Chapter 5.0

Land and Soils

5.0 Land and Soils

5.1 Introduction

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5.1.2 Proposed Development

The proposed development is for seven hundred and fifty-three (753) residential units consisting of sixty-seven (67) detached, two hundred and seventy-eight (278) semi-detached, one hundred and eighty-six (186) terraced, sixty-nine (69) duplex, and one hundred and fifty-three (153) apartment units, along with a crèche and local retail area. A public greenway located predominantly along the south-east of the development is also being proposed.

A description of the proposed development can be found within Chapter 2 of this EIAR. Aspects of the proposed development relevant to soils and geology will include the following construction activities:

- Excavation and site levelling for the construction of access roads and multi-storey buildings.
- Excavation for installation of services, pavements and landscaping on existing soil/rock.
- Temporary storage compound on site required for construction accommodation and machinery and the storage of fuel, oil etc.

5.2 Methodology

The land and soils assessment has been prepared in accordance with the following guidance:

- Environmental Protection Agency (EPA) Guidelines on the Information to be Contained in Environmental Impact Statements (2017);

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

The assessment involved the completion of a desk study and site walkover. The principal impacts to be assessed included the following:

- Geological heritage sites in the vicinity of the perimeter of the subject site
- Landfills, industrial sites in the vicinity of the site and the potential risk of encountering contaminated ground.
- The quality, drainage characteristics and range of agricultural uses of soil around the subject site;
- Quarries or mines in the vicinity, the potential implications (if any) for existing activities and extractable reserves;
- The extent of topsoil and subsoil cover and the potential use of this material on site or

requirement to remove it off-site as waste for disposal or recovery;
- High yielding water supply springs/ wells in the vicinity of the subject site to within a 2 km radius and the potential for increased risk presented by the proposed development;
- Classification (regionally important, locally important) and extent of aquifers underlying the study area perimeter and increased risks presented to them by construction and operation related activities associated with aspects such as for example removal of subsoil cover, removal of aquifer (in whole or part), draw-down in water levels, alteration in established flow regimes, change in groundwater quality;
- Natural hydrogeological/ karst features in the area and potential for increased risk presented by the activities at the proposed development site; and
- Groundwater-fed ecosystems and the increased risk presented by the construction and operational phases of the proposed development both spatially and temporally.

The following sources of information were consulted to establish the baseline environment: -

- Geological Survey of Ireland (GSI)
    - Groundwater wells and springs
    - Karst
    - Drinking water protection areas
    - Groundwater vulnerability, recharge and resources
    - Quaternary sediments
    - Bedrock geology

- Environmental Protection Agency (EPA)
    - Water quality monitoring locations
    - Water Framework Directive (WFD) water body risk
    - Water Framework Directive (WFD) water body status
    - River Q values 1971-2016
    - Protected areas
- GeoHive
    - Topography
    - Land use
    - Historic land use
- Met Eireann
- Priority Geotechnical Ltd., 2017, 2019. Borehole logs.
- JBA Consulting Ltd. Groundwater Seepage Assessment
- MHL & Associates Ltd., 2019. Longview Estates Development – Overall road design plan.
- Fetter, C.W. 2001. Applied Hydrogeology. 4th Edition, Prentice Hall.

Site investigations were carried out by Priority Geotechnical Ltd at the site in 2017 and 2019 (as per Appendix 5.1) and included the following scope of work:

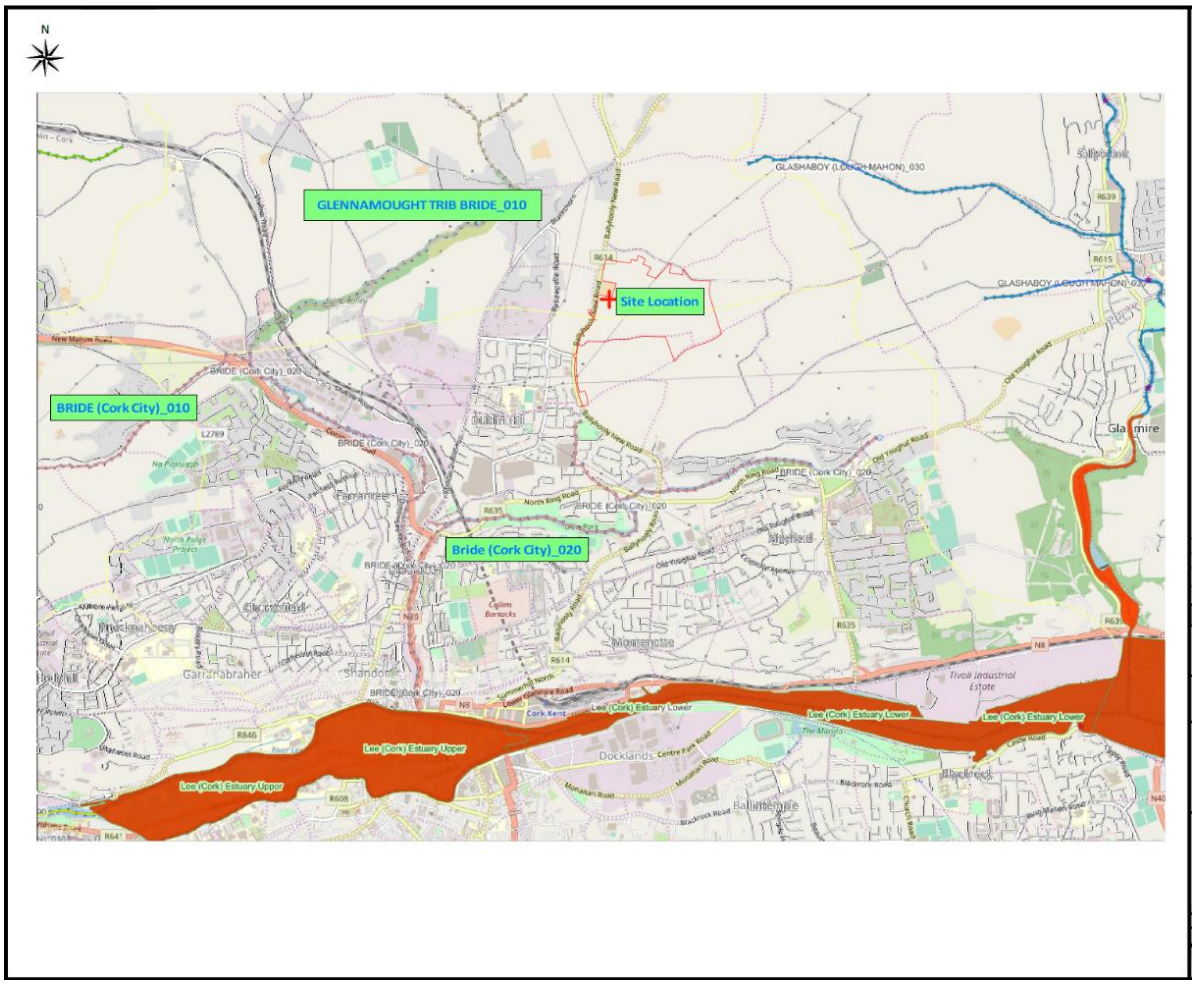
- 13 no. rotary core holes to measure the depth and strength of rock.
- 34 no. trial pits to measure the depth of soil and rock.
- 10 no. infiltration tests to measure the on-site infiltration rate.
- 5 Standpipe Well Installations
- 14 Standard Penetration Tests
- The investigation also included laboratory testing on samples taken from trial pits and core holes and crushing of rock samples taken from trial pits.

5.3 Receiving Environment (Baseline Scenario)

5.3.1 Site Location, Land Use and Topography

The site is located to the north of Cork City along the R614 (Ballyhooly Road) as shown in figure 5.1 below. The site is greenfield and has been in agricultural use for a number of years. The R614 Ballyhooly Road borders the site to the west and the L-2976-0 Local Road is to the north. There are a number of detached dwellings located along the northern boundary of the site and the east and south of the site is bounded predominantly by arable fields.

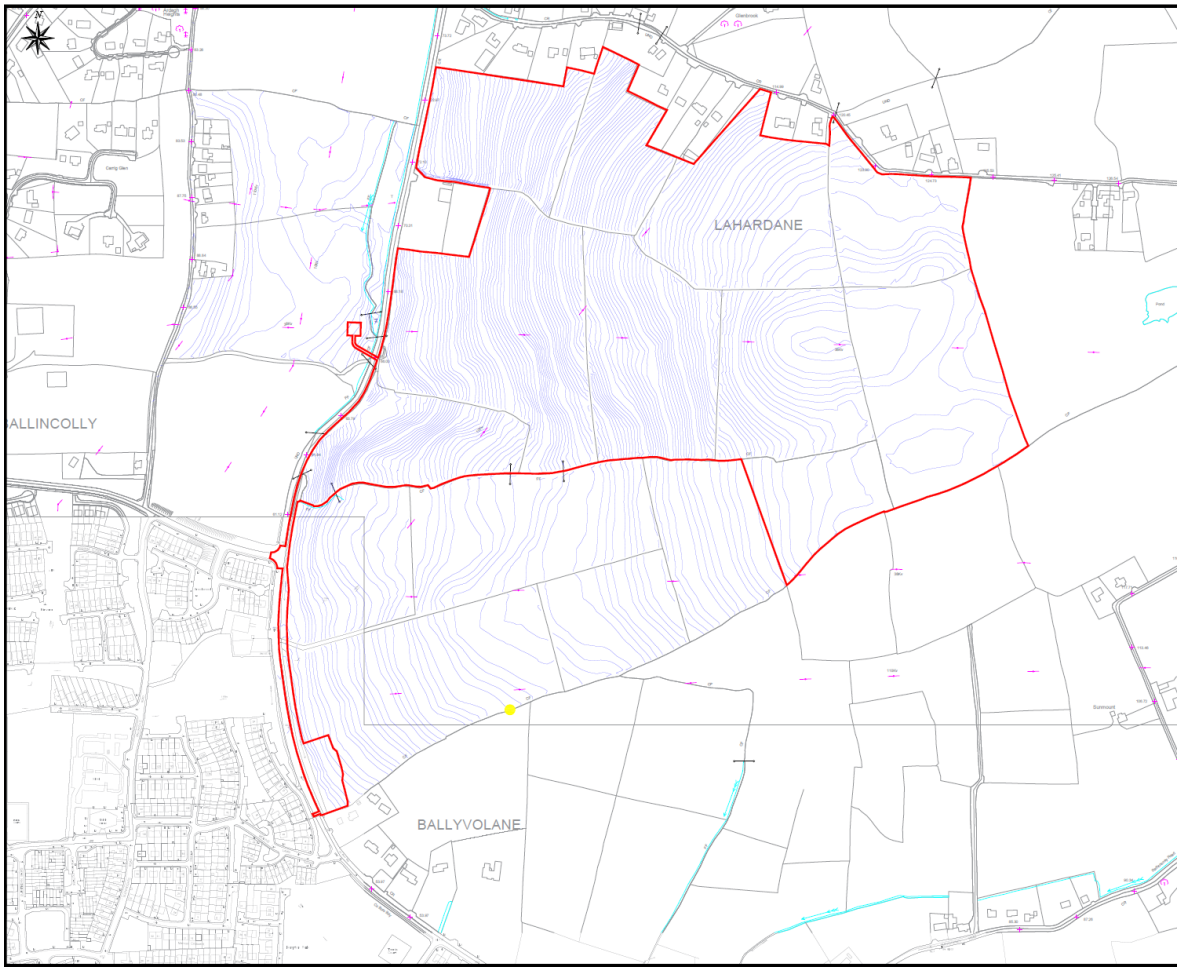
Figure 5.1 Site Location



The site slopes to the east, from approx. 65m OD on the west side on Ballyhooly Road, to approx.130m OD at the eastern extents. Beyond the site to the west, ground elevations continue to fall in a southerly direction.

A topographical survey of the proposed site indicates that elevations vary from: ~61m OD in the south west corner of the site; ~75m OD in the north west corner of the site; ~125m OD in the north east corner of the site; and ~128m OD in the south east corner of the site; see Figure 5.2.

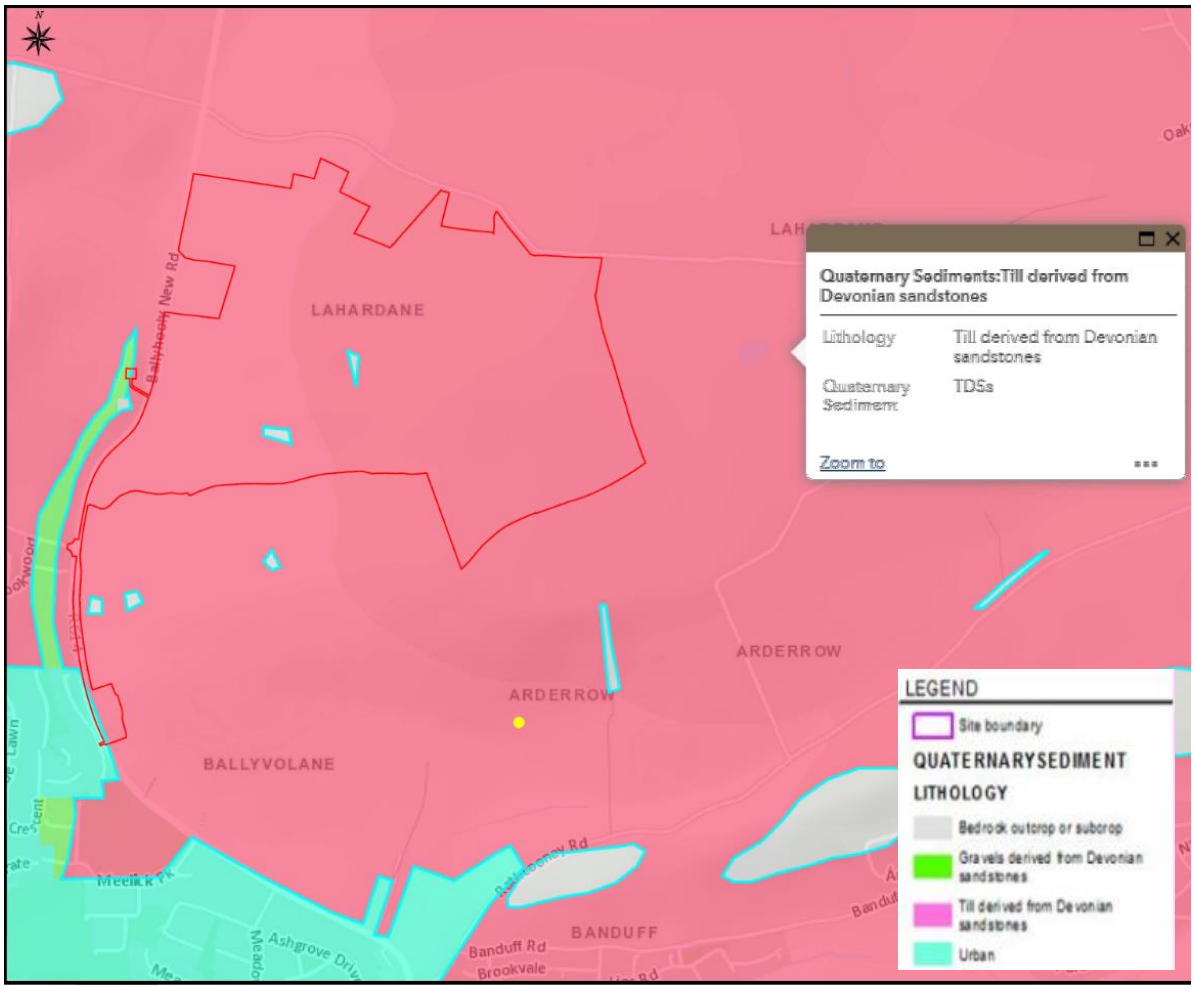
Figure 5.2 Topography over Landholding



5.3.2 Soils

Teagasc sub-soil mapping indicated the superficial deposits in the area were characterised by glacial till derived from Devonian sandstones, Figure 5.3. The National Aquifer Vulnerability Mapping indicates high to extreme vulnerability in the area. Extreme ratings are likely attributed to shallow depth to bedrock or identified outcropping rock in the study area.

Figure 5.3 Superficial Deposits (Sub Soils)



The ground model derived from the site investigation was such that Topsoil was 200mm to 400mm thick; overlying mixed glacial deposits: firm slightly sandy gravelly SILT, firm slightly sandy (slightly) gravelly CLAY, medium dense to dense clayey gravelly SAND, medium dense to dense (very) medium dense to dense silty (very) sandy GRAVEL and medium dense to dense (very) clayey sandy GRAVEL with variable Cobble contents. The mixed glacial, superficial deposits overlay weak to medium strong SANDSTONE/ SILTSTONE 0.9m below existing ground level (bgl) to 4.3m bgl).

The following laboratory testing was carried out in accordance with BS1377 (1990), *Methods Of Test For Soils For Civil Engineering Purposes* and the ISRM suggested methods for rock characterisation, testing and monitoring. The purpose of carrying out these tests was to assess the re-usability of excavated materials as structural fill within the site. The results of these tests confirmed that the bulk of excavated materials on-site could be re-used as either structural fill or general fill depending on the level of improvement works carried out. This is explored further in section 5.4.2.

The full record of ground conditions encountered is provided for on the exploratory records and provides descriptions, in accordance with BS 5930 (2015) and Eurocode 7, Geotechnical Investigation and Testing, Identification and classification of soils, Part 1, Identification and description (EN ISO 14688-1: 2002),– Identification and Classification of Soil, Part 2: Classification Principles (EN ISO 14688-2:2004) and Identification and Classification of Rock, Part 1: Identification & Description (EN ISO 14689-1:2004) of the materials encountered, *in situ* testing and details of the samples taken, together with any observations made during the ground investigation.

Table 5.1 Summary of Laboratory Testing (Ref. Priority Interpretative Report)

Type	Nr.	Remarks
Sulphate (water soluble as SO4)	16	<0.010g/l
Sulphate (acid soluble)	16	<0.010% to 0.028%
Total Sulphur	16	<0.010% to 0.020%
Initial Consumption of Lime	04	TP02, TP03, TP04 and TP05 (+1%, +1.5% pH 12.4)
Compaction, dry density moisture content relationship	04	TP02 1.5m; TP03 0.5m; TP03 1.5m and TP04 0.5m Optimum moisture content 10.3% to 15.3% Maximum dry density 1.8Mgm-3 to 2.1Mgm-3
Moisture condition value, MCV moisture content relationship	04	TP02 1.5m; TP03 0.5m; TP03 1.5m and TP04 0.5m
MCV	01	MCV0
California bearing ratio, CBR moisture content relationship	04	TP02 1.5m; TP03 0.5m; TP03 1.5m and TP04 0.5m
CBR	02	CBR0.2% and CBR4.0%
CBR Lime; OPC	07	CBR2.3% to CBR75%

The use of cement and lime binder additions are proposed to improve the naturally occurring soils and rock. Chemical analysis on the soils post-improvement after a 28-day curing period were carried out.

Table 5.2 Summary of Chemical Analysis (Ref. Priority Interpretative Report)

Type	Nr.	Remarks
pH	07	9.2 to 12.6
Sulphate (water soluble as SO4)	16	0.042g/l to 0.33g/l
Sulphate (acid soluble)	07	0.088% to 0.39%
Total Sulphur	07	0.045% to 0.45%

The CLAY deposits encountered were described being of low to intermediate plasticity, (CL/ CI) with natural moisture content, w ranging between 11% to 17%. The grading analysis for the CLAY indicated a Clay fraction between 26% and 42%; with 25% to 52% Gravel and 22% to 32% Sand fractions.

The SILT deposits encountered were described being of intermediate plasticity, (MI) with natural moisture content, w ranging 16%. The grading analysis for the SILT indicated a Silt fraction 28%, with 56% Gravel and 17% Sand fractions.

The GRAVEL was characterised by natural moisture content, w ranging between 10% and 19% with elevated values of 30% and 33% associated with the shallow high plasticity (MH) silty GRAVEL deposits. The grading analysis or the GRAVEL indicated a Gravel fraction between 42% and 76%; with 9% to 35% Sand and 6% to 22% Silt/ Clay fractions with variable Cobble content 0% to 23%.

The grading analysis for the SAND indicated a Sand fraction between 60% and 77%; with 7% to 13% Gravel and 17% to 27% Silt fractions. Seven (7) number infiltration/ soakaway tests (SA01 to SA07 inclusive) were undertaken upon completion of trial pit excavations. SA01 relates to the soakaway assessment of TP01 (2017).

Tests were carried out in general accordance with BRE Digest 365, Soakaway Design (2003/ 2007). Infiltration coefficients, f of 1.3x 10-4 ms-1 to 1.9x 10-6 ms-1 were measured.

Infiltration viability may be given full consideration where an infiltration coefficient (f) of magnitude 10-5 ms-1 or greater exists (SUDS Manual C753, 2015). The results of infiltration tests carried out are shown in the following table and show that infiltration is a viable option in 5 out of the 7 locations tested.

Table 5.3 Infiltration Test Results (2017)

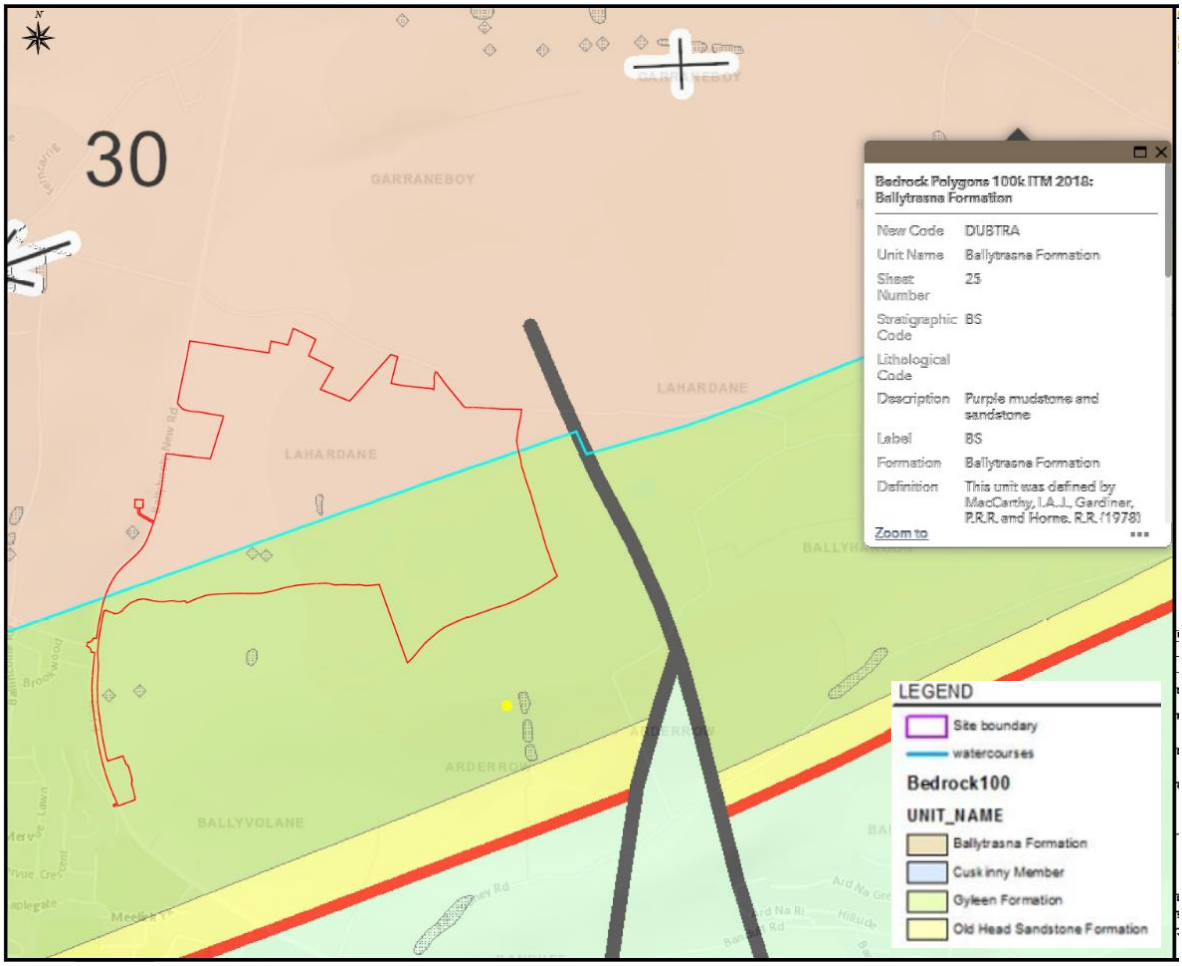
Test No.	Infiltration Rate (f) Metres/second
SA01	3.81534E-06 ms^-1
SA02	2.29860E-05 ms^-1
SA03	2.76069E-04 ms^-1
SA04	7.621E-05 ms^-1
SA05	6.2768E-05 ms^-1
SA06	1.46156E-05 ms^-1
SA07	1.8448E-06 ms^-1

5.3.3 Geology

The Geological Survey of Ireland, 1:100,000 mapping (Sheet 25) indicated the geology of the area was characterised by Ballytransa Formation (BS, purple Sandstone and Mudstone) and the Gyleen Formation (Sandstone, Mudstone and Siltstone). The Siltstone/ Mudstone are dominant in these formations, Figure 5.4.

A geological fault is noted to the eastern bound of the site running in an N-S direction. Bedrock outcrop/ sub-crops were noted in the study area. The GSI well data base (well ref: 1407SEW046 and 1407SEW159) identified bedrock 2.4m to 7.6m deep within the study area. Yield was described as poor.

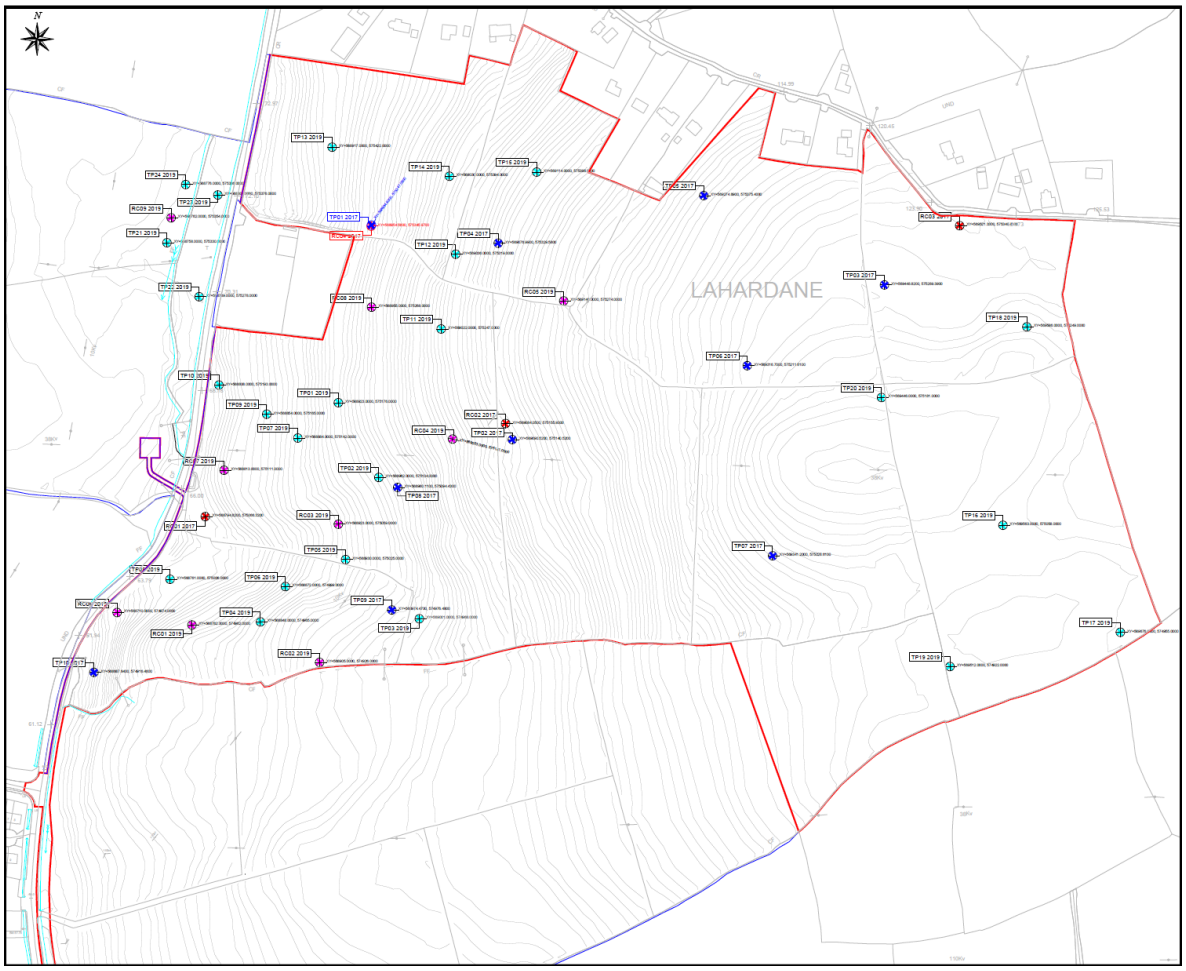
Figure 5.4 Bedrock at proposed Site



The bedrock is largely covered by till derived from Devonian sandstones. In the south east of the site there are gravels derived from Devonian sandstones. In the surrounding region, there are localised areas of bedrock exposed at the ground surface and Made Ground (Urban) areas lie to the south.

Geological information is supported by site investigation data from September 2017 and February 2019 provided by Priority Geotechnical Ltd. Fig. 5.5 presents the locations of the various site investigation works carried out during both time periods.

Figure 5.5 Site Investigation Locations



Trial pit remarks: In the south west of the site, gravelly silt and gravelly clay were encountered. Further north the substrate comprised predominantly gravelly silt. To the west lies clayey sandy gravel while on the higher ground, clayey sandy gravel, cobbles or clayey gravelly silt were encountered.

Borehole remarks: Results indicate slightly sandy gravelly clay, overlying fractured and weathered purple siltstone with sandstone bands, and sandstones. In places the clay was up to 4.3 m thick whilst, in others, bedrock was encountered at the ground surface.

Complete site investigation logs and location drawing are provided in The 'Priority Geotechnical Interpretative Report' submitted as part of the application.

5.3.4 Aquifer Classification

The Geological Survey Ireland (GSI) has a system for classifying bedrock aquifers in Ireland. The aquifer classification for bedrock depends on a number of parameters including, the area extent (km2), well yield (m^3/d), specific capacity ($m^3/d/m$) and groundwater throughout (m^3/d). There are three main classifications – regionally important; locally important and poor aquifers.

The bedrock units which underlie the site are part of the same Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones (Figure 5.6).

5.3.5 Aquifer Vulnerability

Aquifer vulnerability is a term used to represent the intrinsic geological and hydrogeological characteristics that determine the ease with which groundwater may be contaminated generally by human activities. The groundwater vulnerability is described as Extreme (Figure 5.7). The proposed site is located within the Ballinhassig East WFD Groundwater Body (IE_SW_G_004), which is classified as being of 'Good' status under the WFD.

A number of groundwater wells are located to the north of the site serving existing houses. The proposed development will not impact on the operation of these wells as proposed SuDS measures incorporated into the scheme will ensure sufficient aquifer recharge will occur. The JBA Ground Water Seepage Assessment Report covers this in more detail.

Figure 5.6 EPA mapping of bedrock aquifer classification

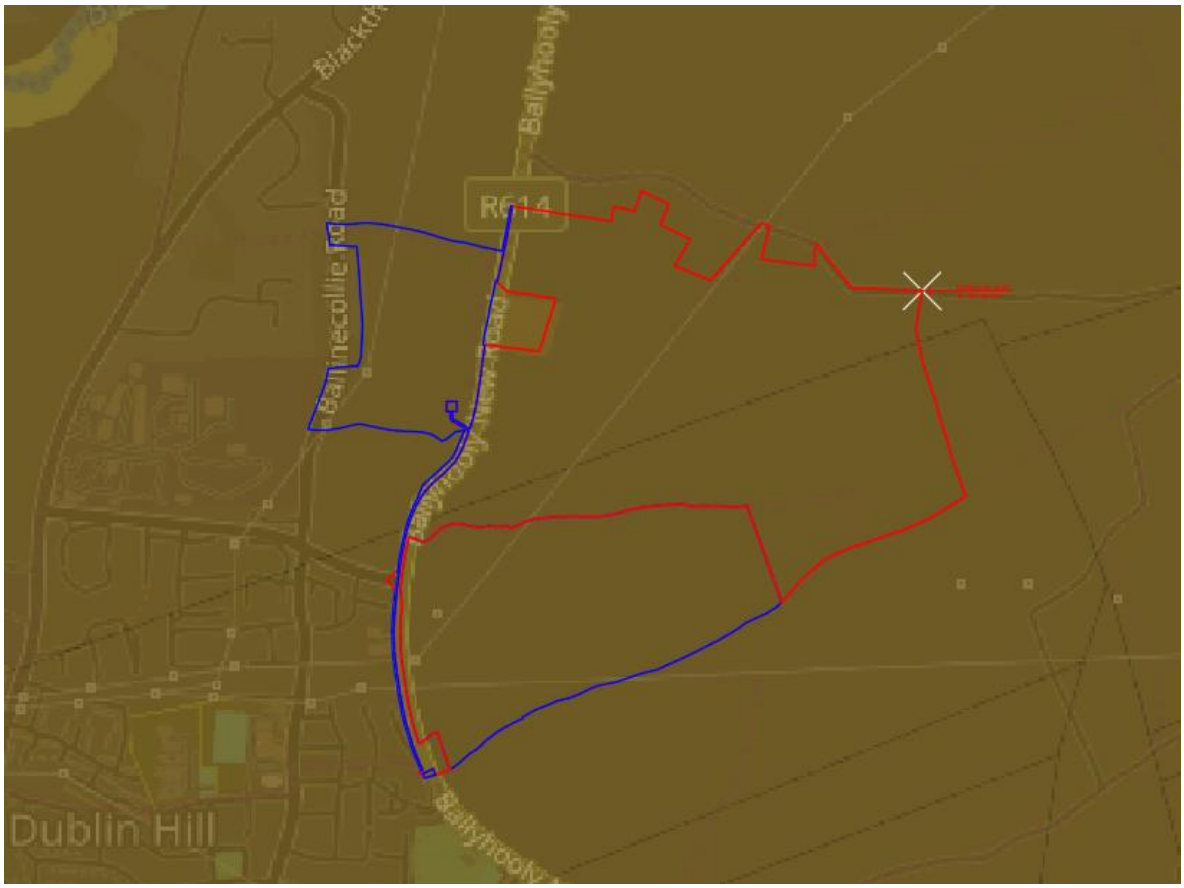
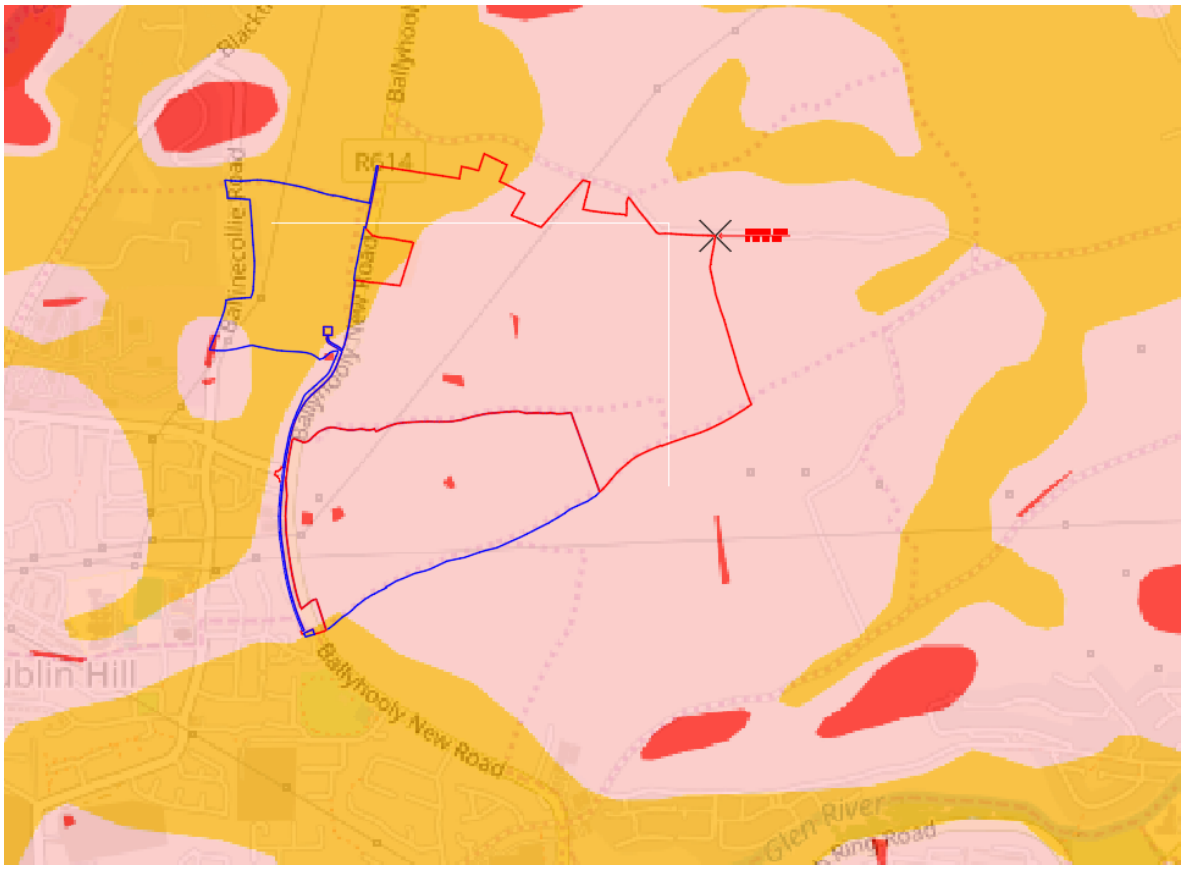


Figure 5.7 EPA mapping of aquifer vulnerability at the proposed site and its environs



5.3.6 Geological Heritage

A review of the Geological Survey Ireland website indicates that there are no County Geological Sites within the site or in the site area.

5.3.7 Economic Geology

The GSI mineral database and the Extractive Industry Register were reviewed to determine whether there were any mineral sites close to the proposed development. There are no active quarries located in the immediate vicinity of the site.

5.4 Potential Impact of the Proposed Development

5.4.1 Do nothing scenario

If the site was not developed, it would remain in its current condition as a greenfield environment that is farmed. There would be no impact on the land, soils or geology of the site. However, the site has been zoned as an urban expansion area of the city to facilitate an increase in residential development.

5.4.2 Construction Phase

Site development works will include actions such as stripping of topsoil, excavation of sub soil layers, filling on excavated ground, construction traffic and associated construction / ground works. It is expected that all excavated materials will be reused on site. Excavation

of subsoil layers will be required in order to allow the construction of the roads network, reprofiling of ground to facilitate the construction of units, foundation excavation, drainage and utility services installation and the provision of underground attenuation/infiltration systems. Excavated materials will be reused as structural fill in the construction of roads and in the general raising of ground levels where required.

The development of the scheme layout has taken consideration of the existing topography in so far as possible however certain regrading works are necessary in order to comply with the principals of DMURS (Design Manual for Roads and Streets) and Part M of the Building Regulations.

The following table presents a summary of cut/fill requirements on a Neighbourhood by Neighbourhood basis and includes a breakdown of topsoil, subsoil and rock.

Table 5.4 Cut/ Fill Breakdown

Summary			Cut Breakdown m^3		
Description	**Cut (m^3)**	**Fill (m^3)**	Topsoil	Subsoil	Rock
Main Distributor Road	33025.15	28830.26	6758.158	17621.66	8645.337
Neighbourhood 1	58223.55	12171.37	7448.902	30180.86	20593.79
Neighbourhood 2	12923.79	33821.76	5843.401	6305.963	774.425
Neighbourhood 3	17088.67	38556.4	4220.603	8655.356	4212.708
Neighbourhood 4	31270.01	22554.65	7708.464	15569.45	7992.096
Neighbourhood 5	16701	11741.69	10940.72	5755.966	4.312
Neighbourhood 6	17600.46	4760.655	2695.258	6229.607	8675.59
Subtotal	**186832.6**	**152436.8**	45615.51	90318.86	50898.26

In line with the findings of the site investigations carried out, it is anticipated that the bulk of excavated subsoil and rock will undergo soil improvement works on-site and will be reused as structural fill material under roads and in the build-up of housing platform areas. Un-treated subsoil will be used as non-structural fill (e.g. Build-up in back gardens, public open spaces and reprofiling the ground in the Park area).

It was found that the rock varied from that of a moderately strong sandstone to a weak siltstone and that much of the rock (approx. 50,000 m^3) will require grading and moisture content reduction prior to use.

Several soil samples taken from the trial pits and assessed to determine its grading capability found that there appears to be two distinct strata with target moistures 10% and 15% to achieve an MCV8 or more and a minimum design CBR 15%. The upper 1.5m was more plastic and had higher fines contents (>20%), while a gravellier deposit was encountered below. A reduction in moisture content of -5% to -6% is required for re-use of any excavated

deposits as general fill material.

These deposits will be compacted dry to the optimum moisture content achieving 95% compaction and a CBR 15% minimum. This may be achieved with the addition of lime alone or the addition of lime and subsequent addition of OPC (Ordinary Portland Cement. The latter will provide a stiffer material where the deposits are more granular (<20% fines). The proposed material processing will be staged on site where a regime of process control and testing will be imposed to ensure adequate bearing of the processed material.

Soil improvement works will be carried out in a designated area with rigorous environmental controls in place. These will include silt fences, settlement ponds, bund structures including incorporating any existing ditches into same and good housekeeping in accordance with the developed CEMP. Such works will only be carried out during periods of dry weather when the improved materials can be placed and 'sealed' within a short timescale. Long-term stockpiling of improved materials will be avoided.

5.4.2.1 Stripping of topsoil

Topsoil removal and replacement will be required to implement the required works throughout the proposed development. The removal and replacement of soil is a direct and permanent neutral impact on the soils and geology of the site as no topsoil is to be exported.

The site investigations carried out indicate an average depth of topsoil of 400mm resulting in an overall excavation of 45,615 m^3. All of this material will be reused on site incorporated into the landscaping of back gardens, public open spaces and the reprofiling of the park area.

5.4.2.2 Excavation of subsoil layers

Subsoil and bedrock removal will be required where works require excavation to install services, house foundations, road formations, and other works as previously outlined. The removal of bedrock during excavation is a direct and permanent impact on the soils and geology. However, the site is not a designated County Geological Site.

The earthworks cut/fill balance for the proposed development has been designed to maximize reusability of materials within the site and reprofiling / relocation of excess top soil / rock if unusable, to the zoned "school site" is proposed as part of the preliminary Construction Environmental Management Plan (CEMP).

During adverse weather conditions surface water runoff across the exposed subsoil could result in increased levels of standing water in excavated areas. This is addressed in the CEMP and proposes a system of silt fences and settlement ponds to control run-off in earthworks areas. At all times the appointed earthworks contractor will be required to seek the approval of the Construction Project Manager or the Environmental Manager prior to the placement of protection measures.

5.4.2.3 Imported fill

In the context of imported materials to site, these will be natural granular materials sourced from local quarries and will be used in the construction of road pavement foundations (Cl.804, Cl.616F), drainage and services bedding materials (Cl.503) and infill material in foundations (SR21).

Materials brought to site will be placed in their final positions in the shortest possible time to

ensure no surplus material results. Any imported material will be kept separate from the on-site excavations.

It is estimated that an imported fill requirement of 60,000 m³ will be required (+/-10%) over and above the fill generated on-site.

5.4.2.4 Construction Traffic

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

The above impacts on the land and soil is expected to be limited to the operations related to the construction works, and therefore is expected to be short term in nature. The vibrations and disturbance from vehicle and plant movements have the potential to compact the subsoil. This is a potential negative impact of imperceptible significance and of short-term duration.

5.4.2.5 Accidental spills and leaks

During construction of the development, there is a potential risk from accidental pollution incidences from the following sources:

- Spillage or leakage of oils and fuels stored on site;
- Spillage or leakage of oils and fuels from construction machinery or site vehicles;
- Spillage of oil or fuel from refueling machinery on site;
- Use of concrete and cement during appropriate foundation and sub-structure construction.

Accidental spillages which are not mitigated may result in the contamination of soils and groundwater underlying the site. Soil stripping and excavation for drainage lines will also reduce the thickness of subsoils in localised areas. In the case of soils, the magnitude of this impact is small adverse as it may result in the requirement to excavate a small portion of contaminated or polluted soil.

Concrete (specifically, the cement component) is highly alkaline and any spillage which migrates though the subsoil would be detrimental to groundwater quality.

5.4.2.6 Geological Environment

There are no likely significant impacts on the geological environment associated with the proposed development of the site. All excavated material is proposed for reuse on site.

Localised areas of excavation, primarily to the west of the development, will interact with existing groundwater conditions where, during construction, the deepest excavations are expected to be required for the installation of the stormwater (Attenuation Tanks & wastewater networks) up to approx. 6.0m deep.

Borehole data received indicates the groundwater on site is on average 2.97m below ground level and sits typically within the bedrock. Site Investigation has indicated that the bulk of

rock encountered on the site is 'ripable' with minimal rock breaking required except for localized service trenches.

5.4.3 Operational Phase

At operational phase, impacts on land and soils from the development will be limited to the risk of fuel leaks from cars parked within the development leaking into the ground. The proposed development will increase impermeable areas throughout the site so there will be no direct discharges to the ground once the development is operational.

The day-to-day activities of the completed development would be unlikely to have any direct impact on the groundwater environment. No significant alteration to groundwater regimes are expected. The proposal provides for SUDS measures that are accommodated in the application submission that allow for controlled run off and infiltration.

Foul waste and surface water discharging to ground through leakage in the drainage systems could occur but is not expected to occur due to IW design standards.

The impacts on soils and geology arising from the operational phase will be temporary and imperceptible.

In an event of electricity supply fail or pump failure in the pumping station, there could be an overflow of sewage in the system which would lead to leakages that would contaminate the soil and the water in the surrounding area however discharge to the existing foul network on Ballyhooly Rd is provided.

5.4.4 Worst Case Scenario

The worst-case scenario in terms of land and soils would relate to the spillage of fuel during the construction period. This would impact on the soil quality and if undetected could contaminate subsoil and or groundwater. Measures as outlined in the CEMP will make this scenario unlikely.

5.5 Ameliorative, Remedial, or Reductive Measures

5.5.1 Construction phase

A preliminary Construction Environmental Management Plan (CEMP) has been prepared for the proposed development. The Draft CEMP, submitted with the SHD application is sufficient to mitigate proposals in own right. The detail of this CEMP will be agreed with the Local Authority prior to commencement of the proposed development. The CEMP contains a range of site-specific mitigation measures which include the following:

- The moving and storage of excess material has been kept to a minimum and has informed the phased delivery of the scheme, N1-N2-N3-N4-N5-N6.
- Excavated material is to be stored on-site as outlined in the CEMP, to be re-used for later stages of the development.
- The preliminary site investigation has identified that certain quantities of subsoil will require soil strengthening methods for re-use as structural fill. These works will be carried out on site within the designated area. This area will include provisions to control the run-off of storm water.
- Given the topography of the site, control measures to protect surface waters from contamination will be put in place prior to the commencement of any site works.

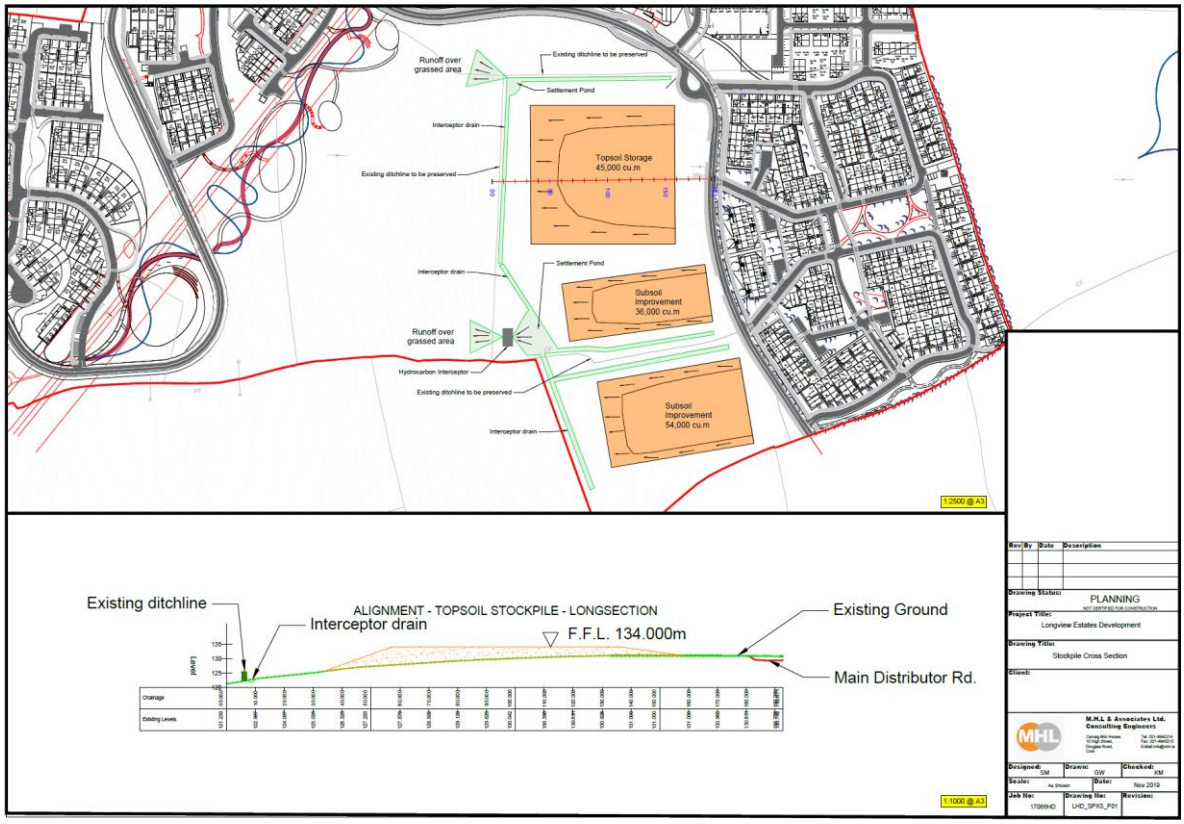
These measures are identified in the CEMP and in Sections 5.5.1.1 to 5.5.1.4 following.

5.5.1.1 Stripping of topsoil

The stripping of topsoil will be carefully controlled and managed. Required temporary storage of topsoil will be carefully managed to prevent any potential negative impact on the receiving environment. The material will be separated from any surface water drains, and the movement of material will be minimised in order to reduce degradation of soil structure and generation of dust. At any time, the extent of topsoil strip will be limited to the immediate vicinity of the active work area.

Topsoil stockpiles will be protected during the construction stage through compaction of the exposed layers. These stockpiles will be placed so as to avoid damage by surface water flow. The following figure shows the proposed location of stockpiles on the site and includes proposed mitigation measures to control surface water run-off.

Figure 5.8 Proposed Stockpile Location



5.5.1.2 Excavation of Subsoil Layers

All excavated materials will be visually assessed for signs of possible contamination such as staining or strong odours. No Site Investigation samples have found materials that are contaminated. However, any samples of any unusual staining or odour will be collected and analysed for the presence of possible contaminants.

Any excavated soil which is determined to be contaminated will be managed according to best practice and disposed of accordingly by a licensed waste disposal contractor. Stockpiles of excavated subsoil materials will be protected for the duration of the works in the area designated in the CEMP and will be separated according to reuse.

5.5.1.3 Imported fill

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

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

5.5.1.4 Construction Traffic

All vehicles delivering to the site will be required to use installed wheel wash facilities at entrances. Road sweeping and dust suppression measures will be implemented as necessary.

Vehicles using the site will be confined to pre-determined haul routes around the site to reduce the area of disturbed ground and limit the potential for soil disturbance and sediment run off. Works will need to be undertaken in accordance with local council requirements and the adopted CEMP.

5.5.1.5 Accidental spills and leaks

To minimise any impact on the underlying subsurface strata from material spillages, all oils, solvents and paints used during construction will be stored within temporary bunded areas. Oil and fuel storage tanks shall be stored in designated areas, and these areas shall be bunded to a volume of 110% of the capacity of the largest tank/ container within the bunded area(s) (plus an allowance of 30 mm for rainwater ingress). Drainage from the bunded area(s) shall be diverted for collection and safe disposal.

Refueling of construction vehicles and the addition of hydraulic oils or lubricants to vehicles will take place in a designated area (or where possible off the site) which will be away from nearby surface water gulley's or drains. In the event of a machine requiring refueling outside of this area, fuel will be transported in a mobile double skinned tank. An adequate supply of spill kits and hydrocarbon adsorbent packs will be stored in this area. All relevant personnel will be fully trained in the use of this equipment. Guidelines such as "*Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors*" (CIRIA 532, 2001) will be complied with.

All ready-mixed concrete will be brought to site by truck. It is recommended that a suitable risk assessment for wet concreting will be completed prior to works being carried out which will include measures to prevent discharge of alkaline wastewaters or contaminated storm water to the underlying subsoil. The pouring of concrete will take place within a designated area using a geo-synthetic material to prevent concrete runoff into the soil/ groundwater media. Wash down and washout of concrete transporting vehicles will take place at an appropriate facility off site.

In the case of drummed fuel or other chemicals which may be used during construction, containers should be stored in a dedicated internally bunded chemical storage cabinet and labelled clearly to allow appropriate remedial action in the event of a spillage.

Potentially contaminated groundwater and polluted surface water generated during construction activities will not be discharged directly to ground or surface drainage. Welfare facilities will be provided for construction operatives but are only likely to

comprise individual 'port-a-loos' with no connection to the foul sewer proposed.

5.5.1.6 Geological environment

The implementation of the construction phase mitigation measures highlighted above will ensure that the soils geology and hydrogeological environment is not adversely impacted during normal and/ or emergency conditions during the construction phase.

A groundwater seepage assessment was conducted by JBA Consulting to ascertain the potential for seepage from groundwater in areas of excavation. The assessment concluded that groundwater discharge rates may be expected to range from 2-92 m^3/d in the south western part of the site, or 0.00004-0.002 l/s per unit length. The design of the proposed stormwater network for the development uses the higher discharge rate within its design capacity calculations to account for groundwater seepage entering the network at the locations where the proposed drainage will be lower than the recorded groundwater level.

5.5.2 Operation phase

In general, drainage from within the proposed development will be collected by gullies and drainage pipelines to a fuel interceptor and attenuation tank prior to discharge to the local surface water network. Drainage to the east and north-east of the site will be collected by open swales or gullies and drainage pipelines before going through to a fuel interceptor and into a soak-away.

5.5.3 'Do nothing' scenario

No mitigation measures are proposed in relation to soils and the geological environment if the development does not proceed.

5.6 Residual (Predicted) Impact of the Proposed Development

5.6.1 Construction phase

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.

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5.6.2 Operational phase

There are no predicted impacts arising from the operational phase.

5.6.3 Do nothing scenario

There are no predicted impacts should the proposed development not proceed.

5.7 Monitoring

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

- Adherence to the Construction Management Plan referenced previously.
- Construction monitoring of the works (e.g. inspection of existing ground conditions on completion of cut to road formation level in advance of placing

capping material, stability of excavations etc).
- Inspection of fuel / oil storage areas.
- Monitoring cleanliness of adjacent road network, implementation of dust suppression and provision vehicle wheel wash facilities.
- Monitoring of contractor's stockpile management (e.g. protection of excavated material to be reused as fill, protection of soils for removal from site from contamination).
- Monitoring sediment control measures (sediment retention ponds, surface water inlet protection etc.).

No ongoing monitoring is proposed on completion of the construction phase. Pumping Stations will be monitored by Irish Water through installed telemetry facilities.

5.8 Reinstatement

All temporary construction compounds are to be removed upon completion of the construction phase. All construction waste and or materials are to be removed once construction is complete.

5.9 Interactions and Potential Cumulative Impacts

There is potential for land and soils to interact with other environmental elements. These interactions include Traffic & Transportation, Water & Hydrology, Waste Management, Noise & Vibration, Air Quality, Flora & Fauna.

Other development currently under construction and approved in the vicinity of the site as listed in Chapter 2 have been considered. Cumulatively these other proposals will not affect the construction works given their scale and distance from the project.

The subject site and the adjoining lands to the south and east have been zoned for the development of an expansion area to Cork City. This is the first proposed development of scale within the urban expansion area and any future developments proposed will be subject to separate planning applications. Any further residential developments permitted on the adjoining lands will have to be developed in accordance with best practice measures which would mitigate any potential effects on the environment. The potential cumulative impact with respect to land and soils of the local and surrounding areas is deemed to be not significant.

5.9.1.1 Traffic and transportation

Delivery of materials to site (e.g. aggregates for road construction, concrete for foundations, delivery of construction plant to site) will lead to potential impact on the surrounding roads network. Mitigation measures to deal with potential impacts are set out in the CEMP.

5.9.1.2 Water and hydrology

Any environmentally damaging fluids accidentally spilled on-site have the potential to impact the surrounding hydrological network. Stripping of topsoil will result in exposure of the underlying subsoil layers to the effects of weather and construction traffic and may result in subsoil erosion and generation of sediment laden surface water runoff. The CEMP outlines mitigations measures to prevent such occurrences from happening.

5.9.1.3 Waste Management

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

5.9.1.4 Noise and vibration

Development of the site will result in an increase in noise and vibration in the area but will be short term. This is dealt with in the Noise and Vibration Chapter of this EIAR.

5.9.1.5 Air quality

Construction traffic will have an impact on the land and soils as well as on the air quality (from dust) on the local environment. This is dealt with in the Air Quality and Climate Chapter of this EIAR.

5.9.1.6 Flora and Fauna

Removal of the existing topsoil layer will be required across the site as well as the removal of some trees and hedgerows. This is dealt with in the Biodiversity Chapter of this EIAR.

5.10 Risks to Human Health

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

- Collapse of trench during excavation works
- Accidental Leaks & Spillages
- Dust generation can also occur during extended dry weather periods as a result of construction traffic.

With the implementation of the aforementioned mitigation measures in the CEMP the likelihood of such events occurring would be minor with non-significant localised impacts. On completion of the construction phase, there will no further anticipated risks to human health from the soils and geological environment.

5.11 References

The following sources of information were consulted to establish the baseline environment: -

- Geological Survey of Ireland (GSI)
    - Groundwater wells and springs
    - Karst
    - Drinking water protection areas
    - Groundwater vulnerability, recharge and resources
    - Quaternary sediments
    - Bedrock geology

- Environmental Protection Agency (EPA)
    - Water quality monitoring locations
    - Water Framework Directive (WFD) water body risk
    - Water Framework Directive (WFD) water body status
    - River Q values 1971-2016

    - Protected areas
- GeoHive
    - Topography
    - Land use
    - Historic land use
- Met Eireann
- Priority Geotechnical Ltd., 2017, 2019. Borehole logs.
- JBA Consulting Ltd. Groundwater Seepage Assessment
- MHL & Associates Ltd., 2019. Longview Estates Development – Overall road design plan.
- Fetter, C.W. 2001. Applied Hydrogeology. 4th Edition, Prentice Hall.