6.0 LAND, SOILS, GEOLOGY AND HYDROGEOLOGY

AWN Consulting has prepared this chapter of the EIAR which assesses and evaluates the potential impacts on the land, soil, geological and hydrogeological aspects of the site and surrounding area.

In assessing likely potential and predicted impacts, account is taken of both the importance of the attributes and the predicted scale and duration of the likely impacts.

6.1 Study Methodology

6.1.1 Appraisals Methodology

The appraisal methodology for the EIAR is completed in accordance with *'Draft Guidelines on the Information to be contained in Environmental Impact Statements'* (EPA, 2017) and Institute of Geologists of Ireland (IGI) 'Geology in Environmental Impact Statements, a Guide', (IGI, 2002) and 'Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements' (IGI 2013). In addition, 'Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes' by the National Roads Authority (NRA, 2009) is referenced where the methodology for assessment of impact is appropriate.

The rating of potential environmental impacts on the land, soils and geology environment is based on the quality, significance, duration and type of impact characteristic identified. Consideration is given to both the importance of an attribute and the magnitude of the potential environmental impacts of the proposed activities on that cited attribute. The EIAR guideline tables (EPA, 2017) are presented in Appendix 6.1. The IGI and NRA criteria for rating the magnitude and significance of impacts at EIA stage on the geological related attributes are also relevant in determining impact assessment and are presented in Appendix 6.2.

The principal attributes (and impacts) to be assessed include 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 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 as well or requirement to remove it off-site as waste for disposal or recovery;
- High-yielding water supply springs/wells in the vicinity of the site to within a 2km radius and the potential for increased risk presented by the proposed development;
- Classification (regionally important, locally important etc.) and extent of aquifers underlying the site perimeter area and increased risks presented to them by the proposed development associated with

aspects for example removal of subsoil cover, removal of aquifer (in whole or part), drawdown 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 site; and
- Groundwater-fed ecosystems and the increased risk presented by operations both spatially and temporally.

6.1.2 Sources of Information

Desk-based geological information on the substrata (both Quaternary deposits and bedrock geology) underlying the extent of the site was obtained through accessing databases and other archives where available. Data was sourced from the following:

- Geological Survey of Ireland (GSI) - on-line mapping, Geo-hazard Database, Geological Heritage Sites & Sites of Special Scientific Interest, Bedrock Memoirs and 1: 100,000 mapping;
- Teagasc soil and subsoil database;
- Ordnance Survey Ireland - aerial photographs and historical mapping;
- Environmental Protection Agency (EPA) – website mapping and database information;
- National Parks and Wildlife Services (NPWS) – Protected Site Register; and
- Louth County Council - illegal landfill information.

Site specific data was derived from the following sources;

- Engineering Assessment Report, Waterman Moylan June 2018
- Ground Investigation Ireland (GII) Ltd. Newtown Drogheda Factual Ground Investigation Report, February 2019
- IGSL Ltd. Site Investigation Report for Waterman Moylan Engineers, July 2018
- Various design site plans and drawings; and
- Consultation with site engineers.

6.2 Receiving Environment

The receiving environment is discussed in terms of; land use, geomorphology; superficial and solid geology and site history including potential for contamination.

The site is located off the Marsh Road in the townland of Newtown, Drogheda, Co. Louth. The site is situated approximately 1.7 km southeast of Drogheda town centre. The proposed development consists of 450 No. residential Units, supporting neighbourhood and employment uses, an underground carpark and all associated infrastructure necessary to service them. Description of Development can be viewed in Chapter 3. The proposed road levels around the development site range from 23.50 to 33.40 m OD Malin and proposed finished floor levels of buildings proposed range between 24.00 to 33.50 m OD Malin. Basement levels range from 15.80 to 26.75 OD Malin. Figure 6.1 presents the topographic nature of the site and surrounding area.

Figure 6.1 Site Location

6.2.1 Land Use

The subject site is Greenfield and is bounded by the Dublin Belfast Railway line which runs along the southern boundary of the site, the Drogheda Waste Water Treatment Plant to the east, and Greenfield lands to the north and west. Historical mapping (OSI, 2019) does not indicate any other use for the site other than Greenfield.

6.2.2 Drainage

The site is in the catchment of the Boyne River and the existing drainage is discussed in Chapter 7 of this EIAR.

6.2.3 Soil & Subsoil

Site specific information was derived from a site investigation involving drilling and trial pitting undertaken at the site in May and July 2018 by IGSL (Report No. 20951) and February 2019 by GII. In 2018 three boreholes were drilled, eight trial pits were excavated, and a number of geotechnical tests were also carried out. Borehole and trial pit locations are included in the investigation report under separate cover. The 2019 investigations consisted of the excavation of 11 no. trial pits to a maximum depth of 3.6m. Bedrock depth was not confirmed during the investigations, all boreholes were advanced to 10 metres below ground level (mbgl). The soils generally comprise glacial till (firm occasional stiff boulder clay) with bands of sands discovered in a number of locations . At circa. 5 mbgl the glacial tills become very stiff with cobble and boulder material encountered. This confirms the GSI regional mapping which states the strata underlying the site is mostly low permeability Irish sea tills from Lower Palaeozoic shale and sandstones (IrSTLPSsS). See Figure 6.2.

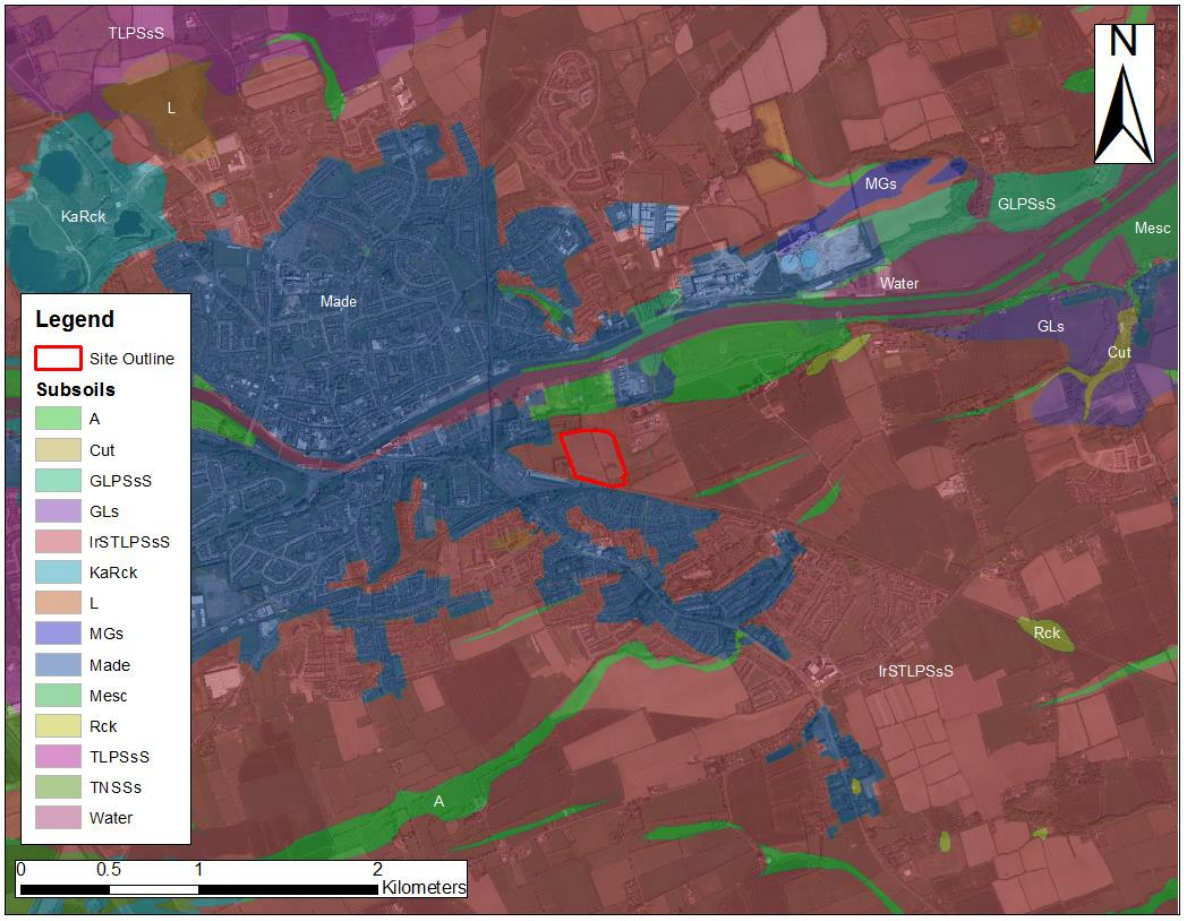
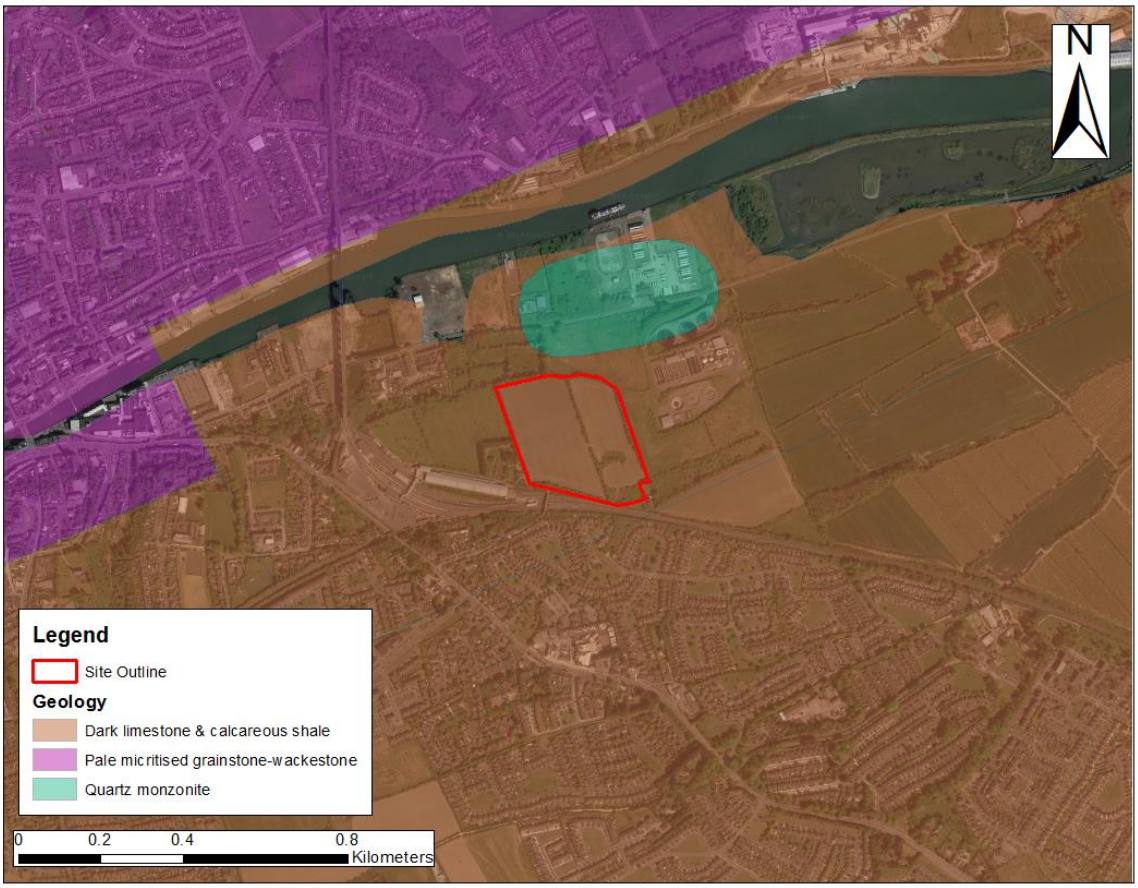


Figure 6.2 Subsoil (GSI, 2019)

6.2.4 Bedrock Geology

Inspection of the available GSI data shows that the bedrock geology underlying the site and surrounding area is dominated by rocks of Carboniferous Age. The site and local area are underlain by dark limestone and calcareous shales and part of the Mornington Formation. The formation consists of thickly to thinly bedded dark grey packstones, wackestones, micrites and occasional grainstones and shales. Turbidites are common in the upper parts. Figure 6.3 shows the local geology

Figure 6.3 Local Geology (GSI, 2019)

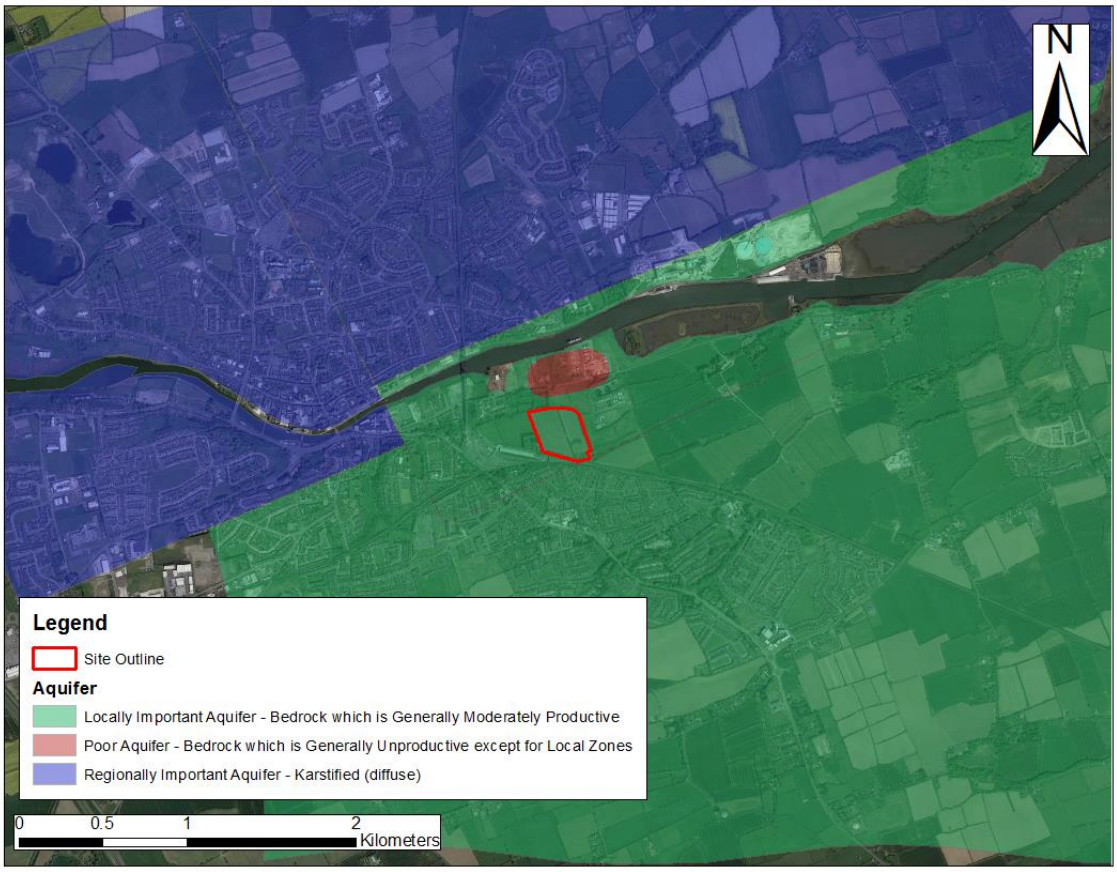


6.2.5 Aquifer Classification

The GSI has devised a system for classifying the bedrock aquifers in Ireland. The aquifer classification for bedrock depends on a number of parameters including, the areal extent (km^2), well yield (m^3/d), specific capacity ($m^3/d/m$) and groundwater throughput (mm^3/d). There are three main classifications: regionally important, locally important and poor aquifers. Where an aquifer has been classified as regionally important, it is further subdivided according to the main groundwater flow regime within it. This sub-division includes regionally important fissured aquifers (Rf) and regionally important karstified aquifers (Rk). Locally important aquifers are sub-divided into those that are generally moderately productive (Lm) and those that are generally moderately productive only in local zones (Ll). Similarly, poor aquifers are classed as either generally unproductive except for local zones (Pl) or generally unproductive (Pu).

The bedrock aquifer underlying the proposed development site according to the GSI (www.gsi.ie/mapping) National Draft Bedrock Aquifer Map is classified as a Locally Important Aquifer (Lm) which is described as *Bedrock which is Generally Moderately Productive* See Figure 6.4.

Figure 6.4 Local Geology (GSI, 2019)



The site is underlain by the Drogheda Groundwater Body (EU code: IE_EA_G_025) which has been investigated by the GSI and is described as having a groundwater flow regime of KA (Karstic). Where the rock is less karstified groundwater flow will be through a series of connected fractures and joints. It would appear due to the classification of the aquifer underlying the site as Locally Important (Lm), the karstified area would be found outside of this in the surrounding Regionally Important (RI) zone.

6.2.6 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. Due to the nature of the flow of groundwater through bedrock in Ireland, which is almost completely through fissures/ fractures, the main feature that protects groundwater from contamination, and therefore the most important feature in the protection of groundwater, is the subsoil (which can consist solely of/ or of mixtures of peat, sand, gravel, glacial till, clays or silts).

The GSI currently classifies the bedrock aquifer in the region of the subject site primarily as having (L) - Low Vulnerability status indicating >10m of low permeability soil see Figure 6.5).

This was confirmed by the most recent site investigations in 2018 and 2019. Borehole drilling was advance to 10 mbgl with no evidence of bedrock at this depth.

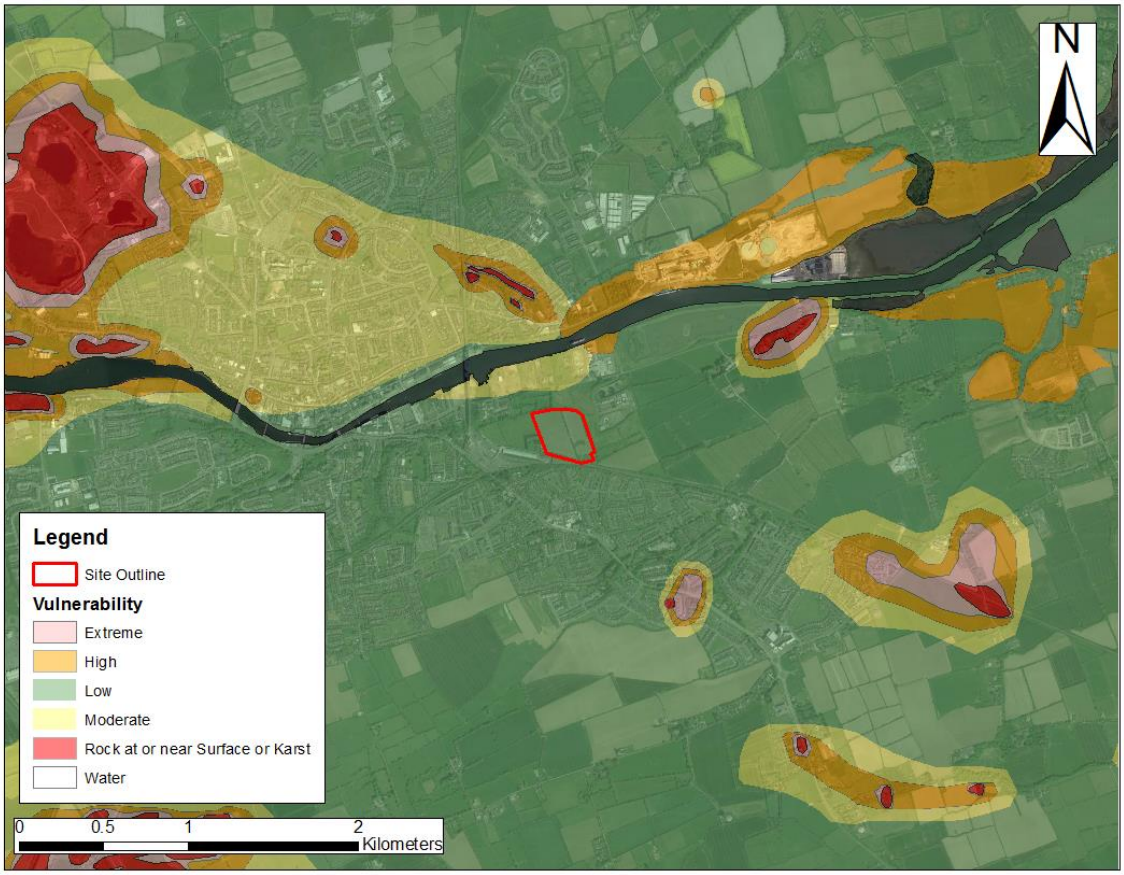


Figure 6.5 Aquifer Vulnerability Map (GSI, 2019)

6.2.7 Groundwater Wells and Flow Direction

There are no recorded groundwater resource protection zones in the area of the proposed site, i.e. zones surrounding a groundwater abstraction area. The closest can be seen north of Drogheda Town centre on the opposite side of the River Boyne. See Figure 6.6.

Figure 6.6 Subsoil (GSI, 2019)

The GSI Well Card Index is a record of wells drilled in Ireland, water supply and site investigation boreholes. It is noted that this record is not comprehensive as licensing of wells is not currently a requirement in the Republic of Ireland. This current index, however, shows a number of groundwater monitoring and abstraction wells within a 3 km radius of the site. The maximum borehole depth of these recorded was 46.9 mbgl. Bedrock was encountered from at 16.5 mbgl and this was the only well listed to have extended to bedrock. As the area is served by public mains, it is unlikely that there are any boreholes in the area used for potable water supply. Figure 6.7 shows the possible known location radius of local wells in the area . The outer radius off 2 wells appear on the site however the locations of these are only accurate from 500m - 1Km and no wells were reported in the site investigation report from IGSL in July 2019.

Figure 6.7 Subsoil (GSI, 2019)

The flow direction in overburden generally follows no fixed pattern or trend. Flows of this nature are typical of cohesive clay strata with intermittent fill areas, where often the water level dipped represents pore water seepages into the monitoring well rather than a true perched water table. Slow to moderate seepages of shallow groundwater were noted in the May-June 2018 investigations in TP2, TP3, TP4, TP6 and TP8 ranging from 1.5 to 3m. There were no bedrock wells installed as part of the investigations but due to the site's location (540m south of the River Boyne and 5.5km west of the Irish Sea) it can be assumed bedrock groundwater flow direction it north -northeast.

6.2.8 Geological Heritage

The Geological Survey of Ireland (GSI) Public Viewer was reviewed to identify sites of geological heritage for the site and surrounding area. There are no recorded sites on the development site. There is no evidence of any site which could be considered suitable for protection under this programme or recorded in the Louth County Development Plan 2015-2021 or the Meath County Development Plan 2013-2019.

6.2.9 Economic Geology

The Extractive Industry Register (www.epa.ie) and the GSI mineral database was consulted to determine whether there were any mineral sites close to the proposed development. There are no active quarries located in the immediate vicinity with the nearest notable quarry located approximately 6 km to the southwest which is classified as the Platin Quarry. The EPA ENVision website also confirmed that there are no active mines on or near the site.

6.2.10 Geo-hazards

There are no expected geohazards at this location. In general, Ireland suffers few landslides. Landslides are more common in unconsolidated material than in bedrock, and where the sea constantly erodes the material at the base of a cliff landslides and falls lead to recession of the cliffs. Landslides have also occurred in Ireland in recent years in upland peat areas due to disturbance of peat associated with construction activities. The GSI landslide database was consulted and the nearest landslide to the proposed development was 4km to the north, the date and exact details were not available on GSI online database. There have been no recorded landslide events at the site. Due to the local topography and the underlying strata there is a negligible risk of a landslide event occurring at the site.

In Ireland, seismic activity is recorded by the Irish National Seismic Network. The Geophysics Section of the School of Cosmic Physics at the Dublin Institute for Advanced Studies (DIAS) has been recording seismic events in Ireland since 1978. The station configuration has varied over the years. However, currently there are five permanent broadband seismic recording stations in Ireland and operated by DIAS. The seismic data from the stations comes into DIAS in real-time and are studied for local and regional events. Records since 1980 show that the nearest seismic activity to the proposed location was in the Irish sea (1.0 – 2.0 Ml magnitude) and ~80 km to the south in the Wicklow Mountains. There is a very low risk of seismic activity to the proposed development site.

6.2.11 Soil Quality

As part of the May-June 2018 investigations 6 no. representative soil samples were collected and analysed by a UKAS accredited laboratory for metals, polycyclic aromatic hydrocarbon (PAHs), total petroleum hydrocarbons (TPH CWG) including BTEX & mineral oil compounds, polychlorinated bi-phenols (PCBs) and total phenols with the results compared to landfill Waste Acceptance Criteria (WAC) limits in all samples. All samples tested (TP2, TP3,TP4, TP5, TP7 and TP8) were below the relevant levels of detection (LOD) for PAHs, mineral oil, TPHs, BTEX compounds, total phenol and PCBs. There are no published Generic Assessment Criteria (GACs) for soil contamination in the Republic of Ireland. However, metal concentrations were compared to Land Quality Management Ltd (LQM) and Chartered Institute of Environmental Health (CIEH) Suitable for Use levels for residential thresholds (the most conservative scenario). All parameters were below their corresponding levels. The results are shown in table 6.1 below.

Sample Type				SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Sample ID				TP2	TP3	TP4	TP5	TP7	TP8
Waste Description				Soil	Soil	Soil	Soil	Soil	Soil
Sample Depth (m)				0.5-1.0	0.5-1.0	0.5-1.0	0.5-1.0	0.5-1.0	0.5-1.0
Date Sampled				10-05-18	10-05-18	10-05-18	10-05-18	09-05-18	09-05-18
Lab Reference				18/7348	18/7348	18/7348	18/7348	18/7348	18/7348
Parameters	**Units**	**LOD**	**LQM/CIEH S4ul for HHRA Residental Threshold at 6% SQM (mg/kg)**						
Total Organic Carbon [Note 1]	%	<0.02	nv	0.14	0.34	0.27	0.4	0.3	1.1
Arsenic	mg/l	<0.5	37	16.6	20.1	14.9	14.3	13.9	10.0
Cadmium	mg/l	<0.1	11	0.6	1.5	0.9	1.2	1.1	1.4
Chromium III	mg/l	<0.5	910	71.7	96.4	57.5	114.8	69.0	66.9
Chromium IV	mg/l	<0.03	6	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Copper	mg/l	<1	2400	29	44	35	36	39	27
Mercury	mg/l	<0.1	1.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel	mg/l	<0.7	180	59	68.5	52.3	66.2	62.8	38.2
Selenium	mg/kg	<1	250	<1	2.000	1.00	<1	<1	<1
Zinc	mg/kg	<5	3700	77	98	84	97	92	162

Legend

16.4 Results exceed LQM/CIEH S4ul for HHRA Residential Threshold with homegrown produce at 1% SQM (mg/kg)

nv Guideline threshold value not available

Notes

HHRA 2015 - LQM/CIEH Suitable 4 Use Levels based on 'Commercial' and/or 'residential' land use using 1% SOM

Sol : sol S4UL presented exceed the solubility saturation limit, which is presented in brackets

Vap: vap S4UL presented exceed the vapour stauration limit which is prensted in brackets

Table 6.1 LQM/CIEH Comparison Table

All samples tested were also below WAC criteria limits for inert material disposal to landfill. No asbestos was detected in any of the sample's analysed. Sample results and locations are included in the SI investigation report, which forms part of the documentation to this SHD application. No samples were taken during the 2019 investigations.

6.2.12 Groundwater Quality

The European Communities Directive 2000/60/EC established a framework for community action in the field of water policy (commonly known as the Water Framework Directive[WFD]). The WFD required '*Good Water Status'* for all European water by 2015, to be achieved through a system of river basin management planning and extensive monitoring. 'Good status' means both *'Good Ecological Status'* and *'Good Chemical Status'*.

The Groundwater Body (GWB) underlying the site is the Drogheda GWB (EU Groundwater Body Code: IE_EA_G_025). Currently, the EPA (2018) classifies the Drogheda GWB as having 'Good Status', with a WFD risk currently under review. However, the GWBs to the north and south of this have are currently at risk of not achieving good status, meaning there is insufficient information to determine the risk , or measures for enhancement have been implemented but some additional monitoring is required to confirm expected improvements have been achieved . Figures 6.8 and 6.9 below present the most recent data from the EPA website.

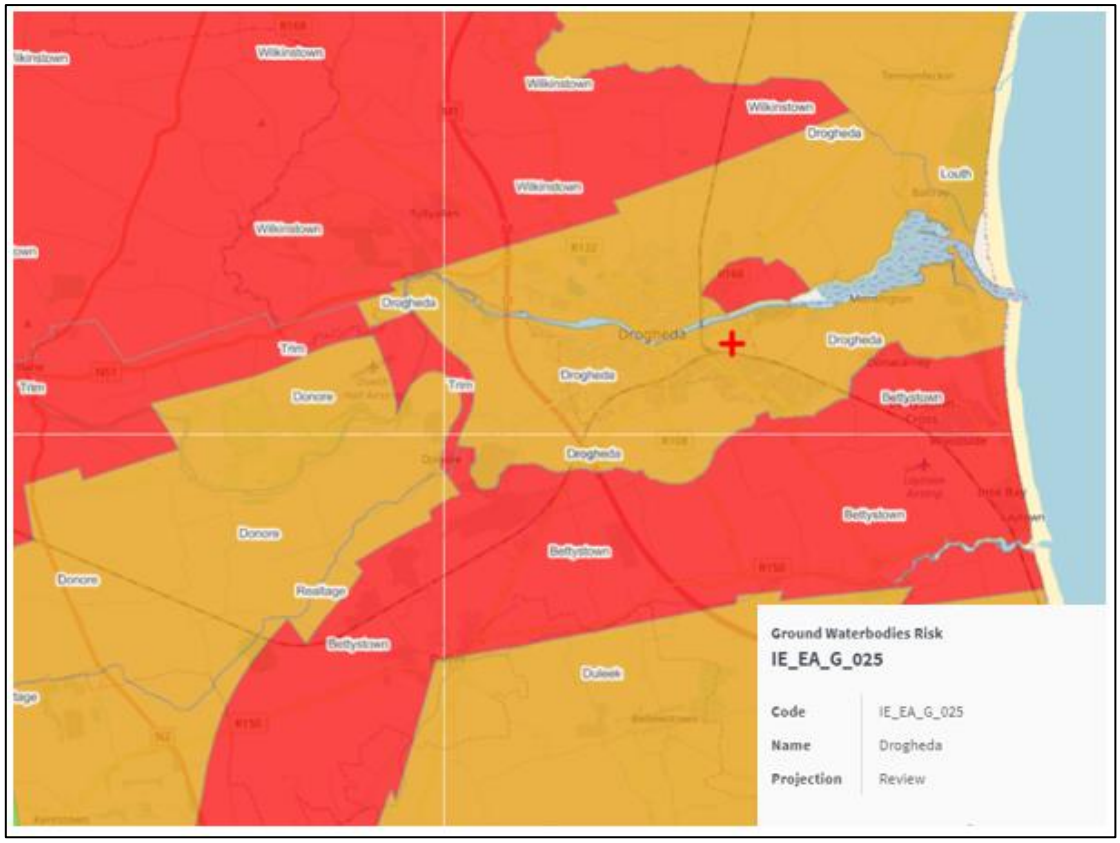


Figure 6.8 GWB Risk (EPA, 2019)

No groundwater samples were recovered during site investigation works as all boreholes installed (to 10 mbgl) were dry on installation. As there was no evidence of residual soil contamination based on visual assessment and laboratory analysis of soils, it is not likely that there is any resultant groundwater contamination leaching from the soil on the subject site.

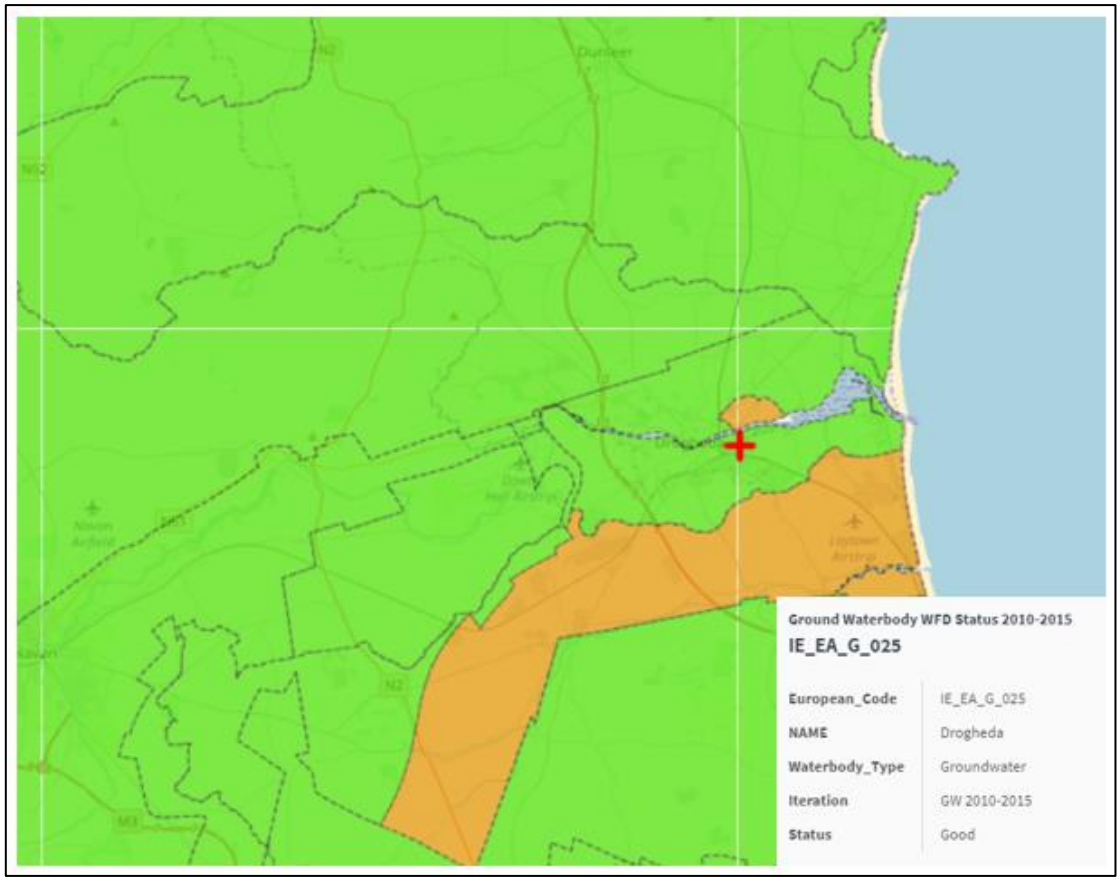


Figure 6.9 GWB WFD Status 2010-2015 (EPA, 2019)

6.2.13 Hydrogeological Features

There is no evidence of springs of karstification at the proposed site according to the GSI Karst database 2015. However, karstification has been noted in the wider Mornington formation.

6.2.14 Area of Conservation

The lands in which the proposed development is located have no formal designations. The nearest designated sites to the proposed development are the River Boyne and River Blackwater SAC (Site Code 002299) at c.550m to the north site and the Boyne Coase and Estuary SAC (Site Code 001957) c.2km to the northeast. The Boyne Estuary SPA is c.480m to the north east.

6.2.15 Rating of site Importance of Geological and Hydrological Features

Based on the NRA methodology (2009) (See Appendix 6.2), criteria for rating site importance of geological features, the importance of the bedrock and soil features at this site is rated as low importance with medium quality significance or value on a local scale. There are no extractable minerals or areas of geological heritage and the soils are suitable for agricultural use but are typical of surrounding agricultural land.

Based on the NRA/IGI criteria for rating the importance of hydrogeological features, the importance of the hydrogeological features at this site is rated as *Low to Medium Importance*. This is based on the assessment that the attribute has a medium quality significance or value on a local scale. The aquifer beneath the site is a *locally important* (Lm) bedrock aquifer to *Bedrock which is Generally Moderately productive.* It is not used for public water supply or widely used for potable use and is well protected (low vulnerability). In addition, it does not host any groundwater dependent ecosystems (SACs/NHAs).

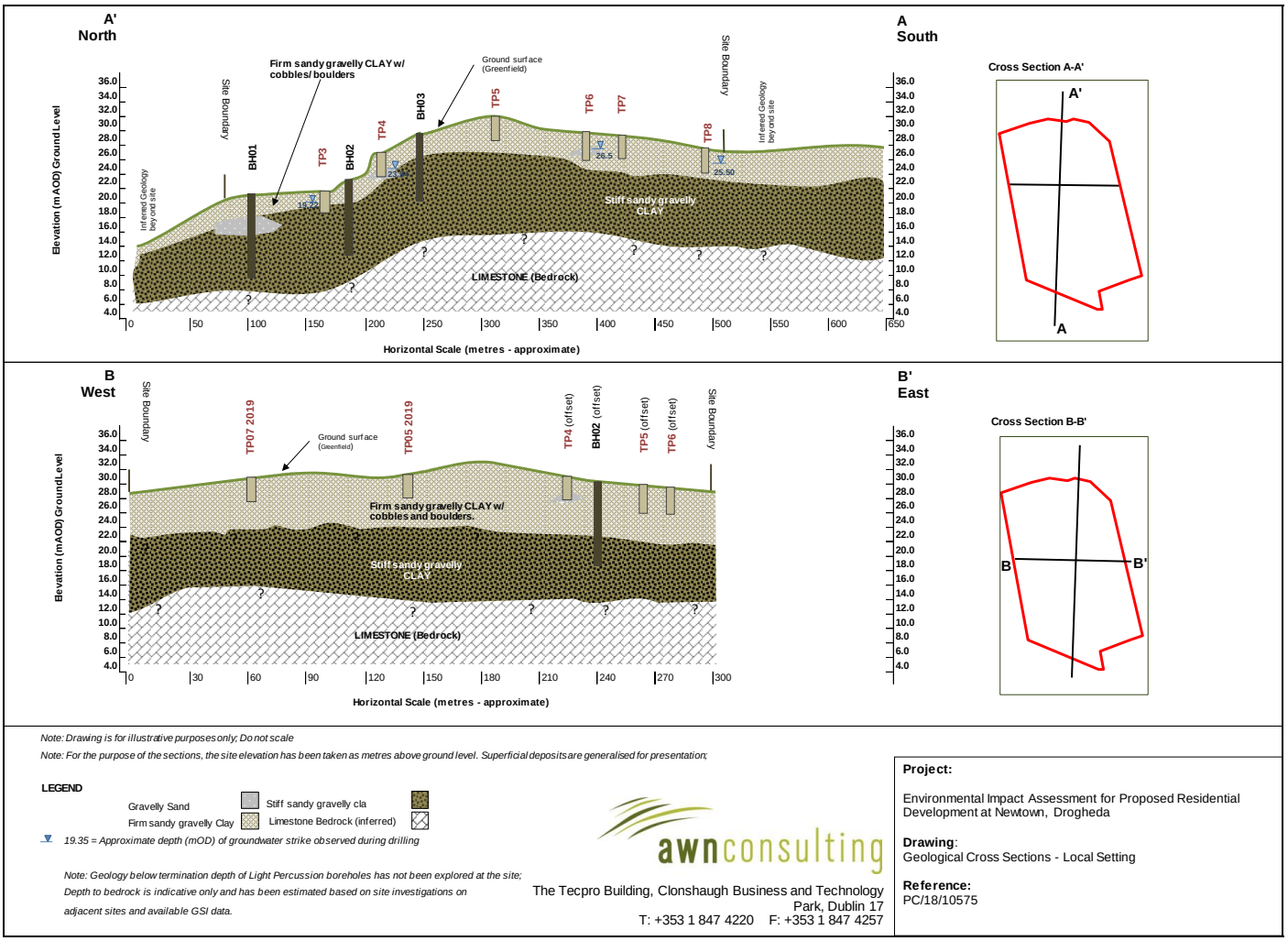
6.2.16 Conceptual Site Model

Interpretative cross sections have been finalised for the site with views appropriate to the characterisation of the site in terms of the geological (and hydrogeological environment). The inserts below present cross sections for the site and regional area and indicate the following:

- The profile on site comprises thin topsoil overlying > 10 m of sandy gravelly CLAY with cobbles and boulders underlain by (Firm) sandy slightly gravelly CLAY with fine to coarse gravels and occasional coarse sand horizons (1-2m) separating the two layers of clay in some locations. The overburden overlays a dark limestone and shale bedrock.
- Depth to bedrock is believed to be >10m across the site, all boreholes were installed to 10 mbgl during site investigations with none identifying bedrock. Consultation with the GSI well card index indicated a nearby well was installed in bedrock at 16.5m.
- The topography of the proposed development site generally slopes from south to north, approximately +32mAOD at the south western boundary of the development site to approximately +21.5mAOD at the northern boundary of the development site. Marsh Road is approximately 3.0 mAOD.
- No continuous perched water table was identified within the overburden. Localised seepage was encountered within the overburden in a number of trial pits (TP2, TP3, TP4, TP6 & TP8). at depths ranging between 1.50m and 3m. The limestone and shale bedrock is likely to have shallow perched water along the weathered surface. Development of the site will not require any significant dewatering considering the depth to the bedrock aquifer and the prevalence of >10m of low permeability clays.
- A basement car park forms part of the proposed works. The final floor level of the basement will be between 15.8 mAOD and 23.30 mAOD (Malin). The current ground level of the area where the car park is proposed id c.24 mAOD. Bedrock is believed to be >10 mbgl. Removal of bedrock should not be necessary for excavation and construction of the underground carpark.
- Review of the hydrogeology and geology in the surrounding region indicates that there are no groundwater source protection area in the vicinity of the site. There are a number of Special Protected Area and Special Areas of Conservation to the north and east of the proposed site but impacts from proposed development are not predicted to occur due to the separation distance between the site and these areas. The proposed development has been subject to Stage 2 Appropriate Assessment and a Natura Impact Statement accompanies the application. There are no sensitive receptors such as groundwater-fed wetlands, Council Water Supplies/ Group Water Schemes or geological heritage sites which could be impacted by this development.

- No evidence of the disposal of waste material was identified at the area proposed for excavation.

*Figure 6.10 Local Site Cross Section Sections**



Note*: Bedrock depth is inferred based on GSI Vulnerability mapping

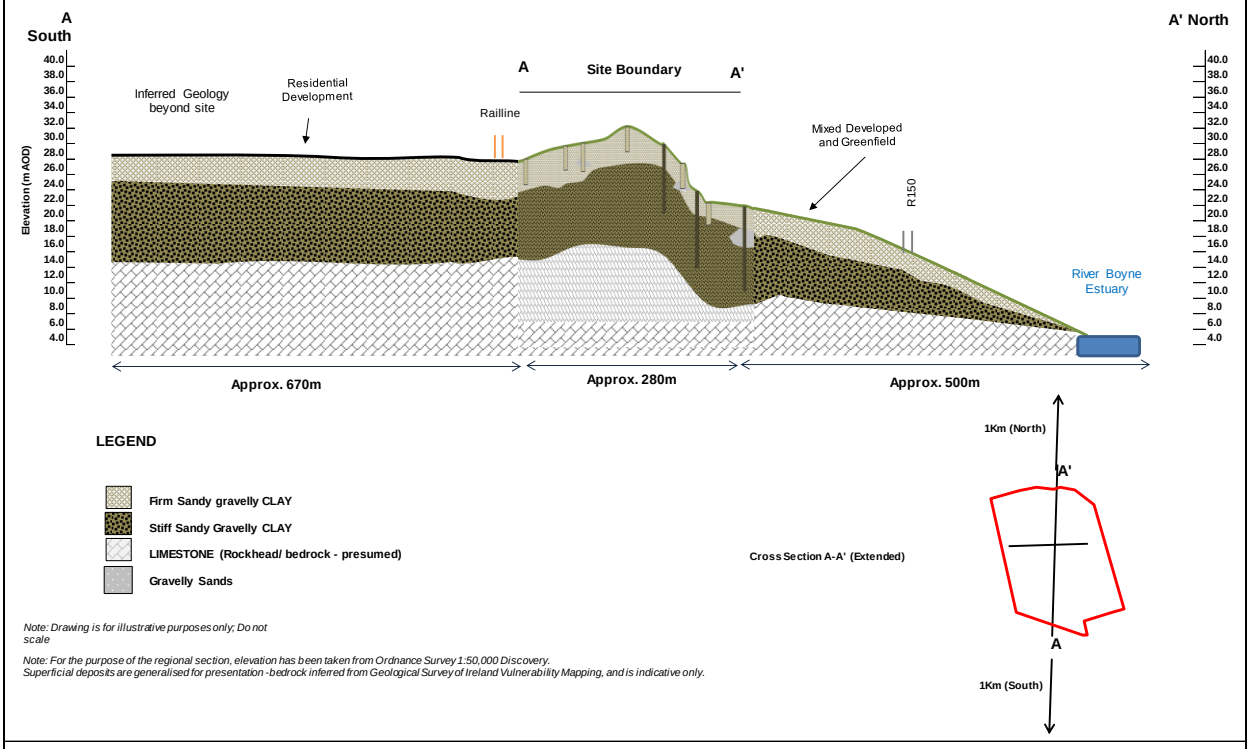


Figure 6.11 Regional Cross Section

awnconsulting

The Tecpro Building, Clonshaugh Business and Technology Park, Dublin 17
T: +353 1 847 4220 F: +353 1 847 4257

Project:
Environmental Impact Assessment for Proposed Residential Development at Newtown, Drogheda

Drawing:
Geological Cross Sections - Regional Setting

Reference:
PC/18/10575

Note*: Bedrock depth is inferred based on GSI Vulnerability mapping

6.3 Characteristics of the Proposed Development

A full description of development can be viewed in Chapter 3. Aspects relevant to this chapter are outlined below:

Construction Activities will include the following:

- Extensive site levelling and excavations for the underground car park will involve the removal of topsoil and subsoil. It is planned to reuse much of the material on site however c. 70,000 tonnes will be removed from the construction of the LIAHF road.
- Local loss of agricultural land and land use change to residential use.
- Temporary storage/use of fuel/oils on site will be required for construction machinery.

Operational Activities will include the following;

- There will be no direct discharges to ground during the operation of the proposed development. Water supply will be supplied from public mains. Foul effluent will be discharged to public foul sewer. See Chapter 7 *Hydrology* for further details.
- The total hardstanding area will be increased, which will reduce local recharge to ground. It is expected that the surface water will be discharge to the public surface water network via attenuation system (underground) and an oil interceptor.

6.4 Potential Impacts of the Development

An analysis of the potential impacts of the proposed development on the land, soils, geology and hydrogeological environment during the construction and operation is outlined below. Due to the inter-relationship between soils, geology and hydrogeology and surface water (hydrology) the following impacts discussed will be considered applicable to both chapter 6 and 7 of the EIAR.

6.4.1 Construction Phase

Excavation & Infilling

Excavation and infilling within the proposed site will be required as part of the preliminary site enabling works as well the levelling and excavation of the site to render it suitable for development. Excavated material will be reused on site for infilling and landscaping works where possible. Site investigation and laboratory analysis has not identified any existing contamination. However, if contaminated soil/water is encountered, it will be required to be removed by a licensed waste contractor. This development will also require importation of clean fill

Accidental release to ground

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

- spillage or leakage of temporary 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 refuelling machinery on site; and
- run-off from concrete and cement works

Accidental spillages which are not mitigated may result in localised contamination of soils and groundwater underlying the site, should contaminants migrate through the subsoil's and impact the underlying groundwater. Groundwater vulnerability at the site is classified as "*low" As such there is significant natural protection to the underlying aquifer from any accidental release.* . Any soil stripping will also further reduce the thickness of subsoil and the natural protection they provide to the underlying aquifer. However, the thickness of sediment on the

site (> 10 m) and provision of capping of site with impermeable paving and building and associated drainage infrastructure will provide additional protection following construction.

6.4.2 Assessment of Impact Pre-Mitigation - Construction

Based on the points stated above in relation to the construction phase the potential impact on the soils, geology and hydrogeology during construction (EPA 2017) is considered to have a short term – not significant effect with a neutral effect on quality. i.e. an effect which causes noticeable changes in the character of the environment without affecting its sensitivities. This is due to the substantial overburden depth at the site (>10m) protecting the underlying bedrock aquifer. The proposed development does not involve the removal of bedrock.

6.4.3 Operational Phase

There will be no direct discharges to the ground or abstractions from the aquifer during the operation of the development. The potential impacts of the development operation in relation to land soils and environment have been assessed under the following headings:

- Accidental Emissions
- Reduction in Local Recharge to Groundwater

Accidental Emissions

There will be no direct discharges of contaminated water to groundwater or soil environments during the operational phase. As there will be no bulk storage of chemicals and no bulk oil storage proposed on site, the likelihood of a potential significant impact on the soil or groundwater quality is negligible. Indirect localised discharges could occur from accidental leakages from cars/vehicles in the car parking areas although

Reduction in Local Recharge to Groundwater

The site will be predominately hardstanding (approximately 60%). This will reduce local recharge to the underlying groundwater aquifer. However, as the area proposed for additional paving is small in relation to the size of the entire Drogheda aquifer, it is not likely to have any significant impact on the overall recharge to the aquifer.

6.4.4 Assessment of Impact Pre-Mitigation - Operation

Based on the points above in relation to the operation phase the potential impact on the land soils, geology and hydrogeology during operation (EPA 2017) is considered to have a long-term, not significant effect with a neutral effect on quality. i.e. an effect which causes noticeable changes in the character of the environment but without significant consequences. There will be a local reduction in recharge to the aquifer due to the increase in hardstand on this and surrounding developed lands, however this will not be significant in terms of the overall aquifer hydrogeological profile. There are no significant potential contaminant sources apart from vehicular traffic which will be mitigated by the introduction of hardstanding and the low vulnerability of the local bedrock aquifer.

6.5 Mitigation Measures

It is important to note that the design of the proposed development has taken account of the potential impacts on the land, soils and geology environment. Measures have been incorporated into the design to mitigate any potential effects on the surrounding land, soils and geology. These are described in further detail below. Due to the inter-relationship between soils, geology, hydrogeology and hydrology the following mitigation measures will be applicable to each of these characteristics of the environment.

6.5.1 Construction Phase

Soil Removal & Compaction

Construction works will require the removal of soils/stones. The aquifer vulnerability is classified as *'Low'* throughout the site area based on site investigations. Removal of soil cover will increase the vulnerability of the underlying bedrock during construction however, due to the thickness of the overburden and the fact that a large proportion of the site will be capped/paved this will provide protection from surface infiltration during operation.

Surface water management in accordance with the design (e.g. runoff directed to attenuation storage and through a petrol interceptor prior to discharge) will ensure there is no risk to the underlying aquifer. Temporary storage of soil will be carefully managed to prevent any potential negative impact on the receiving environment. This material will be stored away from the surface water drainage network. Movement of material will be minimised in order to reduce degradation of soil structure and generation of dust.

Although there is no evidence of contamination at the site, all excavated materials will be visually assessed for signs of possible contamination such as staining or strong odours. In the event that any unusual staining or odour is noticed, samples of this soil will be analysed for the presence of possible contaminants in order to ensure that historical pollution of the soil has not occurred. Should it be determined that any of the soil excavated is contaminated, this will be segregated, classified and appropriately disposed of by a suitably permitted/licensed waste disposal contractor.

Fuel & Chemical Handling

To minimise any impact on the underlying subsurface strata from material spillages it is proposed that all fuels, oils, solvents and paints used during construction will be stored within temporary bunded areas or will be contained in double skinned tanks in designated areas of the site away from surface water drains.

Re-fuelling of construction vehicles and the addition of hydraulic oils or lubricants to vehicles will take place off site or in a designated area that will be away from any existing surface water drains. The area will be determined by the contractor prior to commencement on site but is likely to be carried out in a designated area of the contractor's compound. In the event of a machine requiring refuelling 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.

6.5.2 Operational Phase

Indirect Accidental Emissions

There will be no bulk storage of fuel required for the operation of the proposed residential development. The majority of the site c. (c.60%) will be covered in hardstanding. The impermeable surface will minimise the potential influx of any contaminants into soils and underlying groundwater.

Any accidental leaks from cars within the car parking/road areas will be directed through the surface drainage system via an appropriately sized interceptor.

Attenuation will be provided by underground tanks to ensure that the discharge rate is maintained at greenfield runoff rate. The attention facility will accommodate rainfall events up to, and including, the 1-in-100-year storm event.

The foul water system discharges to the public sewer and subsequently to the Drogheda WWTP to the east of the proposed site. Due to the close proximity of the WWTP, there is a very low risk of contamination to ground from leakage from the foul drainage system.

6.6 Predicted Impacts of the Proposed Development

The proposed development will have no significant impact on the natural groundwater regime either qualitatively or quantitatively. The majority of the soil and excavated will remain onsite for reprofiling and fill during construction. There will be no impact to the underlying bedrock from construction activities.

6.6.1 Construction Phase

Following the implementation of mitigation measures detailed in Section 6.5, the predicted impact on the land, soils and geology during construction phase (in accordance with EPA Draft EIA Guidelines, 2017) is considered to be short-term, imperceptible with a neutral effect on quality.

6.6.2 Operational Phase

Following implementation of the mitigation measures proposed in Section 6.5, the predicted impact on land, soils and geology once the development is constructed and operational (in accordance with EPA Draft EIA Guidelines, 2017) is considered to be long-term, imperceptible with a neutral effect on quality.

6.6.3 'Do Nothing Scenario'

Do nothing' scenario refers to the environment as it would be in the future should the subject project not be carried out. Should the project not proceed the site would remain in its current state with the only likely impact on the underlying soil and/or aquifer due to agricultural processes. The continued use of the site for agricultural purposes is likely to have a Neutral and Imperceptible effects on the environment.

6.6.4 'Worst Case Scenario'

Worst case scenario refers to effects arising from a project in the case where mitigation measures substantially fail. With respect to land, soils and geology, substantial failure of the mitigation measures could result in very localised soil and groundwater quality impacts due to e.g. leaks from construction vehicles when refuelling on what is a locally important hydrogeological feature. Any discharge of bulk fuel (limited to construction phase only) could have a negative effect on the quality of down gradient local groundwater quality. However, as the underlaying soil is comprised of relatively impermeable clays and the maximum volume of fuel stored/used on site during construction will be moderate, it is unlikely that a leak/spill at the site would have a significant effect on springs or the groundwater quality.

6.7 Monitoring

6.7.1 Construction Phase

Regular inspection of surface water run-off and any sediment control measures e.g. silt traps will be carried out during the construction phase. Regular auditing of construction/mitigation measures will be undertaken e.g. concrete pouring, refuelling in designated areas etc.

6.7.2 Operational Phase

No future soil or groundwater monitoring is proposed as part of the proposed development.

Petrol interceptor(s) will be maintained and cleaned out in accordance with the manufacturer's instructions. Maintenance of the surface water drainage system and foul sewers as per normal urban developments is recommended to minimise any accidental discharges to ground.

6.8 Interactions

6.8.1 Hydrology

As previously stated there is an inter-relationship between hydrology and soils, geology and hydrogeology. The underlying aquifer is a locally important source in the surrounding catchment areas. There will be no potential cumulative impacts on the bedrock as the aquifer vulnerability is '*Low*' and the aquifer is locally important with little importance regionally.

Surface water run-off may have the potential to enter soil and groundwater. Implementation of appropriate mitigation measures as outlined in Section 7.5 will eliminate the potential for the influx of surface contaminants into the underlying geology and hydrogeology.

6.8.2 Air Quality

There is a potential for excavations and infilling to impact on air quality in terms of dust generated but suitable mitigation measures (See Chapter 8), will ensure the impact is imperceptible.

6.9 Potential Cumulative Impacts

The primary potential cumulative impact considered the local increase in hardstanding and subsequent decrease in local groundwater recharge. Given the relative scale of the proposed development and that of the geological and hydrogeological environments in which they are based i.e. the bedrock aquifer, the potential cumulative impact with respect to the land, soils and geology of the local and surrounding areas is deemed to be not significant.

The site is currently in agricultural use, as are the neighbouring lands to the west and east. However, the subject site and the neighbouring lands have been zoned by LCC for development and permission has been granted for 133 no. houses and an access road to the south east of the site under P.A. Ref. 17/387. In addition, the vision of the zoning objective, as stated in the Drogheda Borough Council Development Pan 2011 - 2017, is to ensure the provision of high quality new residential environments with good layout and design. In accordance with the Plan, any new residential developments permitted on the neighbouring lands will have to be built to a high standard which would include the adherence to best practice mitigation measures which will mitigate any potential effects on the environment.

The potential cumulative impact with respect to the land, soils and geology of the local and surrounding areas is deemed to be not significant.

6.10 References

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APPENDIX 6.1

DESCRIPTION OF IMPACTS (DRAFT)

ENVIRONMENTAL PROTECTION AGENCY (EPA, 2017)

Impact Characteristic	Term	Description
Quality	Positive	A change which improves the quality of the environment
	Neutral	A change which does not affect the quality of the environment
	Negative/ Adverse	A change which reduces the quality of the environment
Significance	Imperceptible	An effect capable of measurement but without noticeable consequences
	Not significant	An effect which causes noticeable changes in the character of the environment but without noticeable consequences
	Slight Effects	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities
	Moderate Effects	An effect that alters the character of the environment in a manner consistent with existing and emerging baseline trends
	Significant Effects	An effect, which by its character, magnitude, duration or intensity alters a sensitive aspect of the environment
	Very Significant	An effect which, by its character, magnitude, duration or intensity significantly alters the majority of a sensitive aspect of the environment
	Profound Effects	An impact which obliterates sensitive characteristics
Extent & Context	Extent	Describe the size of the area, the number of sites, and the proportion of a population affected by an effect
	Context	Describe whether the extent, duration or frequency will conform or contrast with established (baseline) conditions (is it the biggest, longest effect ever?)
Probability	Likely Effects	The effects that can reasonably be expected to occur as a result of the planned project if all mitigation measures are properly implemented
	Unlikely Effects	The effects that can reasonably be expected not to occur because of the planned project if all mitigation measures are properly implemented.
Duration	Momentary	Effects lasting from seconds to minutes
	Brief	Effects lasting less than a day
	Temporary	Effects lasting less than a year
	Short-term	Effects lasting one to seven years
	Medium-term	Effects lasting seven to fifteen years
	Long-term	Effects lasting fifteen to sixty years
	Permanent	Effects lasting over sixty years
	Reversible Effects	Effects that can be undone, for example through remediation or restoration
	Frequency of Effects	Describe how often the effect will occur. (once, rarely, occasionally, frequently, constantly – or hourly daily, weekly, monthly, annually.
	Indirect Effects (a.k.a. Secondary Effects)	Impact on the environment, which are not a direct result of the project, often produced away from the project site or because of a complex pathway.

Type	Cumulative	The addition of many small impacts to create one larger, more significant impact
	'Do Nothing'	The environment as it would be in the future should no development of any kind be carried out
	Worst case Effects	The effects arising from a project in the case where mitigation measures substantially fail.
	Indeterminable	When the full consequences of a change in the environment cannot be described
	Irreversible	When the character, distinctiveness, diversity, or reproductive capacity of an environment is permanently lost
	Residual	The degree of environmental change that will occur after the proposed mitigation measures have taken effect
	Synergistic	Where the resultant effect is of greater significance than the sum of its constituents

APPENDIX 6.2

CRITERIA FOR RATING SITE ATTRIBUTES – ESTIMATION OF IMPORTANCE OF HYDROLOGY ATTRIBUTES

NATIONAL ROADS AUTHORITY (NRA, 2009)

Table 1 Criteria for rating site importance of Geological Features (NRA)

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

	Volume of peat and/or soft organic soil underlying route is moderate on a local scale	Sub-economic extractable mineral resource
Low	Attribute has a low quality, significance or value on a local scale Degree or extent of soil contamination is minor on a local scale. Volume of peat and/or soft organic soil underlying route is small on a local scale	Large historical and/or recent site for construction and demolition wastes. Small historical and/or recent landfill site for construction and demolition wastes. Poorly drained and/or low fertility soils. Uneconomically extractable mineral resource.

TABLE 2 CRITERIA FOR RATING IMPACT MAGNITUDE AT EIS STAGE – ESTIMATION OF MAGNITUDE OF IMPACT ON SOIL / GEOLOGY ATTRIBUTE (NRA)

Magnitude of Impact	Criteria	Typical Examples
Large Adverse	Results in loss of attribute	Loss of high proportion of future quarry or pit reserves
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	Loss of moderate proportion of future quarry or pit reserves
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of	Loss of small proportion of future quarry or pit reserves
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	No measurable changes in attributes
Minor Beneficial	Results in minor improvement of attribute quality	Minor enhancement of geological heritage feature
Moderate Beneficial	Results in moderate improvement of attribute quality	Moderate enhancement of geological heritage feature
Major Beneficial	Results in major improvement of attribute quality	Major enhancement of geological heritage feature

TABLE 3 CRITERIA FOR RATING SITE ATTRIBUTES - ESTIMATION OF IMPORTANCE OF HYDROGEOLOGY ATTRIBUTES (NRA)

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

Table 4 Criteria for Rating Impact Significance at EIS Stage – Estimation of Magnitude of Impact on Hydrogeology Attribute (NRA)

Magnitude of Impact	Criteria	Typical Examples
Large Adverse	Results in loss of attribute and /or quality and integrity of attribute	Removal of large proportion of aquifer. Changes to aquifer or unsaturated zone resulting in extensive change to existing water supply springs and wells, river baseflow or ecosystems. Potential high risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >2% annually.
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	Removal of moderate proportion of aquifer. Changes to aquifer or unsaturated zone resulting in moderate change to existing water supply springs and wells, river baseflow or ecosystems. Potential medium risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >1% annually.
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	Removal of small proportion of aquifer. Changes to aquifer or unsaturated zone resulting in minor change to water supply springs and wells, river baseflow or ecosystems.

		Potential low risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >0.5% annually.
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	Calculated risk of serious pollution incident <0.5% annually.

Table 5: Rating of Significant Environmental Impacts at EIS Stage (NRA)

Importance of Attribute	**Magnitude of Importance**			
	Neglible	**Small Adverse**	**Moderate Adverse**	**Large Adverse**
Extremely High	Imperceptible	Significant	Profound	Profound
Very High	Imperceptible	Significant/moderate	Profound/Significant	Profound
High	Imperceptible	Moderate/Slight	Significant/moderate	Profound/Significant
Medium	Imperceptible	Slight	Moderate	Significant
Low	Imperceptible	Imperceptible	Slight	Slight/Moderate