10 GEOLOGY, SOILS AND HYDROGEOLOGY

10.1 Introduction

This Chapter of the Environmental Statement/Environmental Impact Statement (ES/EIS) will identify, describe and assess the impact of the proposed development in terms of its impact on soils, geology and hydrogeology. To aid the environmental assessment process, a preliminary risk assessment (desk study) and outline conceptual site model has been prepared to accompany the chapter and is contained within Appendix 10.1.

10.2 Methodology

This Chapter of the ES/EIS describes the potential impact to soils, geology and hydrogeology associated with the proposed development. This section should be read in conjunction with the site layout plans and project description sections of the ES/EIS The expected geology and soils within the proposed development sites are described below.

The preliminary assessment has been carried out within the current UK and European legislative framework with particular attention paid to the guidance set out in CLR 11 '*Model Procedures for the Management of Land Contamination*' published by the Environment Agency and DEFRA, UK. The Desk Study examined the potential for sources of contamination and pollutant linkages to be present and an outline conceptual site model and preliminary risk assessment was developed to ascertain the potential unacceptable, long term risks to future human users and the environment of the developed sites.

A glossary of terms used to explain the quality and significance of impacts used in this assessment are outlined below;

- *Positive Impact* – A change which improves the quality of the environment.
- *No Change Impact* – A change which does not affect the quality of the environment.
- *Negative Impact* – A change which reduces the quality of the environment.
- *Minor Impact* – An impact which causes noticeable changes in the character of the environment without affecting its sensitivities.
- *Moderate Impact* – An impact that alters the character of the environment in a manner that is consistent with existing and emerging trends.
- *Major Impact* – An impact which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.

The following sources of information were used in the compilation of this assessment:

- Solid and Drift Geology Maps – Geological Survey of Northern Ireland,
- Hydrogeological Map of Northern Ireland 1:250,000,
- Groundwater Vulnerability Map of Northern Ireland 1:250,000,
- Historic Ordnance Survey Maps obtained from Land Property Services,
- Radon in Dwellings in Northern Ireland – Health Protection Agency and Northern Ireland Environment Agency 2009;
- The Local Authority Guide to Ground Gas – Chartered Institute of Environmental Health 2008;
- British Geological Curvey Geoindex Website - http://maps.bgs.ac.uk/gsni_geoindex/,
- Northern Ireland Environment Agency - http://maps.ehsni.gov.uk/wmuviewer
- Ordnance Survey of Ireland Environmental Report
- Geological Survey of Ireland – www.gsi.ie/mapping
- Environmental Protection Agency – www.epa.ie
- Internet based aerial photography
- Site walkover survey
- Consultation with statutory bodies

10.3 Existing Environment

10.3.1 Geology and Soils

The existing geology and soils are described under the two distinct units of Solid Bedrock Geology and Drift Geology.

10.3.1.1 Solid Geology

Greencastle, Co. Down
The 1:50,000 Sheet 71 Solid Geological Map for the area (Figure 10.1) indicates that the site is underlain by Silurian Greywacke-Sandstones and interbedded cleaved mudstones. The Carlingford Limestone Group is located immediately south east of the site.

Greenore, Co. Louth
The 1:50,000 Sheet 71 Solid Geological Map for the area (Figure 10.2) indicates that the site is underlain by The Carlingford Limestone Group.

10.3.1.2 Drift Geology

Greencastle, Co. Down
The Geoindex online database indicates that the site is underlain by Blown Sands and Raised Beach Deposits (Figure 10.3).

Greenore, Co. Louth
The Environmental Protection Agency (EPA) online Envision Viewer indicates that the site is underlain by Made Ground and Beach and Marine Sands and Gravels (Figure 10.4).

10.3.2 Hydrogeology and Groundwater Vulnerability

Greencastle, Co. Down
The Hydrogeological Map of Northern Ireland Scale 1:250 000 (Figure 10.5) indicates that the site and the surrounding area is underlain by an aquifer of limited potential in which flow is predominantly in fractures. However a superficial aquifer is likely to be present associated with the blown sand and raised beach deposits.

In accordance with the Water Framework Directive (2000/60/EC) it is necessary to understand the groundwater vulnerability of the site, which is defined as the tendency and likelihood for general contaminants to reach the water table after introduction at the ground surface. The vulnerability classification is divided into 5 categories with Class 1 areas having the lowest risk of groundwater pollution and Class 5 the highest.

The groundwater vulnerability class of 4e has been mapped within the study area of the site due to the presence of the superficial aquifer (Figure 10.6).

Greenore, Co. Louth
The Draft National Bedrock Aquifer Map indicates that the site is underlain by a locally important aquifer which is generally moderately productive (Figure 10.7).
The aquifer has been classified as having a high vulnerability (Figure 10.8). The site is not designated as a source protection zone

10.3.3 Hydrology

Both sites are located adjacent to Carlingford Lough. Carlingford Lough forms part of the Neagh Bann River Basin District. The River Basin Management Plan for the Neagh Bann RBD is implemented locally under the Carlingford and Newry Local Management Area. The Carlingford and Newry LMA identifies that Carlingford Lough is euhaline and classified as having Moderate Ecological status.

10.3.4 Ground Borne Gases

Methane and Carbon Dioxide gas emissions may arise from fill materials and organic rich deposits as a result of anaerobic degradation of organic materials. The Chartered Institute of Environmental Health

guidance '*The Local Authority Guide to Ground Gas*' indicates that the source potential of natural soil strat with low degradable organic content e.g. sand is very low with a very low risk for on site development.

Radon has been considered as a potential risk to proposed development, as gas protection measures may require to be incorporated if elevated concentrations are measured. According to information published by the Health Protection Agency, 1-3% of homes in the Greencastle area are above the Action Level of 200 Becquerels per cubic metre. The Northern Ireland Environment Agency has indicated that areas where 1% or more of homes are likely to have Radon levels above the Action Level are Radon Affected Areas and may require protective measures. According to the Radiological Protection Institute of Ireland, more than 20% of homes in the Greenore area are above the action level of 200 Becquerels per cubic metre.

10.4 Construction Impacts

10.4.1 Soils and Geology

It is anticipated that limited earthworks will be required during the construction of the development. It is likely that it will be necessary to utilise a piled foundation solution for the new slipways, however it is unlikely that piles will need to be driven into the underlying bedrock.

The potential risk to construction workers from contaminants during the earthworks is likely to be low should appropriate health and safety practices and personal protective equipment be employed.

The impact to soils and geology are considered to be Minor and short term in nature. Construction activities may also include noise, dust, odour and site traffic generation problems as well as potential contamination issues arising with the use of fuel storage tanks, vehicles and the use of paints and oils.

10.4.2 Groundwater

It is unlikely that groundwater will be encountered during construction on shore as piling activities will only be carried out for the construction of the slipways which will take place within the water line. However any groundwater encountered during construction will require careful management in order to maintain its quality status.

10.5 Mitigation Measures

10.5.1 Construction

The effects of existing contamination beneath the surface of the site can be minimised through construction design and implementation of a comprehensive remedial strategy.

The construction activities should be conducted in a safe environmentally conscious manner and in line with all health and safety guidelines. The following practical steps will be followed:

- Provision of noise, dust and odour abatement measures including a Dust Management Plan to mitigate the effects of large scale stone import, infill and construction practice. Dust suppression measures may include physical barriers to limit dust migration and/or wet suppression measures such as water spraying. The Dust Management Plan will be prepared by the Contractor prior to the commencement of construction. The Plan will include details on; potential dust creating activities and their timescale, list of all dust and emission control methods to be used, details and procedures for dealing with dust in extremely dry weather, details of authorised person deemed responsible for monitoring dust levels and implementing suppression measures and details for recording and dealing with complaints from members of the public/local authority.
- Fuel storage tanks, paints and oils will be stored in clearly labelled and bunded areas. Reference will be made to Pollution Prevention Guideline (PPG) 2: Above Ground Oil Storage Tanks. Bunds will be at 110% of the capacity of the largest tank.
- Refuelling of all plant and machinery will only take place in designated areas away from surface waters and drains. Spill kits will be placed within the designated re-fuelling areas to contain any accidental spillages of fuel.
- An emergency plan to deal with accidental spillages will be drafted prior to construction and implemented to prevent contamination of groundwater and surface water.

- Reference should be made to PPG6: Working at Construction and Demolition Sites and PPG5: Works in, near or liable to affect watercourses for guidance on dealing with refuelling and potential spillages as outlined above.
- A construction Environmental Management Plan (CEMP) will be prepared and implemented by the Contractor to detail the mitigation measures required during construction. The EMP will provide details of procedures for monitoring reporting the environmental effects of the development during construction.
- A Groundwater Management Plan will be prepared and implemented by the Contractor to minimise the potential risk to any groundwater encountered during construction activities. Reference should be made to *CIRIA C515 Groundwater Control – Design and Practice.*
- A Foundation Works Risk Assessment will be undertaken prior to the commencement of construction to ascertain the potential risk which piling activities may pose to the groundwater quality of the underlying aquifer. Reference should be made to the Environment Agency publication '*Piling and Penetrative Ground Improvement Methods on Lands Affected by Contamination and Pollution Prevention'*.
- The fuel storage tank adjacent to the security hut at the Greenore site will be decommissioned and removed by a competent contractor. Verification soil samples will be taken from the area beneath the removed tank to ascertain if the soils have been impacted by hydrocarbons.
- Should any unexpected contaminated materials be encountered during site re-development, these materials shall be excavated and quarantined within a separate lined area away from the waters edge, for further analysis and assessment. Depending on the outcome, the CSM may need to be re-assessed. Any unexpected waste encountered on site will be dealt with in accordance with the appropriate current legislation relevant to the jurisdiction.

The proper management of waste soil arisings through the preparation of a Site Waste Management Plan will be required in order to:

- Determine waste acceptance criteria (WAC) for the excavated material being disposed off-site to a licensed waste facility. A number of representative samples from the excavated material will be sent to a laboratory for leachate analysis (BS EN 12457/3) to determine its waste classification,
- Improve reuse and recycling rates and subsequently reduce costs,
- Reduce the potential for sub-surface infiltration by placing all stockpiled soil material on impermeable heavy duty plastic liners and covering all stockpiles to minimise rainwater infiltration.
- Any soil material imported onto the site must undergo WAC testing to ensure that the material is classified as inert and does not pose a risk to the underlying groundwater through leaching of contaminants. Any topsoil which is imported onto the site will be chemically analysed and screened against generic screening values for a commercial end use to ensure that it does not pose a risk to human health.
- Reference should be made to Department of Trade and Industry guidance on the preparation of a Site Waste Management Plan.

10.5.2 Operation

10.5.2.1 Soils and Geology

The outline conceptual site model developed in the Desk Study and preliminary risk assessment has not identified any potential significant relevant pollutant linkages (RPLs) for either site. Both sites will be covered in hard-standing which will act as a barrier to the underlying soils. In addition, the hard-standing will reduce infiltration which in turn will minimise the potential for any contaminants to leach out of the sub-soils and into the underlying groundwater.

10.5.2.2 Ground Borne Gas

Methane and Carbon Dioxide gas emissions may arise as a result of anaerobic degradation of organic rich materials and Made Ground. Both sites will be open to the air with the exception of a portacabin on each site which will function as a ticket office/toilet. The underlying sand and beach deposits are considered to be low in organic content and therefore do not represent a potential source of ground gases. Made ground is likely to be present on the Greenore site however no pathway will exist for any potential gases in relation to the portacabin as it will not be sitting in direct contact with the ground and will have a void space underneath it.

10.5.2.3 Sulphates

Sulphates that may be present within the soils or sediments which could result in damage to concrete foundations etc if the materials are susceptible to sulphate attack.

10.5.2.4 Groundwater

The proposed development will have a neutral impact on the underlying aquifer during the operational phase of the proposed development.

As per the guidance provided in CLR 11 no significant source-pathway-receptor linkages can be identified for the proposed development.

Any fuel storage tanks will be bunded and inspected regularly for any leaks or spillages (As per the guidance in PPG2). All boilers will be maintained and serviced on a regular basis. Car park personnel will employ spill kits to contain any spillages or leaks of fuel or oil from parked cars and vehicles. Spill kits should be sufficient to cater for a spillage of up to 25 litres.

10.5 Cumulative Impacts

The geology, soils and hydrogeology impacts above have all been addressed both independently and with regards to any potential cumulative impacts resulting from potential interactions between the construction or operational phases of any ongoing developments, recently approved development and pre-application developments outlined in Chapter 3. Due to the small scale of the proposed Carlingford Ferry development and the distance from developments outlined in Chapter 3 no cumulative impacts on geology soils and hydrogeology are predicted.

10.6 Residual Impacts

No substantial, negative, long term residual impacts are predicted.

A summary of the predicted impacts during the construction and operational phases is provided below in Table 10.1.

Table 10.1: Summary of Significance of Effects

Impact	No Change Impact	Slight Impact (+/-)	Moderate Impact (+/-)	Substantial Impact (+/-)
Construction Phase	×	√ **(-)**	×	×
Operational Phase	√	×	×	×
Residual Impacts	√	×	×	×
Cumulative Impacts (interaction with traffic, air quality and noise, ecology and water quality)	×	√ **(-)**	×	×