been transposed into Irish law through the Planning and Development Act 2000 (as amended), the Regulations made under the European Communities Act (1972) including the European Communities (Environmental Impact Assessment) Regulations 1989 – 2006, the European Union.

- The Water Framework Directive (2000/60/EC) and resultant regulations include.
  - European Communities (Water Policy) Regulations, 2003 (S.I. No. 722 of 2003);
  - European Communities Environmental Objectives (Surface Waters) Regulations, 2009 (S.I. No. 272 of 2009);
  - European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010)
  - European Communities (Technical Specifications for the Chemical Analysis and Monitoring of Water Status) Regulations, 2011 (S.I. No. 489 of 2011)
  - European Union (Water Policy) Regulations 2014 (S.I. No. 350 of 2014)
- Environmental Impact Assessment Directive (2011/92/EU);
- Integrated Pollution and Prevention Control Directive (2008/1/EC);
- The management of waste from extractive industries (2006/21/EC);

- Environmental Liability Directive (2004/35/EC);
- Groundwater Directive (2006/118/EC); and
- Habitats Directive (1992/43/EEC).

In January 2014 the Freshwater Fish Directive (2006/44/EC) was revoked and was subsumed under the WFD. The WFD is implemented through a series of River Basin Management Plans.

8.1.1.3 National Irish Legislation on the protection of the water environment

The Protection of Water, including groundwater was determined with the enactment of the Water Protection Act of 1977. This act was amended by the Local Government (Water Pollution) (Amendment) Act of 1990. Its pollution control provisions are fully applicable to groundwater. Part IV of the regulations makes further provisions for the control of discharges of harmful substances to groundwater. Since 2000 water management in EU member states has primarily been directed by the Water Framework Directive (2000/60/EC) and the associate 'daughter' Groundwater Directive (2006/118/EC). Irish legislation implementing these, and other relevant directives currently includes:

- S.I. No. 9 of 2010 European Communities Environmental Objectives (Groundwater);
- Regulations 2010 and amendments (S.I. 389 of 2011 and S.I. 149 of 2012).
- S.I. No. 272 of 2009 European Communities Environmental Objectives (Surface Waters);
- Regulations 2009 and amendment (S.I. 327 of 2012);
- S.I. No. 684 of 2007 Waste Water Discharge (Authorisation) Regulations, 2007, as amended (S.I 231 of 2010);
- S.I. No. 278 of 2007 European Communities (Drinking Water) (No.2) Regulations;
- Water Services Acts 2007 and 2012;
- S.I. No. 722 of 2003 European Communities (Water Policy) Regulations.
- S.I. No. 122 of 2010 European Communities (Assessment and Management of Flood Risks) Regulations 2010; and
- S.I. No. 457 of 2008 European Communities (Environmental Liability) Regulations which bring into force the Environmental Liability Directive (2004/35/EC).

8.1.1.4 Guidelines

The assessment of the potential impact of the proposed development on water bodies was carried out in accordance with the methodology and the specific criteria set out in the following documents:

- EPA Guidelines on Information to be Contained in an Environmental Impact Statement (2022);
- EIA Directive 2014/EU/52, Advice Notes on Current Practice (in preparation of Environmental Impact Statements) (EPA 2003);
- Environmental Impact Assessment (EIA), Guidance for Consent Authorities Regarding Sub-Threshold Development (DoEHLG 2003),
- Development Management Guidelines (DoEHLG, 2007); and

- Guidelines for Planning Authorities and An Bord Pleanála on Carrying out Environmental Impact Assessments (DoECLG, March 2013).

8.1.1.5 Kildare County Development Plan 2023-2029 (2023)

The Kildare County Development Plan 2023-2029 which took effect on 28th January 2023 is the key strategy document which structures the proper planning and sustainable development of land-use across County Kildare over the six-year statutory time period of the plan.

The aspects of the Kidare County Development Plan and the policies therein relevant to this assessment include:

- IN O23 - Require new developments to reduce the generation of storm water runoff and ensure all storm water generated is disposed of on-site OR attenuated and treated prior to discharge to an approved water system, with consideration for the following:
    - The infiltration into the ground through the provision of porous pavement such as permeable paving, swales, and detention basins.
    - The holding of water in storage areas through the construction of green roofs, rainwater harvesting, detention basins, ponds, and wetlands.
    - The slow-down in the movement of water.
- IN O24 - Only consider underground retention solutions when all other options have been exhausted. Underground tanks and storage systems will not be accepted under public open space, as part of a SuDS solution.
- IN 025 - Promote the use of green infrastructure (e.g., green roofs, green walls, planting, and green spaces) as natural water retention measures.
- IN- 026 - Ensure as far as practical that the design of SuDS enhances the quality of open spaces. SuDS do not form part of the public open space provision, except where it contributes in a significant and positive way to the design and quality of open space. In instances where the Council determines that SuDS make a significant and positive contribution to open space, a maximum of 10% of open space provision shall be taken up by SuDS. The Council will consider the provision of SuDS on existing open space, where appropriate.
- Ensure development proposals in rural areas demonstrate compliance with the following:
    - The ability of a site in an un-serviced area to accommodate an onsite wastewater disposal system in accordance with the County Kildare Groundwater Protection Scheme, and any other relevant documents and legislation as may be introduced during the Plan period.
    - The ability of a site in an un-serviced area to accommodate an appropriate on-site surface water management system in accordance with the policies of the Greater Dublin Strategic Drainage Study (2005), in particular those of Sustainable Urban Drainage Systems (SuDS).
    - The need to comply with the requirements of the Planning Systems and Flood Risk Management Guidelines for Planning Authorities, published by the Minister for the Environment, Heritage, and Local Government (2009) quality of open spaces. SuDS do not form part of the public open space provision, except where it contributes in a significant and positive way to the design and quality of open space. In instances where the Council determines that SuDS make a significant and positive contribution to open space, a maximum of 10% of open space provision shall be taken up by SuDS. The Council will consider the

provision of SuDS on existing open space, where appropriate. The 'Sustainable Urban Drainage Systems Guidance Document' prepared as an action of this plan shall supersede this standard.

- IN P7 - Support the implementation of the Water Framework Directive, the River Basin Management Plan, and the Local Authority Waters Programme in achieving and maintaining at least good ecological status for all water bodies in the county.
- IN O56 - Protect water quality from pollution by agricultural sources and to promote the use of good farming practices in accordance with the Nitrates Directive (91/676/EEC) and Ireland's Nitrates Action Programme 2017- 2021 (including any subsequent update).
- IN O58 - Require development proposals which may have an impact on water quality to undertake site specific assessments to determine localised pressures and demonstrate suitable mitigation measures to protect water quality.

8.2 STUDY METHODOLOGY

8.2.1 Consultation

Informal scoping of potential environmental impacts was undertaken by consultations with the Planning Authority through pre-application meetings.

8.2.2 Sources of information

Information regarding the local surface water and hydrogeological environments was assembled from the following sources:

- Environmental Protection Agency (EPA) interactive mapping and water quality data;
- Ordnance survey Ireland (OSI) mapping;
- Geological Survey of Ireland (GSI) online mapping service;
- Topographical survey;
- Site inspection / walkover;
- Office of Public Works (OPW) National Flood Hazard Mapping & CFRAM Studies (Catchment Flood Risk and Management Studies);
- Kildare County Development (January 2023) Plan 2023 – 2029;
- Kildare County Council Sustainable Drainage Systems Guidance Document 2024;
- System and Flood Risk Management Guidelines;
- Irish Water Standard Details and Codes of Practice for Water and Wastewater Infrastructure;
- CIRIA Sustainable urban Drainage Systems (SuDS) Manual C753 (2015);
- Inland Fisheries Ireland Planning for Watercourses in the Urban Environment; and
- Roughan and O'Donovan (2019) Maynooth Eastern Ring Road Part VIII Planning Application Report.

8.2.3 Desk study

This chapter entails a desk study of the area of the proposed development to establish the baseline conditions. The desk study involved collecting all relevant geological, hydrological, hydrogeological data available for the study area. The characterisation of the baseline hydrogeological condition for the proposed development is based upon analysis of the data sources presented in Section 8.2.2 of this chapter. It encompasses knowledge obtained from site visits and information from the EPA and Geological Survey of Ireland (GSI) websites. Geological Survey of Ireland holds records of historical field surveys that were carried out and these were used to assess the hydrogeological aspects of the proposed development.

8.2.4 Assessment Methodology

An assessment of potential impacts from the proposed development on local hydrogeology were undertaken through a combination of desk-based analysis, site survey work, qualitative and quantitative impact assessment and consideration of potential impact mitigation requirements. The potential impacts from the proposed development have been defined by reference to baseline geological, hydrogeological assessment and detailed development design proposals. Where necessary, mitigation measures have been defined for any effects considered to be significant with the aim of reducing any residual risk to an acceptable level. The criteria for determining the significance of impact is based upon the following:

- Assessment of potential receptor sensitivity;
- Assessment of potential magnitude of impact; and
- Determination of potential impact significance.

The assessment was completed in the sequence described below.

A source - pathway - receptor model is used to identify the level of risk to groundwater receptors within/adjacent/down hydraulic gradient of the Proposed development in terms of flow, sediment and pollutants.

The receptor sensitivity is defined as low, medium, high, very high and extremely high depending on the specific receptor character and its ability to tolerate change as presented in Table 8.1.

Table 8.1: Criteria for rating the importance of identified features (based on NRA Guidelines (2008); Box 4.3: Criteria for Rating Site Attributes- Hydrogeology

Importance	Criteria	Typical Example
Extremely High	Attribute has a high quality or value on an international scale.	Groundwater that supports river, wetland or surface water body ecosystem protected by EU legislation e.g. 'European sites' either SAC or SPA status.
Very High	Attribute has a high quality or value on a regional or national scale.	Regionally Important Aquifer with multiple Wellfields. Groundwater that supports river, wetland or surface water body ecosystem protected by National Legislation – NHA status. Regionally important water supply supplying > 2500 homes. Inner source protection area for regionally important water source.

Importance	Criteria	Typical Example
High	Attribute has a high quality or value on a local scale	Regionally Important Aquifer. Groundwater provides large proportion of baseflow to local rivers. Regionally important water supply supplying > 1000 homes. Outer Source protection area for Regionally important water source. Inner source protection area for locally important water source.
Medium	Attribute has a medium quality or value on a local scale	Locally Important Aquifer Potable water supply > 50 homes Outer Source protection area for Regionally Locally important water Source from flooding.
Low	Attribute has a low quality or value on a local scale	Poor Bedrock Aquifer Potable water source supplying < 50 homes

The magnitude of potential impacts arising as a product of the Development are defined in accordance with the criteria provided by EPA (2022), presented in Table 8.2. These descriptive phrases are considered general terms for describing potential effects of the Development, and allow consideration of baseline tends, for example, a Moderate impact is one which is consistent with the existing or emerging trends. The magnitude of impact is defined below:

- Imperceptible (Negligible) - an impact capable of measurement but without noticeable consequences.
- Slight (Small Adverse) - an impact that alters the character of the environment without affecting its sensitivities.
- Moderate (Moderate Adverse) - an impact that alters the character of the environment in a manner that is consistent with the existing or emerging trend;
- Significant (Large Adverse) - an impact, which by its character, magnitude, duration or intensity alters a sensitive aspect of the environment; and
- Profound- an impact which obliterates all previous sensitive characteristics.
- This matrix defined in Table 8.2 is adapted from the NRA (2008) Guidelines. The Significance of any impact is determined based on:
- the Importance of the feature to be protected; and
- the magnitude of the impact on the receiving geological/hydrogeological environment

For each hydrogeological feature, the magnitude of the impact has been assessed in the absence of mitigation. The impact rating in Table 8.2 takes into account the sensitivity/ importance of the feature in combination with the magnitude/character/duration/likelihood and consequences of any potential impact.

Table 8.2: Rating of significance of Impact at EIAR Stage

		Magnitude of Impact			
Sensitivity (Importance of Attribute)		**Negligible**	**Small**	**Moderate**	**Large**
	Extremely High	Imperceptible	Significant	Profound	Profound

		Magnitude of Impact			
	Very High	Imperceptible	Significant / Moderate	Profound / Significant	Profound
	High	Imperceptible	Moderate / Slight	Significant / Moderate	Severe / Significant
	Medium	Imperceptible	Slight	Moderate	Significant
	Low	Imperceptible	Imperceptible	Slight	Slight / Moderate

The final element of the steps adopted in this assessment builds on the outcome of the preceding elements, by identifying mitigation measures to address potential significant or profound effects and then assessing the significance of any residual impacts. The embedded design measures which have been incorporated into the design for the proposed development are detailed in Section 10. The final impact assessment includes a description of any residual impact and cumulative impact. The significance of any residual impact is determined based on the same methodology and reported. The application of methodology was carried out as per the guidelines referenced in section 8.1 above.

8.2.5 Study Area

The Proposed development is located at Railpark, Maynooth, Co. Kildare, approximately 1km southeast of Maynooth town centre. The lands are currently greenfield bounded by existing hedgerows/vegetation on all sides with existing residential developments also located immediately to the west (as shown on Drawing No. 24.111-ROD-EAC-SW_AE-DR-EN-300001-Study area).

The Proposed development lands have a site area of approximately 15.27 hectares and the area under study compasses the Proposed development and areas that are within 2km of the redline boundary.

8.3 THE EXISTING RECEIVING ENVIRONMENT (BASELINE SITUATION)

8.3.1 Topography and Land use

The subject lands within the Proposed development are predominantly flat in character with a gentle slope from an elevation of approximately 65m above ordnance datum (mOD) in the area along the eastern boundary (i.e. 470m west of L5053 road). The land in the northern boundary of the Proposed development which is approximately 425m south of the waterbody, the Royal Canal Main Line (Liffey and Dublin Bay) and railway is at an elevation of circ. 62mOD.

8.3.2 Bedrock Aquifer Classification

The bedrock geology consists of Waulsortian Limestones (massive, unbedded lime-mudstones) which underlies the majority of the Proposed development with Tober Colleen Formation (calcareous shales and limestone conglomerate) underlying a small area in the northwestern corner according to GSI's 1:100,000 Bedrock Geology map on the GSI Spatial Resources website[4].

[4] Geological Survey of Ireland. Bedrock Geology. Available at Geological Survey Ireland Spatial Resources (arcgis.com). [Accessed on 10th October 2024]

ROD (2019)[5] in their report relating to the Maynooth Ring Road Project noted that good quality limestone was also confirmed in all rotary boreholes. The overburden is typically 3 to 4 m deep, with the greatest thickness of 4.5m recorded just north of the Royal Canal Main Line (Liffey and Dublin Bay). The overburden is of homogenous composition, described as till derived from limestones in GSI's 1:100,000 Quaternary Sediments map on GSI Spatial Resources website. The borehole logs confirm this, consistently describing the overburden as firm to stiff sandy gravely clay. In addition to this, trial pits occasionally describe the uppermost layer as topsoil (sandy gravelly silt/clay), with typical depths up to 1m.

The groundwater rock unit underlying the Proposed development is Dinantian Pure Unbedded Limestones (bedrock). The Dinantian Pure Unbedded Limestones is classified as a Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones (Ll). An aquifer is a body of rock that holds groundwater. Locally important aquifers are capable of supplying locally important abstractions (e.g. smaller public water supplies, group schemes), or good yields (100-400 m^3/d). In the bedrock aquifers, groundwater predominantly flows through fractures, fissures, joints or conduits.

The groundwater units and their respective classification are described in Table 8.3.

Table 8.3: Groundwater Rock Units and Aquifer Classification within 2km of the Proposed Development

Groundwater Rock Units	Description and designation	Location with respect to the proposed development
Dinantian Pure Unbedded Limestones	Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones	Underlies the proposed development and extends to the areas north and south outside the boundary.
Dinantian Upper Impure Limestones	Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones	Underlies areas outside the proposed development boundary in the east and west.

8.3.3 Groundwater Vulnerability

In accordance with the Water Framework Directive (2000/60/EC) it is necessary to understand the groundwater vulnerability of the site, which is defined as the tendency and likelihood for general contaminants to reach the water table after introduction at the ground surface. The GSI vulnerability mapping guidelines are as per GSI (www.gsi.ie) Groundwater vulnerability classifications. These are based on the type and thickness of subsoils and the presence of karst features.

The groundwater vulnerability classification which is based primarily on the overburden depth and also on the subsoil permeability and the nature of the underlying aquifer provides a vulnerability measure for pollution of the underlying aquifer and groundwater resources. There are five levels of groundwater vulnerability classified by the GSI, namely:

- Extreme with outcropping or sub-cropping: X;
- Extreme (overburden cover < 3m): E;
- High (overburden cover 3 to 5m): H;

[5] Roughan and O Donovan (2019) Maynooth Eastern Ring Road Part VIII Planning Application Report.

- Moderate (overburden cover 5 to 10): M; and
- Low (overburden cover > 10m): L.

The vulnerability category assigned to a site, or an area is thus based on the relative ease with which infiltrating water and potential contaminants may reach groundwater in a vertical or sub-vertical direction. The groundwater vulnerability class of groundwater underlying the study area is shown in 24-111-ROD-EAC-SW_AE-DR-EN-300002-Groundwater Vulnerability class. GSI Data viewer mapping classifies the proposed development's groundwater vulnerability as "High".

Within the 2km of the Proposed development, the vulnerability class of groundwater ranges from Moderate to Rocks at or near surface. The area approximately 700m southeast of the Proposed development boundary is underlain by groundwater of Extreme vulnerability and encloses small areas with Rock at or near surface vulnerability. These areas are proximal to the Ballygoran Reservoir. There are other isolated areas within the study area where groundwater is classed as Extreme and encloses small areas with Rock at or near surface vulnerability and these areas are 700m southwest, 1700m west and 1000m northwest and 1600m northeast of the Proposed development.

8.3.4 Soil and subsoil type, permeability

The GSI Spatial Resources Teagasc soil mapping identifies the underlying the Quaternary Sediment Type as Till derived from limestones (TLs) at the Proposed development (refer Teagasc soils mapping of the area).

Only a small section in the northwestern corner of the Proposed development is underlain by 'Urban'.

The following are the description of Quaternary Sediment Type outside of the boundary of the Proposed development:

- Made ground is expected to be present where residential buildings are present to the west and southwest of the Proposed development and these comprise hard standing areas described as Urban on the GSI map. Urban indicates deposits associated with anthropogenic action. The subsoil comprises the unconsolidated geological deposit known as the till deposit;
- Alluvium is present along the Royal Canal Main Line (Liffey and Dublin Bay). It is expected that the areas with fill and embankment limited to the Royal Canal Main Line (Liffey and Dublin Bay) comprises hardstanding materials;
- Cut over raised peat is present at approximately 900m south of M4 road;
- Lacustrine sediments are present in an isolated area north of R148 road; and
- Along the M4 road are small, isolated areas with Bedrock outcrop or subcrop associated with the Ballygoran Reservoir.

The permeability of the subsoils underlying the Proposed development is Moderate. Outside the boundary of the Proposed development (within 2km of the boundary) are predominantly areas with subsoils of Low permeability and other isolated small areas that are Not mapped.

8.3.5 Study Area Ground Condition and Groundwater

Three (No 3) historical ground investigation reports were reviewed to establish the ground condition of the Proposed development and areas proximal. These include:

- Site Investigation Liffey Valley Regional Sewerage Scheme, Part 11 Pumping Stations for Kidare County Council (by Nicholas O'Dwyer, Son & Partners Consulting Ltd;
- Irish Soil Laboratories Limited, Leixlip Bypass Report No. 513 (31088), Vol. 1; and
- Maynopoth Eastern Ring Road Detailed Ground Investigation Contract Factual Report No P18247.

Below are the summary of the two boreholes drilled as part of the Site Investigation for Liffey Valley Regional Sewerage Scheme pumping station in Maynooth which is approximately at 1.26km north west from the nearest boundary of the Proposed development. The lithology comprises:

- Soils -both boreholes at this site encountered firm brown organic clay with some sand and fine gravel from Ground Level to 1.40m deep. It was noticed in one of the boreholes that this soil contained the remnants of dried (or partly dried) sewage sludge;
- Superficial deposit- immediately beneath the soil layer the two boreholes encountered 1.30m of grey sandy clay over sand and gravel with cobbles and boulders; and
- Cohesive deposits were encountered from ground level to 2.70m and 3.30m deep in two boreholes. The consistency of these deposit was firm to stiff, however they may soften under wetter weather conditions than were prevailing during the investigation.

A summary of the lithology extrapolated from the ground investigation of the Maynooth Eastern Ring Road project has been summarised and presented in Table 8.4.

Table 8.4: Geological strata underlying the study area

Lithology	Depth (Ranges) (m)	Depth Ranges (mOD)	Location with respect to the Proposed development
Topsoil - Brown, slightly gravelly sandy SILT with low cobble content. Sand is fine to coarse. Gravel is fine to coarse.	0.5 - 1.0	61.44 - 62.70	Present in trial pits 103-106 outside of the proposed development, including trail pits 107 and 108 located within the proposed development area.
Grey, brown, silty very sandy GRAVEL with high cobble content and low boulder content (Broken rock). Cobbles are sub-angular to sub-rounded, 63mm to 200mm dia, Limestone lithology. Boulders are 200mm to 400mm dia, sub-angular to angular, Limestone lithology.	1.0 - 3.2	59.41 - 61.47	Present in trial pit 106 located outside the proposed development area. It is also in trail pit 108 located inside the development area.
Grey, brown, slightly sandy slightly gravelly CLAY/ SILT with medium / high cobble content and low boulder content. Cobbles are 63mm to	0.8 – 3.40	56.28 - 61.64	Present in all trial pits apart from 106 which is not located in the proposed development area whilst 108 is located in the proposed development area. It is also present in all

Lithology	Depth (Ranges) (m)	Depth Ranges (mOD)	Location with respect to the Proposed development
200mm dia, angular to sub-angular, Limestone lithology. Boulders are angular to sub-angular, Limestone lithology.			boreholes however, none are located in the proposed development area.

Topsoil comprising brown slightly gravelly sandy silt is shown to be consistent across the Proposed development. Borehole (BH101) close the boundary of the Proposed development in the northeast shows that the grey, brown, slightly sandy slightly gravelly Clay/Silt is shallower in that area compared to the depths shown across the Proposed development as it terminates at 0.8m (at the top of the bedrock). Gravel lenses were shown in two (2) trial pits, and this layer is not extensive across the Proposed development. The top of the bedrock ranges between 0.8m to 3.4m and this confirms that the bedrock is between 3-5m. This range of depth (3-5m) to bedrock combined with the moderate permeability class of subsoils relates to groundwater vulnerability class of 'High'.

8.3.6 Groundwater Waterbody and WFD catchment

The Proposed development lies within the Hydrometric Area 9 known as the Dublin Groundwater Body (GWB). GWB is the management unit under the WFD. Groundwater bodies are subdivisions of large geographical areas of aquifers to allow effective management to protect the groundwater and linked surface waters[6]. This GWB is located in the Greater Dublin City area and extends southwest towards Kildare. The area is generally low-lying, with areas of higher elevation surrounding to the south and to a lesser extent to the north. Elevations decrease towards the various river estuaries around Dublin city. At the boundaries of the GWB the highest elevations are to the south at the foothills of the Dublin Mountains and to the northwest where the Namurian rocks form an area of higher elevation to the southwest of Dunshaughlin[7].

In the bedrock aquifers, groundwater predominantly flows through fractures, fissures, joints or conduits. In general, transmissivity in these rock units is likely to be low (1 - 10m^2/d). Secondary dolomitisation along faults in the Dublin area suggests that they have been, and may still be, open to allow fluid migration. A series of hydrogeological tests were carried out in the Barrockstown area around 4.5km north of Maynooth. Double Packer tests carried out on two boreholes in the area gave permeabilities ranging from 1.4 x 10^{-6} to 6.1 x 10^{-7}m/s. In situ Rising/Falling Head tests in eight of the bedrock wells gave similar results but more diverse than the packer test results, varying from 5.04 x 10^{-5} to 7.39 x 10^{-9} m/s. Pumping test analysis at the public supply boreholes at Dunboyne, Co. Meath (22 km northwest of Dublin) provided transmissivity values between 10 and 150 m^2 /d. There are thick deposits of till along the coast, over 10m thick in places. The thickness reduces further inland. In the West of Lucan (at approximately 13km east of the Proposed development) the till deposits are mostly quite thin (<3m), with some exceptions e.g. along the river channels of the Liffey and other streams[6].

[6] Geological Survey Ireland (2024) Programmes and Projects Groundwater Activities Available at www.gsi.ie/en-ie/programmes-and-projects/groundwater/activities/understanding-ireland-groundwater/Pages/Groundwater-bodies.aspx [Accessed on 10th October 2024]
[7] Geological Society of Ireland (2024) Dublin GWB: Summary of Initial Characterisation. Available at https://gsi.geodata.gov.ie [Accessed on 10th October 2024]

8.3.7 Ground Waterbodies WFD Risk 3rd Cycle and Status

In terms of the WFD Risk 3rd Cycle for Ground Waterbodies, Dublin GWB (IE_EA_G_008) is projected as Review according to the EPA Online Map[8]. Waterbodies that are categorised as Review either because additional information is needed to determine their status before resources and more targeted measures are initiated or the measures have been undertaken, e.g., a wastewater treatment plant upgrade, but the outcome has not yet been measured/monitored.

The Ground Waterbody WFD Status 2016 - 2021 for the Dublin GWB is Good[8]. This dataset contains status results based on the assessment of groundwater chemical and quantitative figures in Ireland. This is drawn from the representative monitoring points selected specifically for the WFD groundwater monitoring programme.
The trends in groundwater status as follows:

- Ground Waterbody WFD Status 2010 – 2015: Good;
- Ground Waterbody WFD Status 2013 – 2018:Good; and
- Ground Waterbody WFD Status 2016 – 2021:Good.

The "parameters" used in classification are groundwater level regime for quantitative status; and conductivity and the concentrations of pollutants for chemical status. The result show that Dublin GWB has maintained a Good status for the period between 2010 and 2021.

8.3.8 Groundwater flow

Given that the Proposed development has a northern boundary proximal to the Royal Canal Main Line (Liffey and Dublin Bay) and the topographic gradient is towards the Royal Canal Main Line (Liffey and Dublin Bay) and Rye Water_040, it is likely that groundwater will discharge to the local surface water bodies (Rye Water_040) in the locale. Groundwater flow is expected to be slow moving as the bedrock is only moderately productive in local zones as such is further impeded by the overburden comprising gravel with cobbles and boulder.

Regional groundwater flow is expected to be north easterly in the direction of Carton Demesne and the Rye Water_040.

8.3.9 Groundwater recharge

The recharge to the aquifer underlying the Proposed development is controlled by the permeability of the overlying soils and subsoils. Recharge is the primary method through which water enters the aquifer. Groundwater recharge is defined as the downward movement of water from the unsaturated (vadose) zone of soil or rock and into the groundwater. The lower the recharge, the less likely for groundwater to flow to the saturated unit of the superficial deposit or bedrock. The greenfield underlying the Proposed development has moderate permeability and consequently moderate recharge. The bedrock is confined by Boulder Clay which is likely to limit recharge to the bedrock aquifer.

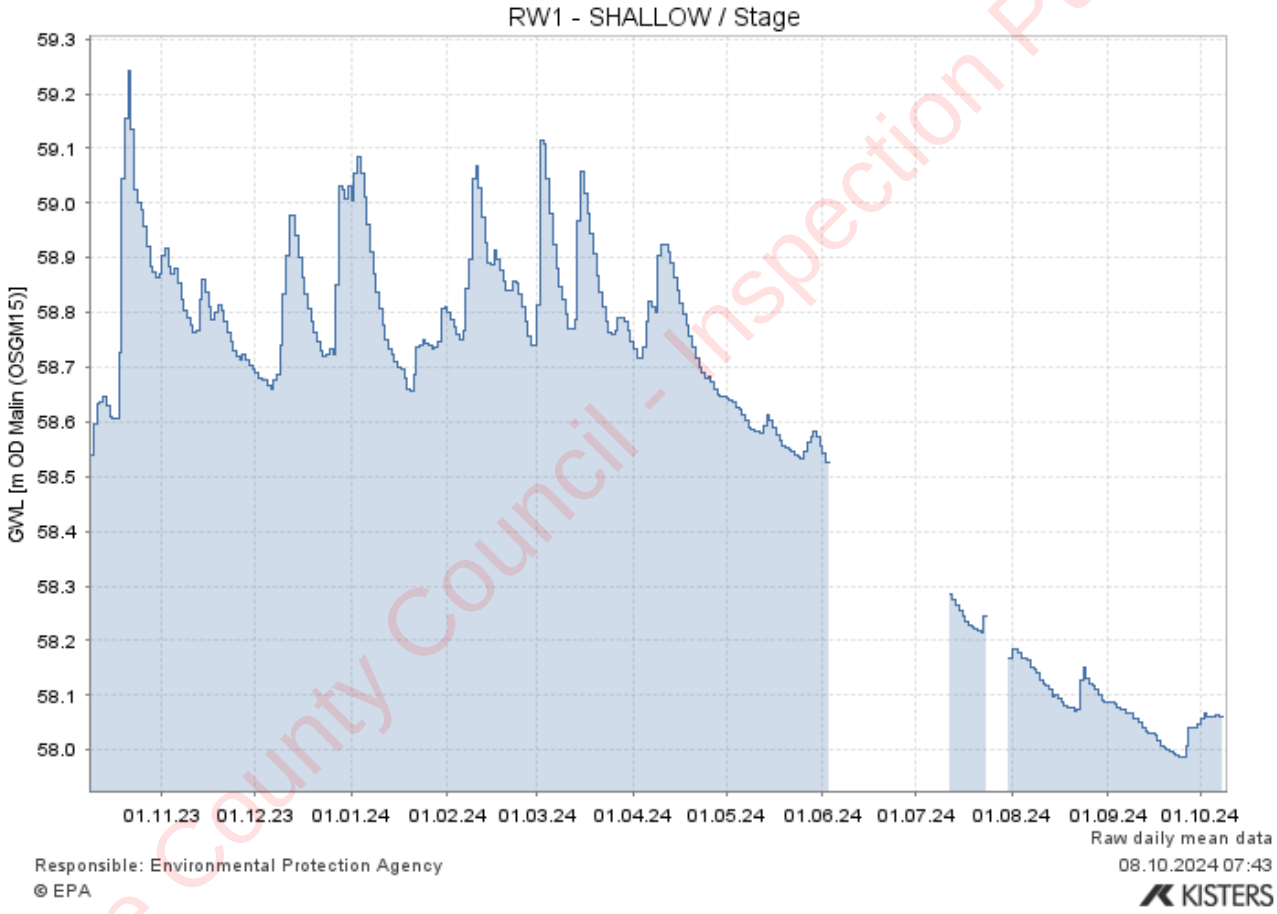
[8] Environmental Protection Agency, 2024. Available at EPA Maps [Accessed on 10th October 2024]

The majority of the Proposed development is underlain by subsoils with an average recharge rate of 200.0mm/yr whilst the remaining small portion to the south has an average recharge rate of 78.3mm/yr according to the GSI Map (shown on 24.111-ROD-EAC-SW_AE-DR-EN-300004 Groundwater Recharge).

8.3.10 Groundwater Level

The national groundwater monitoring network is maintained by EPA. There are no active groundwater level monitoring points within the Proposed development however a monitoring point (RW1-Shallow) is present at approximately 1.3km northwest from the boundary with Groundwater levels ranging from 57.8 mOD to 59.25mOD as shown in Figure 8.1 below.

Figure 8.1: Groundwater levels in a shallow borehole (RW1-Shallow) at approximately 1.3km northwest from the Proposed development boundary



The ground investigation undertaken for Maynooth Ring Road Project showed that the groundwater level readings varied between 0.65m to 6.7m below ground level (mbgl) in the boreholes (BH104 and BH110) that are at approximately 295m and 450m northeast of the boundary of the Proposed development respectively and proximal to the Royal Canal Main Line (Liffey and Dublin Bay). Groundwater levels monitored on 23 April 2019 were 58.9 mOD and 58.3mOD in BH104 and BH110 respectively.

Groundwater elevation is lower in the borehole which is more proximal to the Royal Canal Main Line (Liffey and Dublin Bay, therefore it is assumed that groundwater flow from the Proposed development will be north eastward in the direction of the canal and river water body (Rye Water).

8.3.11 Public and Private Water Supply

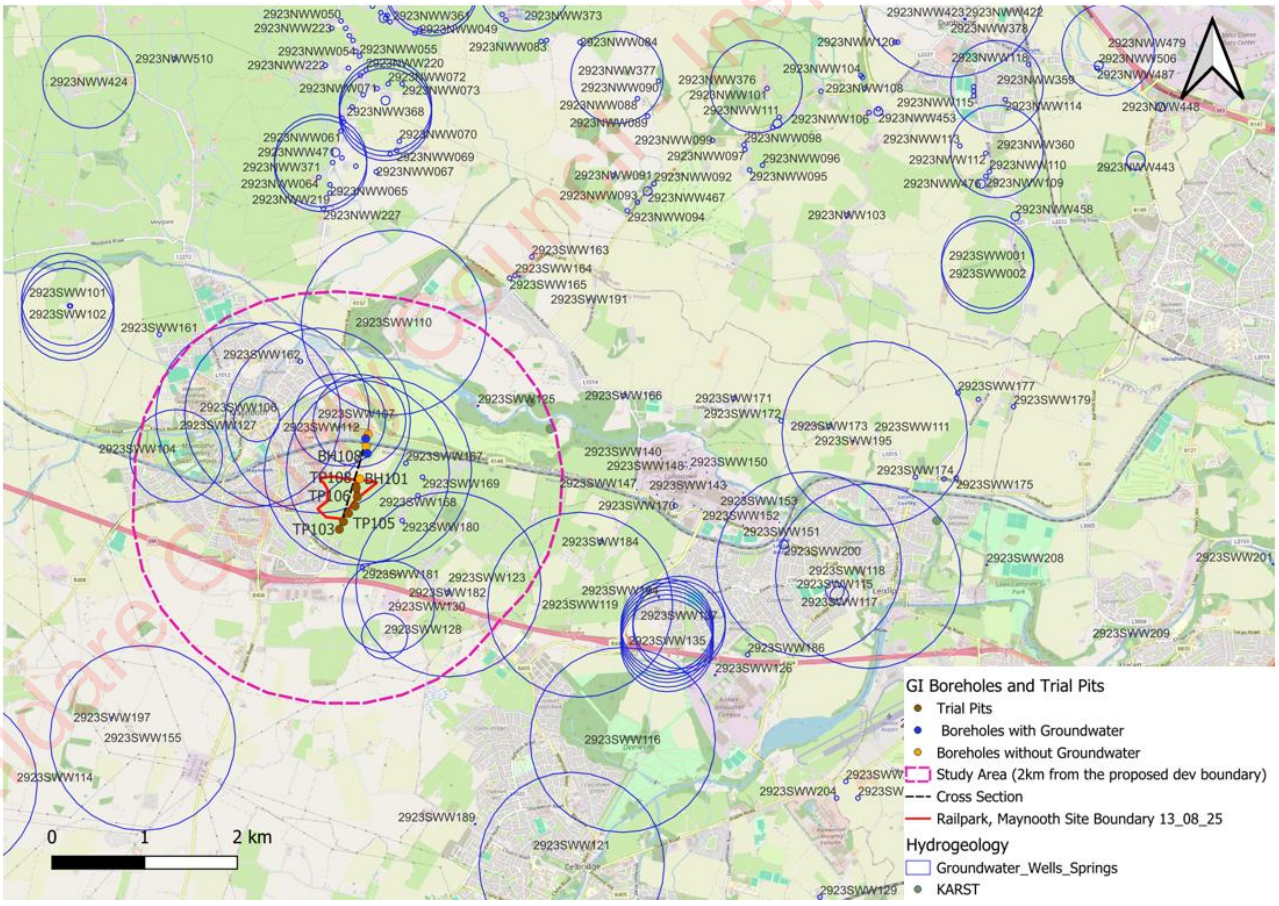
All groundwater bodies nationally are identified as Drinking Water Protected Areas (DWPA) according to EPA. The designated drinking water groundwater body underlying the Proposed development is Dublin (EA_G_008). It is known as Groundwater Body for abstraction of Drinking water-Dublin Urban Groundwater body.

There are no recorded public groundwater supply schemes or group water schemes in the vicinity of the Proposed development.

There are a number of private boreholes recorded in the GSI database in the vicinity of the Proposed development, however the majority of residences and businesses are serviced by the public local authority water supply.

A review of the GSI Map shows that there are 24 no. boreholes/water wells within 2km of Proposed development boundary and the locations are shown on Figure 8.2 below and Drawing No 24.111-ROD-EAC-SW_AE-DR-EN-300006- Wells, Boreholes and Spring.

Figure 8.2: Location of GSI groundwater wells and boreholes and cross section



A description of the boreholes and their locations relative to Proposed development are provided in Table 8.5 below.

There are a few groundwater wells with depths ranging from 3.3m to 22.9m. There are fifteen (No 15) boreholes with depths ranging from to 3.7m and 91.4m shown to be present within 2km of the Proposed development (refer to Table 8.5: Groundwater Wells/Boreholes and Springs within circ. 2km of the Proposed development boundary). The indicative depth to bedrock in the boreholes is between 0 to 27m, suggesting the presence of thick till deposit at some locations.

Table 8.5: Groundwater Wells/Boreholes and Springs within circ. 2km of the Proposed development boundary

Borehole/Well ID	Eastings (E)	Northing (N)	Depth to bedrock (m)	Depth (m)	Yield (m^3/d)	Location relative to the Proposed development
2923SWW104	692870.6	737435.7	6.1	76.2	31.40	Borehole present at 1km up hydraulic gradient & NE
2923SWW105	693650.4	737875.6	2.1	3.7	-	Borehole present 50m up hydraulic gradient &
2923SWW106	693960.4	737885.6	3.5	13.7	163.6	Borehole intersected
2923SWW107	694400.3	737815.6	-	45.7	45.80	Borehole intersected
2923SWW108	694820.2	737255.7	1.5	8.8	-	Borehole intersected
2923SWW109	694630.2	737825.6	24.0	27.1	32.70	Borehole 126m down hydraulic gradient & N
2923SWW112	694850.2	737815.6	8.2	35.1	32.70	Borehole present 132m down hydraulic gradient & N
2923SWW113	695060.1	737285.7	0.0	27.1	27.30	Borehole intersected
2923SWW110	695220.1	738875.4	7.3	51.5	26.20	Borehole 740m up hydraulic gradient & N
2923SWW119	694400.3	735826.0	-	22.9	54.60	Borehole 1.7km up hydraulic gradient & SE
2923SWW123	695809.9	736045.9	1.8	79.2	10.90	Borehole present at 340m up hydraulic gradient & SE
2923SWW127	693740.4	737835.6	6.1	36.6	54.60	Borehole present at 700m up hydraulic gradient & NW
2923SWW128	695120.0	735486.1	27.4	91.4	16.40	Borehole present at 1.0km & up hydraulic gradient and SE
2923SWW130	695160.1	735806.0	6.1	36.6	54.60	Borehole present at 580m & up hydraulic gradient and SE
2923SWW162	694210.3	738455.5	-	6.4	-	Dug well present at 1.3km & up hydraulic gradient and NW

Borehole/Well ID	Eastings (E)	Northing (N)	Depth to bedrock (m)	Depth (m)	Yield (m^3/d)	Location relative to the Proposed development
2923SWW167	695350.0	737355.7	-	5.8	-	Dug well present at 388m down hydraulic gradient & NE
2923SWW168	695480.0	737005.8	-	22.9	-	Dug well present at 500m up hydraulic gradient and E
2923SWW169	695530.0	737205.7	-	-	-	Dug well present at 504m down hydraulic gradient & NE
2923SWW180	695310.1	736735.8	-	6.6	-	Dug well present at 580m up hydraulic gradient & E
2923SWW181	694880.1	736226.0	-	4.4	-	Dug well present at 580m up hydraulic gradient & SE
2923SWW182	695799.9	735956.0	-	3.3		Dug well present at 1.3km up hydraulic gradient and SE
2923SWW162	694210.3	738455.5	-	6.4	-	Borehole present at 1.3km up hydraulic gradient & NW
2923SWW125	696129.9	737975.6	10.4	91.4	327.0	Borehole present at 1.4km down hydraulic gradient & NE

- No records available

With the exception of the four (No 4) boreholes (2923SWW106 -108 and 2923SWW113) intersected by the Proposed development which are within a location accuracy of 2km, majority of the boreholes and water wells are up hydraulic gradient of the Proposed development. As such, it is envisaged that groundwater from the proposed development will not flow towards most of the wells/boreholes. However, three (No 3) boreholes (2923SWW112, 2923SWW125 and 2923SWW109), and two groundwater wells (2923SWW169 and 2923SWW167) are present down-hydraulic gradient of the Proposed development with the nearest being 126m away. Therefore, these wells and boreholes present down-hydraulic gradient are potential groundwater receptors.

8.3.12 Groundwater Dependent Eco-Terrestrial Habitat (GWDTE)

A GWDTE is present at approximately 1.2km northeast from the nearest boundary of the proposed development which is listed as a Natura 2000 Site - Rye Water Valley/Carton SAC [001398], an SAC with Water Dependent Habitats/Species - Dec 2018001398 as shown on 24.111-ROD-EAC-SW_AE-DR-EN-300005 Groundwater Dependent habitat. The groundwater related features that are a qualifying interest for this SAC; are specifically the petrifying springs and tufa formations. The springs are located in the immediate vicinity of the Rye Water and two caves are also recorded in the GSI karst database to the north-east of the Carton Demesne. Due to the distance of the proposed development from the GWDTE and the infrastructures (Railway, Royal Canal and Maynooth- R148 Road) separating them, it is unlikely that there will be a direct hydraulic connection between the groundwater at the Proposed development and the GWDTE.

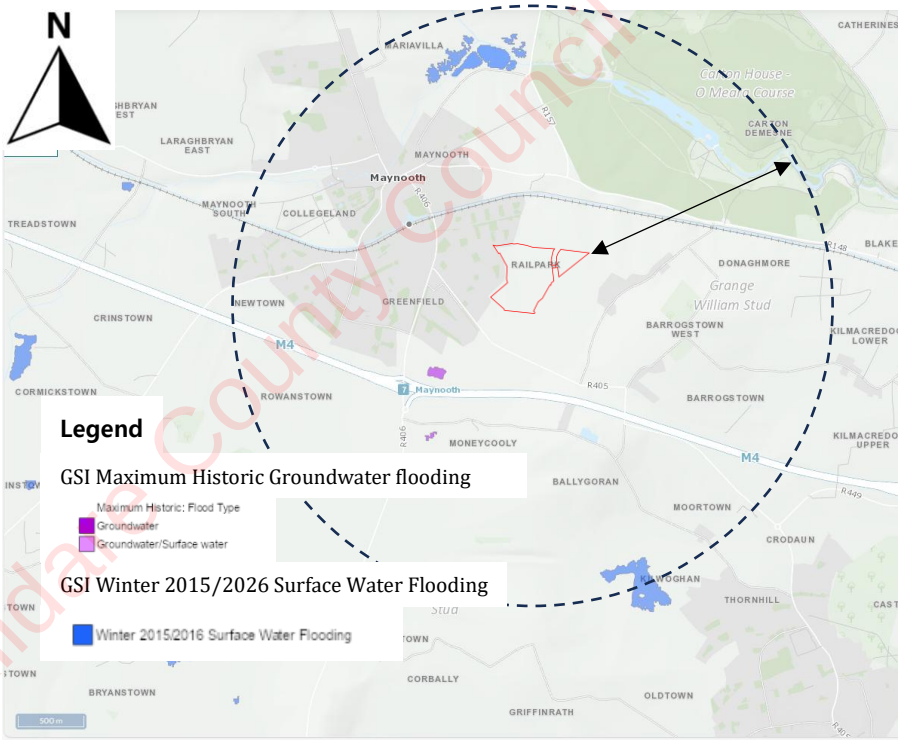
8.3.13 Groundwater Karst Data

There are two (No 2) known karst features (caves) in the nearby Carton Demesne which are at approximately 1.7km northeast from the northern boundary of the proposed development (see Figure 8.2). ROD (2019) reports that the boreholes and geophysical survey completed as part of the Maynooth Ring Road Project show no indication of karst features within the Proposed development area. Some evidence of clay infilled voids and fractures were encountered during drilling but was largely confined to boreholes located to the south of Carton Demesne proximal to the Royal Canal Main Line (Liffey and Dublin Bay) . These voids and fractures were typically encountered between 5 – 8m bgl within the upper weathered zone of the limestone bedrock and were either absent or infrequent further west. As the Proposed development is unlikely to have foundations extending to a depth greater than 3m, the voids are not as risk of impact.

8.3.14 Groundwater flooding

A review of the Office of Public Works (OPW) Map show that a small area of approximately 700m southwest of the Proposed development is classified under the GSI Maximum Historic Groundwater Flooding as having groundwater flooding (refer to Figure 8.3). This area is separated from the Proposed development by Cellbridge Road and residential houses and up hydraulic gradient of the Proposed development, hence, there is no direct hydraulic connection to the Proposed development via groundwater flow.

Figure 8.3: Historic GSI Groundwater and Surface Water Flooding within 2km of the boundary of the Proposed development

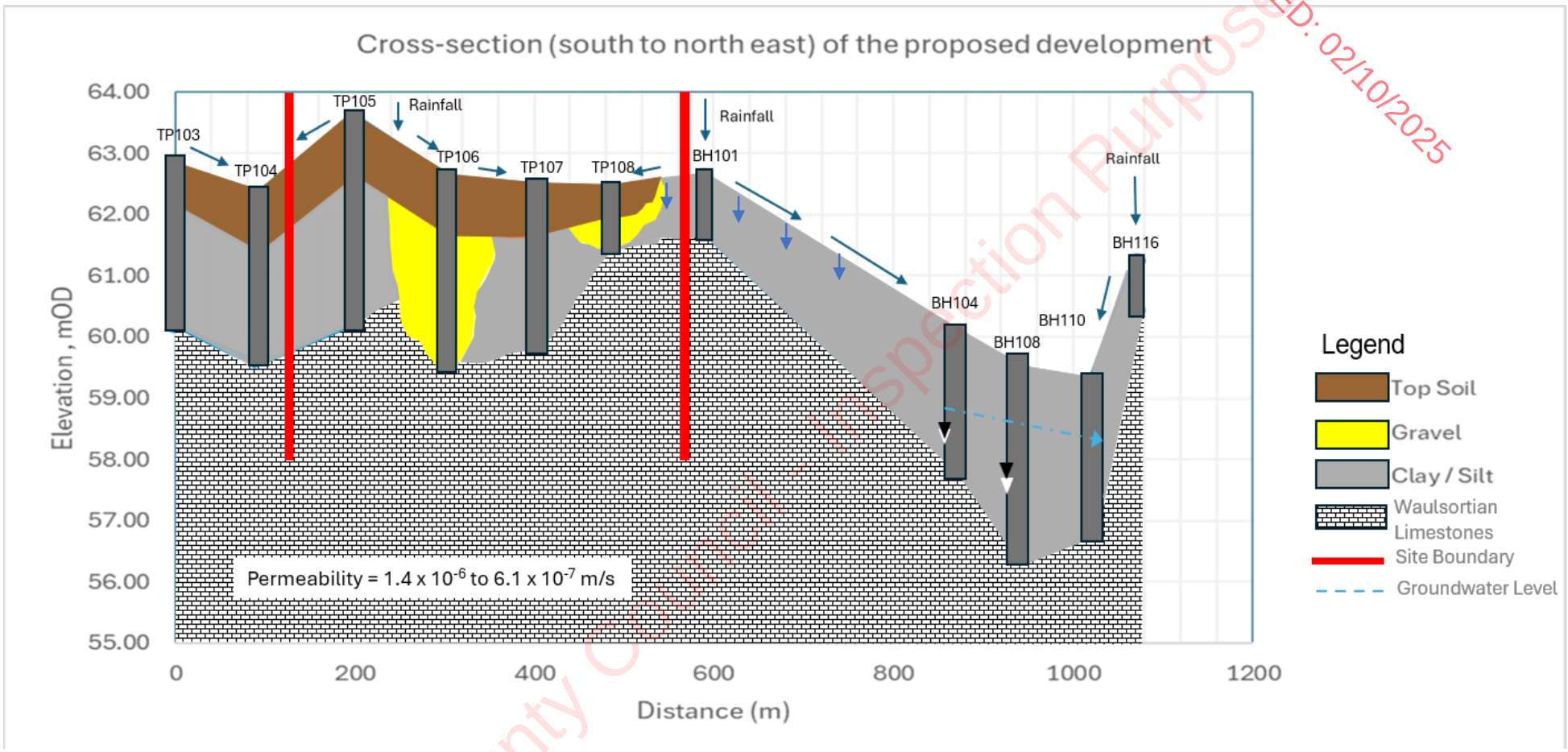


The other areas mapped by GSI as having a maximum historic groundwater flooding and winter 2015/2016 surface water flooding within 2km of the boundary the Proposed development is shown in Figure 8.3. Due to the distance of these areas from Proposed development, no impact in terms of flooding of the Proposed development is anticipated.

8.3.15 Conceptual (Hydrogeological) Site Model

A CSM was compiled showing the depth and extents of the superficial deposit, bedrock profile, permeability, location of surface water features and groundwater levels based on the boreholes and trial pits with locations and cross-section shown on Drawing No. 24.111-ROD-EAC-SW_AE-DR-EN-300007 -Trial pits and Boreholes. No groundwater strikes were encountered in the two trial pits within proposed development boundary. However, approximately 295m from the northeastern boundary of the Proposed development, groundwater was found to be present in the borehole proximal to the Royal Canal Main Line (Liffey and Dublin Bay). In this CSM, the ground condition in trial pits 105 and 106 (near the boundary of the Proposed development in the east) were assumed to represent the ground condition at the Proposed development, hence this was projected to the cross-section in Figure 8.4.

Figure 8.4: Site conception hydrogeological model



The CSM is shown in Figure 8.4 above and summarised as follows:

- The Proposed development is underlain by topsoil overlying the superficial deposit comprising of grey, brown, silty very sandy gravel and gravelly clay, and sandy silt. These are in turn underlain by the bedrock (Waulsortian Limestones);
- The thickness of topsoil varies from 0.5 to 1m across the Proposed development becoming thinner in the northeast and absent in BH101 outside the Proposed development boundary;
- The till deposit comprises grey, brown, slightly sandy slightly gravelly clay/silt with depth ranging from 1.0m - 3.2m bgl. The till deposit also comprises grey, brown, silty very sandy gravel as shown in only two trial pits (TP06 and TP08) as gravel lenses. The till deposit extends continuously across the proposed development to the area outside of the boundary;
- As groundwater was not encountered in the trial pits at the proposed development, it is assumed that the same condition exists for the areas adjacent to the Proposed development. Groundwater is shown to be present in BH104, BH108, and BH110 outside the boundary of the Proposed development with the nearest being 295m away. As groundwater is not found in the till deposit at the Proposed development, it is assumed that there is no direct hydraulic connection between the Proposed development and the till deposit outside the boundary. Figure 8.4 shows that there is a probability of water infiltrating directly to the bedrock aquifer especially where the gravel lenses are present as it will be more permeable compared to the silt/clay. However, these areas are shown to be isolated and limited in extent;
- Recharge to the bedrock through the topsoil at the Proposed development will be limited due to the nature of the subsoils which are of moderate permeability. However, outside the proposed development boundary, in the northeast, the recharge is likely to be directly to the clay/silt (the till deposit) and this is evident due to the absence of topsoil and presence of the groundwater in the till deposit in this area. Therefore, the potential for rapid recharge to groundwater in the Proposed development is limited due to the presence of topsoil;
- The indicative direction of groundwater flow from the Proposed development will be north easterly towards the Royal Canal Main Line (Liffey and Dublin Bay) and Rye Water; and
- Groundwater (pathway) connection between the elements of the Proposed development and the bedrock aquifer will be through infiltration to the Waulsortian Limestones (a Locally Important aquifer) via the unsaturated till deposit. The four (4) wells /boreholes present down-hydraulic gradient are the only potential groundwater receptors.

8.4 CHARACTERISTICS OF THE PROPOSED DEVELOPMENT

The proposed development involves the construction of 581 no. residential units, consisting of 396 no. houses (59 no. 2 bed units, 275 no. 3 bed units and 62 no. 4 bed units) and 185 no. apartments/duplex apartments (53 no. 1 bed units, 92 no. 2 bed units and 40 no. 3 bed units) at lands located at Railpark, Maynooth. The proposal includes significant public open space and a neighbourhood centre including a childcare facility, café, health centre and shops. Proposed access to the site is

The current drainage regime for the development lands is that surface water drains via infiltration into groundwater and overland flow routes to the surrounding hedgerows and ditches.

Further information regarding the proposed infrastructure elements of the proposed development are detailed in the separate "Engineering Report For Planning", document reference 24.111-ROD-GEN-SW_AE-RP-CD-300001 by ROD Consulting Engineers.

It is anticipated that the main development characteristics impacting groundwater comprise the following:

- General construction activities across most of the site;
- Installation of sub surface utilities;
- Installation of additional stormwater storage;
- Installation of SUDS features; and
- Changes to ground levels across the site to facilitate final development levels.

The Maynooth Eastern Ring Road (to be provided by Kildare County Council) will traverse the proposed development lands in a north-south direction. Vehicular access to the proposed development will be via the new T-junction on the Maynooth Eastern Ring Road (MERR). The north-east section of the development will be accessed via a new local access road connecting the MERR. The MERR will connect the proposed development to the R148 Leixlip Road to the north and the R405 Celbridge Road to the south.

A full description of the proposed development is provided in Chapter 2 of this EIAR. A ten year permission is sought for this development

8.5 POTENTIAL IMPACT OF THE PROPOSED DEVELOPMENT

8.5.1 Construction Phase

The potential effects that may be generated during the construction phase of the Proposed development are outlined below:

- Construction site runoff – suspended fine sediments;
- Construction site runoff – Chemical spillages;
- Morphological impact and loss of the Rye Water Valley/Carton SAC, a GWDTE during construction works and/or new structures installed;
- Change in the vulnerability class of groundwater due to the removal of soils and subsoils during excavation for foundation;
- Temporary- permanent increase in impermeable area; and
- Alteration of groundwater flow path during the re-installation of existing services.

Infiltration and groundwater recharge rates are likely to be altered due to the anticipated changes in ground condition during construction as the current drainage regime for the development lands is via infiltration and via overland flow. A significant volume of the subsoils will be excavated for foundation to be constructed. This will leave a very thin layer of gravelly silt and clay materials and expose the bedrock aquifer to potential contamination. There is no groundwater in the till deposit at the site, and the presence of the cohesive soils on site will limit infiltration, therefore groundwater in the bedrock is not likely to be impacted by the proposed activities which will be limited to the 1-2m bgl.

8.5.1.1 Construction site runoff (suspended fine sediments) infiltrating onto the aquifer

Construction of the Proposed development will require the removal of a large part (159,800m^2) of the topsoil to facilitate the construction of the residential units, infrastructure service provision, road construction and surface water storage systems etc. Given the extent (159,800m^2) of disturbance, there is potential for weathering and erosion of the surface soils from precipitation and run-off and infiltration. The disturbance of ground during the construction phase may also contain increased silt levels or result in pollution from the construction processes. The infiltrating contaminants, such as concrete and cement, which are alkaline, and corrosive have the potential to cause pollution to the Locally Important bedrock aquifer of Medium importance.

The locally important bedrock aquifer may be slightly altered by fine sediment mobilised by surface water runoff originating from construction activities associated with the development. Run off laden with fine sediment is generated principally by rain falling onto land, where surface vegetation has been removed and the ground compacted, preventing infiltration. Other sources of silt-laden runoff come from the use of water as part of construction works (e.g. vehicle washings, runoff from stockpiles). In wet weather, mud can be generated from haul roads and access points.

The topography of the Proposed development is generally flat and thus the risk level is considered to be low in terms of the overlying till deposit protecting the bedrock. Water is likely to flow down hydraulic gradient and infiltrate into the bedrock through permeable materials. Without mitigation, the risk from groundwater contaminated with fine sediments is likely to have a short term, temporary, slight adverse effect on the Locally Important Aquifer leading to a **Slight** significance of impact.

8.5.1.2 Construction site runoff – Chemical spillages

During construction fuel, hydraulic fluids, solvents, grouts, paints and detergents and other potentially polluting substances will be stored and/or used at the Proposed development. Leaks and spillages of these substances could pollute the aquifer if their use is not carefully controlled, and spillages enter existing groundwater flow pathways. The contaminants present during construction have the risk of reducing water quality in the Locally Important bedrock aquifer. To allow such substances to enter groundwater could be in breach of the WFD requirement and therefore measures to control the storage, handling and disposal of such substances will need to be in place prior to and during construction. No existing sources of contamination are present and the risks related to works will be managed by the adoption of a Construction Environmental Management Plan (CEMP). The cohesive nature of the till deposit will greatly reduce the risk of contamination infiltrating into the Locally Important Aquifer of medium importance.

The Proposed development will require a drainage network including overland attenuation storage features to accommodate surface water runoff from the development. Due to the poor infiltration rates (low recharge) and subsoils of moderate permeability at the Proposed development, discharges to the ground would be limited. Once the subsoils are excavated, it is likely that this activity will have a slight, adverse, permanent, residual impact on the underlying aquifer. Without mitigation measures spillages of chemicals/fuel stored and/or used on-site could cause short- term, short term, and moderate effect. It is likely that the activities related to construction has a **Moderate** significance of impact on groundwater within the Proposed development.

8.5.1.3 Mobilisation of contamination to groundwater wells

A total of nine (No. 9) groundwater supplies (boreholes and wells) are intersected and present down hydraulic gradient of the Proposed development as listed in Table 8.5. There is a risk of pollution to groundwater as a result of the spillage of fuels or chemicals associated with construction activities used within the proposed development. The quaternary aquifer may act as a pathway for these contaminants to enter water supplies tapping water from it, however the risk of contamination mobilizing from the Proposed development through the till deposit is low due to the absence of groundwater. The risks from hazardous substances are similar to those highlighted above for the mobilization of contamination into the aquifers. Additionally, due to the potential attenuation of contamination to occur in the unsaturated till deposit, the effect on the well is likely to be negligible and temporary. The significance rating of the impact on the High importance receptor is **Imperceptible**.

8.5.1.4 Alteration of groundwater flow path and recharge in the aquifers

Excavation of soil and sub-soil layers and concrete infill may reduce the ability of the lands to recharge groundwater. Dewatering is not anticipated as the superficial deposit underlying the Proposed development is shown to be dry (unsaturated) as shown in Figure 8.4. Surface water runoff will be collected and discharged from the Proposed development to a SUDs feature which in turn will be discharged to the existing surface water pipe network. Infiltration into groundwater is likely to increase during construction as the soils on Site will be stripped and this will increase the infiltration capacity of the subsoils.

The magnitude of effect on groundwater in terms of the alteration of flows will be small adverse and short term and the significance of impact on groundwater receptors (a Locally Important Aquifer) of Medium importance will be **Slight**.

8.5.1.5 Groundwater flooding

The area classified as having groundwater flooding is approximately 650m southwest of the proposed development and is not likely to receive groundwater flow from the proposed development as it is up hydraulic gradient.

Heavy rainfall or a high level of groundwater could produce ponding in open trenches. Discharge of this rainwater pumped from excavations to drains or ponds could compromise the infiltration capacity of the Locally Important bedrock aquifer and as such cause localised flooding. The natural underground drainage system may change due to the alteration of ground condition resulting in a situation where rainfall cannot drain away quick enough, causing the water table to rise above the ground surface. As groundwater is not like likely to be encountered, a negligible impact is anticipated leading to an **Imperceptible** impact on the Locally Important Aquifer

Table 8.6: Summary of potential hydrogeology impacts during the construction phase

Features	Description	Location	Importance	Impact Description	Quality	Duration	Scale	Magnitude	Significance
Construction Site Runoff-suspended fine sediments									
Aquifer	Bedrock – Locally Important Aquifer - Bedrock	Adjacent / Throughout	Medium	Contamination	Negative	Temporary	Local	Small adverse	Slight
Construction site runoff – Chemical spillages									
Aquifer	Bedrock – Locally Important Aquifer - Bedrock	Adjacent / Throughout	Medium	Contamination	Negative	Permanent	Local	Moderate adverse	Moderate
Mobilisation of contamination to groundwater wells									
Groundwater wells near the proposed development)	Hydraulically connected	Adjacent / Throughout	Medium	Contamination	Negative	Temporary	Local	Negligible	Imperceptible
Alteration of groundwater flow path and recharge									
Aquifer	Bedrock – Locally Important Aquifer - Bedrock	Adjacent / Throughout	Medium	Localised flow alteration	Negative	Short-term	Local	Small adverse	Slight
Groundwater flooding									
Groundwater wells (near the proposed development)	Hydraulically connected	Outside the boundary and upgradient	Medium	Localised flow alteration	Negative	Short-term	Local	Negligible	Imperceptible

8.5.2 Operational Phase

Potential operational phase impacts are noted below:

- Contamination risk arising from development use / leaking pipes / contaminated surface water runoff and accidental hydrocarbon leaks and subsequent discharge into piped surface water drainage network (e.g. along roads and in driveway areas);
- Increased impermeable surface area will reduce local groundwater recharge; and
- Risk contamination and alteration of flow to groundwater supply boreholes.

8.5.2.1 Contamination risks arising from the Proposed development

The Proposed development will introduce new sources of diffuse urban pollution to groundwater receptors that currently are not affected by this type of pollution. Across the Proposed development, surface water runoff from the roofs of buildings, hard standing (e.g. car park bays) and access road surfaces may transport small quantities of chemical pollutants (e.g. oils and heavy metals from vehicles using the site, herbicides, etc.), organic matter (e.g. leaf fall), detergents, animal faeces (containing nutrients and pathogenic bacteria), inert particles (dust/silt) and litter into the surface water drainage system and eventually into groundwater.

The proposed drainage of surface water from the Proposed development will be at greenfield runoff rate and will build in SuDS features to attenuate and treat runoff and support infiltration of water into the aquifer. Assuming the inclusion of SuDS features in the detailed drainage design, the effect is deemed to be negligible and then the significance of impact on groundwater of Medium importance is **Imperceptible**.

8.5.2.2 Increase in permanent impermeable area and increased pluvial flooding

The Proposed development will increase the permanent impermeable area on-site which will limit the infiltration compared to the current use of the Proposed development. This could potentially increase localised pluvial flooding by causing back up groundwater water to build up behind the impermeable surface extending into the ground, as well as increase flood risk to people and property in the immediate surrounding area. Given that the foundation is unlikely to encounter groundwater (i.e. based on the baseline condition) including the application of an appropriate water drainage design with measures that attenuate flow together with a maintenance regime, the magnitude of effect on the Locally Important bedrock aquifer is deemed to be Negligible and has an **Imperceptible** significance of impact.

8.5.2.3 Risk of contamination and alteration of flow to groundwater Supply (wells and boreholes)

As noted above, the underlying receiving groundwater is a Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones. The risk of contamination and alteration of flow to the groundwater supply sources down hydraulic gradient of the Proposed development during operation is considered to be low given the nature of subsoils of moderate permeability encountered as part of the site investigation and the absence of groundwater in the subsoils. The unsaturated subsoils at the Proposed development acts as a natural protection against groundwater pollution and reduces infiltration because of the moderate permeability of the subsoils. Hence, the magnitude of effect in terms of

contamination migration, reduced recharge and flow to the wells/boreholes is Negligible and leading to an **Imperceptible** significance of impact.

8.6 POTENTIAL CUMULATIVE IMPACT

8.6.1 Surface storm water infrastructure

The cumulative impacts of the proposed development are such that the requirement to attenuate the subject site to pre-development run-off rates will ensure that during extreme storm events the surface water from the development is limited to QBAR run off rate in accordance with the GDSDS requirements. The use of sustainable urban drainage features will aid in improving overall storm water quality prior to ultimate discharge and infiltration to the ground.

8.6.2 Potable Water Infrastructure

The potential impacts for the local public potable water are that the Proposed development will reduce the capacity in the public watermain. A Pre-Connection Enquiry was submitted to Irish Water CDS24003193 and subsequent confirmation of feasibility letter states that connection is feasible subject to upgrades.

The nature and scale of the proposed development in combination with two other separately proposed projects (DART+ West Railway Order - Dublin City to Maynooth and M3 Parkway and a residential masterplan for some 105 No. units, with ABP Case 312671) in the area are such that they would not give rise to any significant impacts on groundwater.

8.7 'DO NOTHING' IMPACT

In order to provide a qualitative and equitable assessment of the proposed development, this section considers the proposed development in the context of the likely impacts upon the receiving environment should the proposed development not take place.

If the proposed development does not proceed, there would be no additional impact on the local groundwater systems. The rate of surface water run-off and groundwater recharge would continue to operate in its current state.

Groundwater flooding would continue as they have in the areas outside the boundary of the Proposed development.

The WFD Groundwater status/risk projection would also remain unchanged if the existing land use continued.

8.8 AVOIDANCE, REMEDIAL & MITIGATION MEASURES

8.8.1 Incorporated Design Mitigation

Mitigation incorporated into the scheme design are as follows:

- Excavated material must be contained to ensure excavated material (from piling or earthworks) does not enter watercourse or infiltrate into the ground;
- Any in-situ concrete work to be lined and areas bunded (where possible) to stop any accidental spillage entering the drains;
- Design of site services / drainage works are in accordance with the relevant design guidance;
- Appropriately designed site services / drainage / sewers will protect the water, hydrogeology and hydrology from risk of contamination arising from the development such as light liquids separator or SuDS treatment train. Features such as green roofs, bio-retention areas, filter strips, bio-swales and open-bottom attenuation are proposed to intercept pollutants and promote groundwater recharge where possible; and
- Surface water drainage for the development must be designed in accordance with the Greater Dublin Strategic Drainage Study (GDSDS), Volume 2, Technical Document on New Development GDSDS and Kildare County Council Sustainable Drainage Systems Guidance Document 2024 to avoid risk to Human health.

Good construction management practices, as outlined in the CIRIA guidance Control of Water Pollution from Construction Sites – Guidance for consultants and contractors (Masters-Williams et al., 2001) will be employed by the appointed contractor to minimise the risk of transmission of hazardous materials as well as pollution of adjacent watercourses and groundwater.

8.8.2 Construction Phase Mitigation

To minimise the impact of the construction phase on the water environment it is recommended that mitigation measures included in Section 8.8.1 and the Outline CEMP will be implemented as part of a Site-Specific Construction and Environmental Management Plan, as per below.

HYDROGEOLOGY CONST 1: Construction and Environment Management Plan
General site works:

- It is recommended that best practice construction methods and practices complying with relevant legislation to avoid or reduce the risk of contamination of watercourses or groundwater in accordance with section 8.8.1 and the CEMP;
- It is recommended that a Site-Specific Construction and Environment Management Plan be developed and implemented during the construction phase. Site inductions to include reference to the procedures and best practice as outlined in the CEMP;
- Measures to be implemented to capture and treat sediment laden surface water runoff especially from basement excavations and stripped land (e.g. sediment tanks, surface water inlet protection and earth bunding adjacent to open drainage ditches);
- Weather conditions and seasonal weather variations will also be taken account of when planning stripping of topsoil and excavations, with an objective of minimizing soil erosion.
- The extent of sub-soil and topsoil stripping to be minimised to reduce the rate and volume of the run-off during construction until the topsoil and vegetation are replaced;
- Concrete batching will take place off site or in a designed area with an impermeable surface;
- Concrete wash down and wash out of concrete trucks will take place on-site into an appropriate washout facility;

- Discharge from any vehicle wheel wash areas is to be directed to on-site settlement tanks;
- Oil and fuel stored on site for construction should be stored in designated areas. These areas shall be bunded and should be located away from surface water drainage and features;
- Refuelling and servicing of construction machinery to take place in a designated hardstanding area, remote from surface water inlets (when it is not possible to carry out such activities off-site);
- Any hazardous materials to be stored within secondary containment designed to retain at least 110% of the storage contents - to prevent the accidental release (fuels, paints, cleaning agents, etc.) with bunds for oil/diesel storage tanks;
- Spill kits will be kept in designated areas for re-fuelling of construction machinery; and
- Dewatering measures will only be employed where necessary.

8.8.3 Operational Phase Mitigation

Operational phase mitigation measures are noted below:

HYDROGEOLOGY OPERA 1: Scheme Design and Maintenance

- The design of proposed site levels (roads, Finished Floor Level, (FFL) etc.)) has been carried out to replicate existing surface contours, break lines etc where possible, and therefore replicating existing overland flow paths where possible, and not increasing additional surface water flow in a particular location.
- Surface water runoff from the site will be attenuated to the greenfield runoff rate as recommended in the Greater Dublin Strategic Drainage Study (GDSDS). Surface water discharge rates will be controlled by a flow control devices, with permeable paving and detention basins provided to store runoff from a 1 in 100-year return period event. SUDs features are implemented in the surface water drainage network to reduce the rate of runoff form hard standing area and to improve the quality of surface water runoff.
- Surface water runoff from the development will be collected by an appropriately designed system with contaminants removed prior to discharge i.e. SuDS management train.
- A regular maintenance and inspection programme of the flow control devices, attenuation storage facilities, gullies and SuDS features will be required during the Operational Phase to ensure the proper working of the development's networks and discharges.
- Waste generated by the everyday operation of the development should be securely stored within designated collection areas with positive drainage collection systems to collect potential runoff.
- Operational waste should be removed from site using licenced waste management contractors.

8.9 RESIDUAL EFFECTS OF THE PROPOSED DEVELOPMENT

The predicted residual effects of the construction and operation activities following implementation of the mitigation measures above is summarised below.

- As surface water drainage design will be carried out in accordance with the GDSDS, and SuDS methodologies will be implemented as part of a treatment train approach, therefore there are no predicted impacts on the water and hydrogeological environment arising from the operational phase.

- Implementation of the measures outlined in will ensure that the potential impacts of the development on soils and the geological environment are minimised during the construction phase and that any residual impacts will be short term and imperceptible.
- Residual impacts from earthworks haulage and the risk of contamination of groundwater are deemed to be of minimal risk since the unsaturated superficial deposit will limit infiltration to the Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones. The residual impacts for this residential development, and open space are imperceptible post construction (during the operational phase) on groundwater.

8.10 MONITORING

Construction phase monitoring relates to the good maintenance of mitigation measures outlined above in section 8.8 including the project specific CEMP. It is recommended that any monitoring of any hazardous material stored on-site be carried out in accordance with the CEMP. It is recommended that a dust management/monitoring programme be implemented during the construction phase of the development in accordance with the CEMP.

8.10.1 Monitoring measures – construction

Proposed monitoring during the construction phase in relation to the hydrogeological environment are as follows:

- Contractors must adhere to the CEMP;
- Construction monitoring of the works (e.g. inspection of services and SuDS installation and backfill, stability of excavations etc.);
- Inspection of fuel / oil storage area;
- Monitoring cleanliness of adjacent road network, implementation of dust suppression and provision of vehicle wheel wash facilities;
- Monitoring of contractor's stockpile management (e.g. protection of excavated material to be reused as fill; protection of soils from contamination for removal from site); and
- Monitoring sediment control measures (sediment retention tanks, surface water inlet protection etc.).

8.10.2 Monitoring measures – operational phase

Proposed monitoring during the operational phase in relation to the hydrogeological environment are as follows:

- The performance of all SuDS features must be monitored by the relevant authorities during the life of the development.
- Water infrastructure system must be regularly inspected and maintained.
- Monitoring of the installed flow controls, SuDS features and gullies will be required to prevent contamination and increased runoff from the site.

- Although no specific monitoring will be required as part of the proposed development, it is envisaged that EPA Monitoring of the water quality of the water bodies will continue in the area through the life of the development.

8.11 REINSTATEMENT

No specific reinstatement measures are required in respect to Hydrogeology

8.12 INTERACTIONS

The most significant interactions with groundwater is between land, soils, geology, hydrology and hydrogeology, population and human health and air quality. The mitigation measures that will be put in place at the Proposed development will ensure that all activities comply with all surface and groundwater legislative limits and therefore the predicted impact is short-term, negative and imperceptible with respect to the construction phase and long-term, and imperceptible with respect to the operational phase. A potential risk to human health from water, can be linked to the potential for contamination of the potable water supply downgradient of there is a leakage from the proposed development during the operational phase. The groundwater and supply network would present possible pathways; however, this is unlikely, and the impact will be imperceptible.

8.13 DIFFICULTIES ENCOUNTERED IN COMPILING REPORT

No particular difficulties were encountered in completing this section.

8.14 REFERENCES

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