9 LAND AND SOIL

9.1 INTRODUCTION

This Chapter assesses the impact to the land and soils environment and considers any direct and indirect effects on these natural resources arising from the proposed development and associated project components including replacement forestry lands and grid connection as detailed in Chapter 2. The baseline conditions at the site are presented and the potential effects anticipated from the proposed development are discussed. Mitigation measures are suggested where appropriate and any residual impacts are assessed.

9.1.1 Scope of Assessment

The chapter includes data and descriptions of the soil and subsoil at the site as well as any prominent geological features. Data includes information from site visits as well as desktop research. The geology is briefly described at the local and regional level. All activities associated with the project are considered for the construction, operation and decommissioning phase impacts. Cumulative impacts have also been considered. The assessment was completed having regard to the *Draft Guidelines on the Information to be contained in Environmental Impact Assessment Reports.* Environmental Protection Agency (2017).

9.1.2 Methodology

A desk study was first undertaken to collate and review available information, datasets and documentation sources pertaining to the site's natural environment. The desk study involved the following:

- Examination of maps and aerial photography;
- Examination of the Geological Survey of Ireland (GSI) datasets pertaining to geological issues (bedrock, heritage, subsoil) and extractive industry data;
- Examination of Geohive/ EPA / Teagasc online soil and subsoil maps;
- Preparation of site maps.

Field surveys were undertaken between March 2019 and November 2020 and comprised the following:

- A walkover survey of the site to identify geological and soil features, geomorphological features, relict failures, rock exposures, wet ground, general soil and rock types and drainage patterns.
- The walkover included a review of slope inclination and identification of prominent features.
- Identification, if present, of any water and drainage features on site and existing drainage patterns.
- The survey also determined the presence, extent and depth of any peat. Gouge coring was carried out to ascertain soil depths and hand shear vane tests were carried out to obtain shear strength parameters. The results of the peat assessment are presented in the Peat Stability Risk Assessment Report (refer to **EIAR Volume 3 – Appendix 9-1**).

- The initial site reconnaissance survey completed by MWP for this report was carried out in June 2019. Further site investigations and site visits were carried as part of the iterative design process on the dates detailed in Table 9-1.

Table 9-1 List of Site Visits

Names	Title	Date	Purpose
Fergus Doyle Eoin Doyle	Geotechnical Engineer Civil Engineer	12th March 2019	Peat Survey
Fergus Doyle Eoin Doyle	Env. Engineer Civil Engineer	13th March 2019	Peat Survey
Fergus Doyle Eoin Doyle	Engineer Civil Engineer	26th April 2019	Peat Survey
Paddy Curran	Geotechnical Engineer	25th June 2019	Review of potential borrow pit locations
Paddy Curran Fergus Doyle	Geotechnical Engineer Env. Engineer	8th August 2019	Peat Survey
Fergus Doyle Eoin Doyle	Env. Engineer Civil Engineer	27th August 2019	Peat Survey
Fergus Doyle Jeremy King	Engineer CAD Technician	2nd November 2020	Peat Survey
Eoin Doyle Jeremy King	Engineer CAD Technician	30th November 2020	Peat Survey

9.1.3 Assessment Criteria

The assessment is based on the EPA Glossary of Effects, included in the draft revised Guidelines on Information to be contained in Environmental Impact Assessment Reports (2017). The assessment of the Likely Significant Impacts using the methodology set out in the Institute of Geologists of Ireland Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapter of Environmental Impact Statements (2013) was also consulted.

9.1.4 Competency of Assessor

The engineering team within Malachy Walsh and Partners have been involved in all aspects of geotechnical design of wind farms, from conception through to commissioning, and are intimately familiar with similar projects to the proposed development, having worked on numerous wind farms across Ireland that are set in similar ground conditions.

This section has been prepared by Paddy Curran of Malachy Walsh & Partners. Paddy is a Senior Engineer with 10 years' experience in civil engineering, particularly in the area of Geotechnical Engineering. Paddy graduated from University College Cork, Ireland in 2008 with a B.E. (Hons) in Civil Engineering and completed a Master's of Science in Soil Mechanics (MSc DIC) at Imperial College London, United Kingdom in 2012. Paddy's professional registrations include being a Chartered Engineer and Registered Ground Engineering Professional with the Institution of Civil Engineers. He has worked on all stages of the project life cycle from feasibility through to commissioning on a large number of wind farm and roads projects. His experience includes environmental assessment, geotechnical investigation/interpretation, design and construction support. His project experience at the planning and environmental impact assessment stage includes Mountlucas Wind Farm, Derryadd Wind Farm, M25 Regional Investment Scheme, Galway Wind Park, Toberatooreen Wind Farm Grid Connection and Beennanspuck Wind Farm. This included assessment of environmental impact on Land, Soils, Geology, and Hydrogeology as well as cumulative impacts with various other aspects of the environment.

9.2 EXISTING RECEIVING ENVIRONMENT

9.2.1 Location of the Proposed Site

The proposed development is a twelve (12) No. wind turbine and grid connection project. The proposed development is situated within the rural locale between Listowel and Ballylongford in North Co. Kerry. The development site is located in an area of open low peatland east of the R552 Regional Road, approximately 4km southeast of Ballylongford village and 6km north of Listowel town. The assessment area includes the wind farm site, replacement forestry lands and grid connection as shown in Figure 9-1.

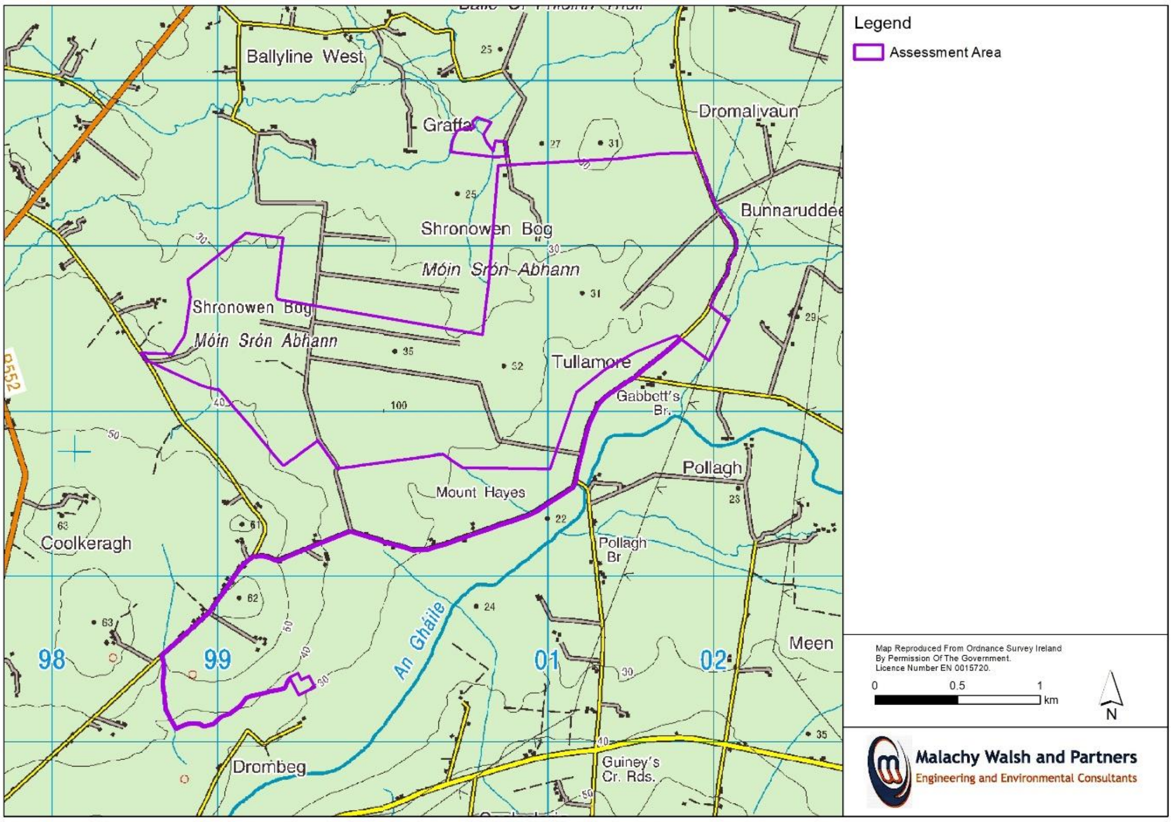

Figure 9-1: Proposed Site Layout and Assessment Area

9.2.2 Site Topography

The site is located in a flat low- lying area. This is evident from the large distance between contours on the OS mapping shown on Figure 9-1. This was also noted during the site visits listed in Table 9-1. The site elevation ranges from 40m, at the south west corner of the site, to 20m elevation in the north of site. The majority of the proposed development lands occupy relatively flat low-lying terrain with topographic heights generally being below 30m OD.

9.2.3 Land Use

The mapped land use of the site is shown in Figure 9-2. This mapping was created using information from CORINE Land Cover 2018 available on the EPA online mapping system. The following land uses have been identified within the assessment area:

- Peat bogs
- Pastures
- Mixed forest

T3 to T12 and the Permanent Met Mast are located in areas mapped as *Peat Bogs*. T1 is located in a mapped area of *Mixed Forest*. T2 is located in an area of *Pastures*. The proposed access tracks and cable routes traverse areas of *Peat Bogs, Pastures and Mixed Forest*.

The majority of the wind farm site is covered in peat bogs, a small portion of which has been planted over with coniferous forests at the north western edge. There is also evidence that a significant amount of small-scale peat extraction has taken place throughout the wind farm site. This was noted from aerial photography and during visits to the site.

The grid connection and substation are mapped in areas of *Peat Bogs and Pastures.* A large portion of the proposed grid route to Drombeg is noted as being along existing public roadway.

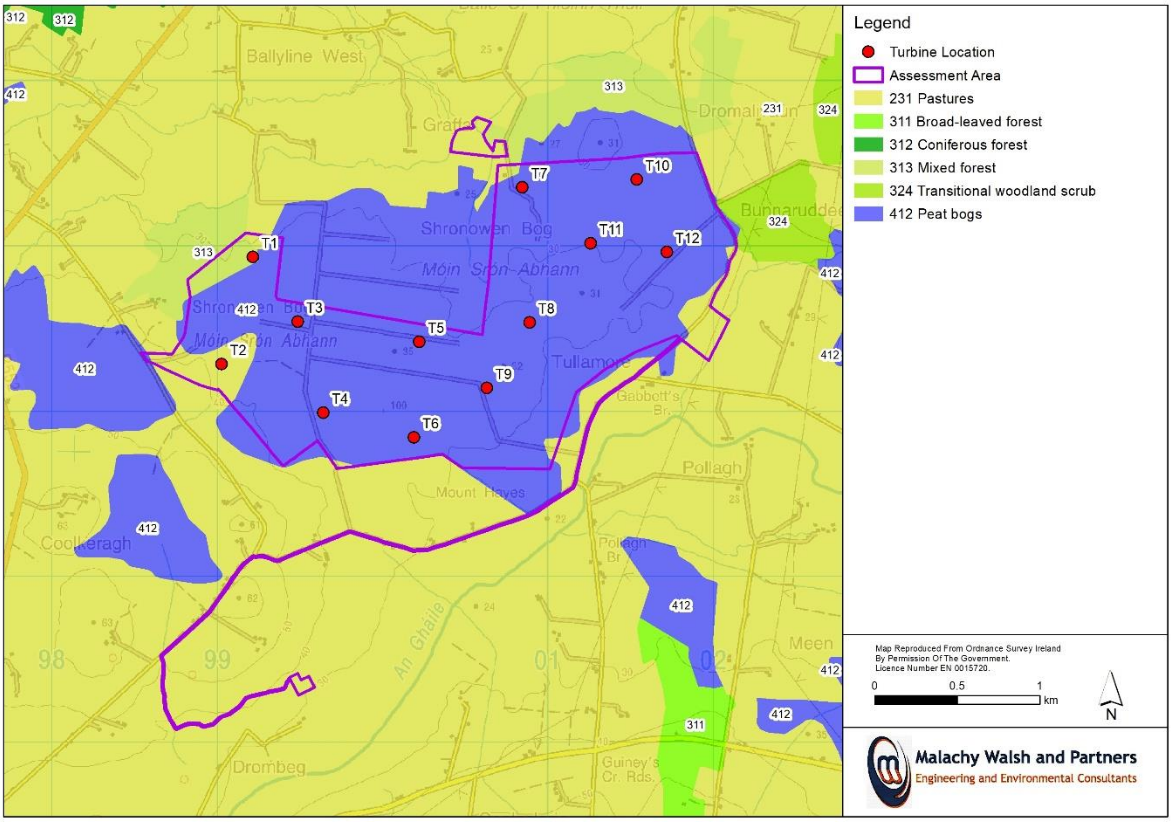

Figure 9-2: Land Cover (CORINE)

9.2.4 Regional Geology

The regional geology of County Kerry is discussed below to provide a wider context to the geology of the site which is discussed on a localised scale in subsequent sections of this report. A map of the geology of Co. Kerry at a regional scale is given in Figure 9-3.

The geology of County Kerry is described within the County Development Plan as varying in age and rock type across the county. The oldest geological formations date to the Ordovician period (490-450 million years ago (Ma)) and outcrop on the Dingle Peninsula. Much of the county's geology was formed in the Silurian and Devonian period (444-359 Ma). Following the Ordovician, rocks dating from the Silurian period (450 -415Ma) were formed with evidence on the Dingle Peninsula, in Dunquin, Bull's Head, and Derrymore Glen.

The Old Red Sandstone that makes up much of the Iveragh and Beara Peninsulas, Kerry Head and an area to the east of the Dingle Peninsula was laid down in the Devonian period (415Ma). The Lower

Carboniferous (360-326 Ma) period is represented in the limestones of central and parts of north Kerry with the Upper Carboniferous represented in the shales (326-300 Ma) of east Kerry and the Stacks mountains. Around 300Ma the Armorican/Hercynian earth movements resulted in the creation of the east-west trending tectonic grain strongly represented in the Iveragh Peninsula where a landscape of mountain ridges and valleys now dominate.

The County’s geology has also been shaped by various periods of glaciation over the last 2 million years. The Weichsel or last glaciation is represented in north Kerry by a small area around Tarbert. This glaciation deposited thick drift in the Roughty valley and where it debouched on the Killarney lowlands.

During the Ordovician period (488-444 million years ago [Ma]) Ireland was south of the equator, and the area that now makes up Kerry, was under an ocean that separated two continents. This ocean closed and as it did so mud and sand was deposited into it and these eventually became the mudstones. Later during the Silurian period (430 Ma) small volcanic islands that grew above a shallow sea erupted lavas and ash in the Clogher Head area. The muddy sediments were deposited near Dunquin and in Derrymore Glen, and the sandy sediments formed sandstone near Dingle and Slea Head. Eventually by the beginning of the Devonian period (416 Ma) the ocean closed completely and a large continent had formed which was largely desert. Kerry contained large areas of sand dunes which formed much of the sandy Old Red Sandstone which makes up much of the Iveragh Peninsula, and in between the dunes occasionally flowed rivers or flash floods. These produced pebbly coarser rocks called conglomerates which may contain white quartz or red jasper. By the end of the Devonian the land in the County was flooded by warm shallow tropical seas which resulted in the presence of fossils in the Carboniferous limestones (350 Ma). Later the ocean became deeper and muds were carried into it by rivers from the east and north and these became the shales now found in east Kerry and the Stacks Mountains (310 Ma). The proposed development is located in an area of shales. Much later during the Cretaceous period (146-65 Ma), the whole area was covered by water and chalk, and a pure limestone was deposited.

During parts of the last million years Ireland was covered in ice when glaciers formed on mountainsides and in valleys and spread over the lowlands. Many corries were formed when ice collected on the mountainsides and these now often contain lakes such as Mangerton Lake near Killarney and Pedler's Lake near the Connor Pass. When the ice melted it left behind boulder clay containing many different rock types. The proposed development is located in the north of Co. Kerry in an area mapped of Namurian shale, sandstone, siltstone and coal (See Figure 9-3).

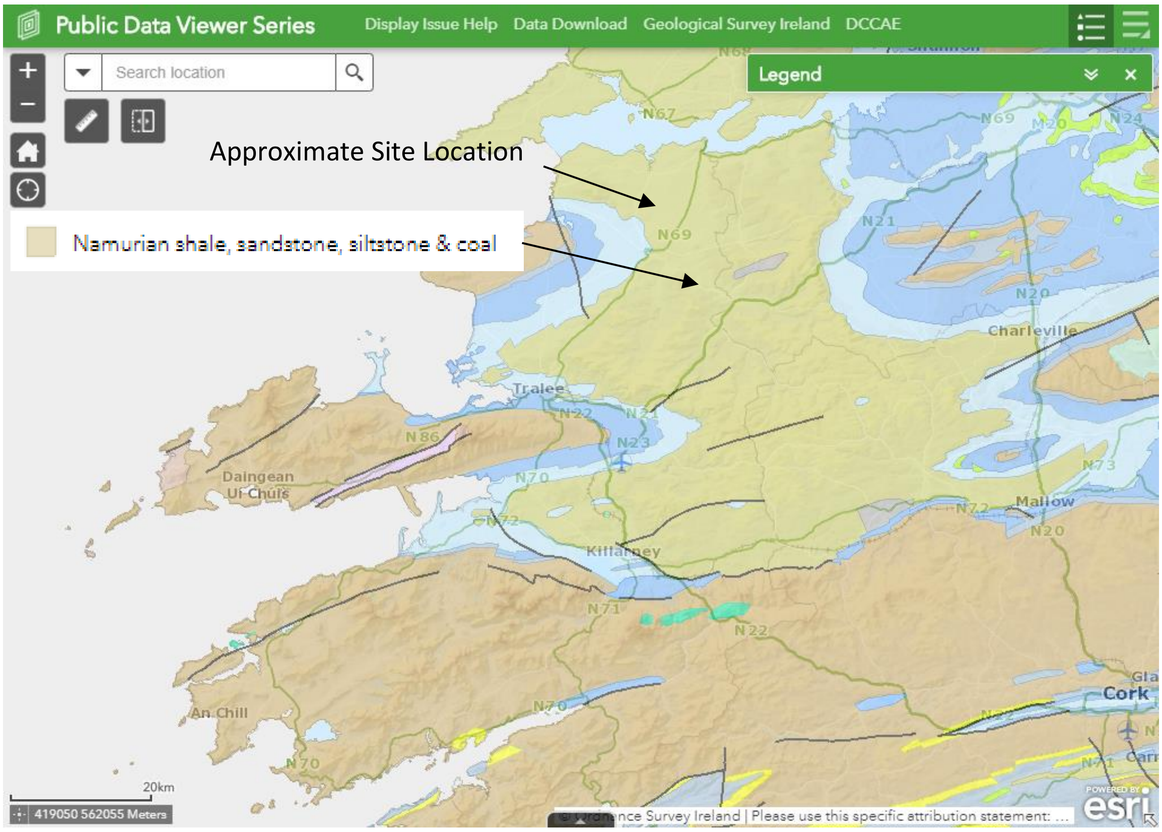

Figure 9-3: Regional Geology Map (From GSI Online Maps - Bedrock Geological Units 1:1,000,000)

9.2.5 Local Geology

The assessment area is predominantly underlain by the Shannon Group Formation as shown in Figure 9-4. This formation consists of mudstone, siltstone and sandstone. All of the proposed wind farm, substation and replacement lands are underlain by the Shannon Group Formation. A small portion of the grid connection route enters an area underlain by the Clare Shale Formation at the western end of the route. This material is described by GSI as "Mudstone, Cherty at Base". The site generally reflects the regional geology discussed within the previous section. (Geological Survey of Ireland, Online Maps 2020).

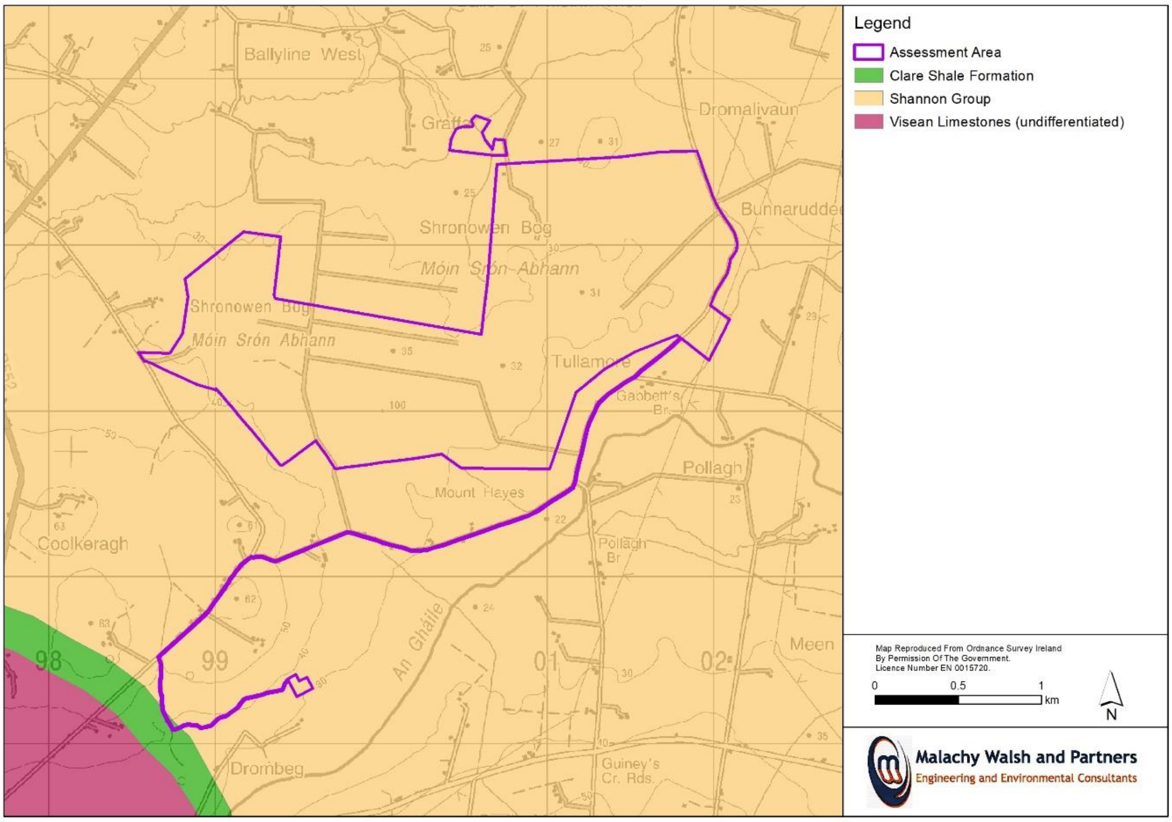

Figure 9-4: Bedrock Geology - Unit Names

9.2.6 Soil and Subsoil

Soil includes the topsoil (soil) and subsoil, which together provide for the following important functions;

- Facilitate the hydrological cycle in the filtration/recharge, storage and discharge of rainwater
- Support all terrestrial ecology, including all flora and fauna (and all food crops)
- Protect and enhance biodiversity
- Holding or preserving archaeological remains
- Provision of raw materials and a base on which to build

Soil (topsoil) and subsoil may derive from parent geological material and organic matter under the influence of processes including weathering and erosion.

The soils maps for the site are given in Figure 9-5 and Figure 9-6. The predominant soil type present at within the proposed wind farm area is "*Cutover/ Cutaway Raised Bog*" according to the Teagasc/ EPA Soil Maps available on the Geological Survey of Ireland online mapping system, refer to Figure 9-5. Areas of "*Peaty Podzols*" are present in the northern half of the site. Pockets of "*Surface water Gleys/ Ground water Gleys Acidic*" and "*Peaty Gleys Acidic*" are present to the north and south of the site. An area of "*Mineral Alluvium*" is present along mapped watercourses to the north and south of the site. The characteristics of the *Peat* soil type based on data from Teagasc are a high level of organic matter and very high moisture content.

Quaternary sediments for the majority of the proposed wind farm area is dominated by "*Cutover Peat*", aside from a small area of alluvium on the northern edges around the Ballylongford and Coolbeha rivers, and a small pocket of till derived from Namurian sandstones and shales around the same area. See Figure 9-6 for further information.

The proposed substation is located in an area mapped as *"Cut – Raised Bog Cutaway/Cutover*". The grid connection route traverses areas mapped as "*Cutover Peat", "Till derived from Namurian sandstones and shales"* and *"Alluvium".*

The field survey undertaken between March 2019 and November 2020 verified the published literature on soil and subsoil at the site in that the dominant spatial coverage soil unit is Peat. The peat stability within the proposed development boundaries is fully assessed in the Peat Stability Risk Assessment Report (refer to **EIAR Volume 3 – Appendix 9-1**).

A number of photographs of the peat and soils taken during site walkovers at Shronowen are shown in Figure 9-7.

Land use practice has much altered the natural soil environment at the site over time through disturbance for peat harvesting, afforestation and improvement for agricultural purposes. Peat depths at several different points have been investigated, with depths ranging from 0.0m to 7.4m. The deepest points were recorded on the eastern side of the site. A small portion of raised peat has been planted over with conifer trees on the north western edge of the site. Evidence of peat harvesting was noted onsite (See Photographs on Figure 9-7).

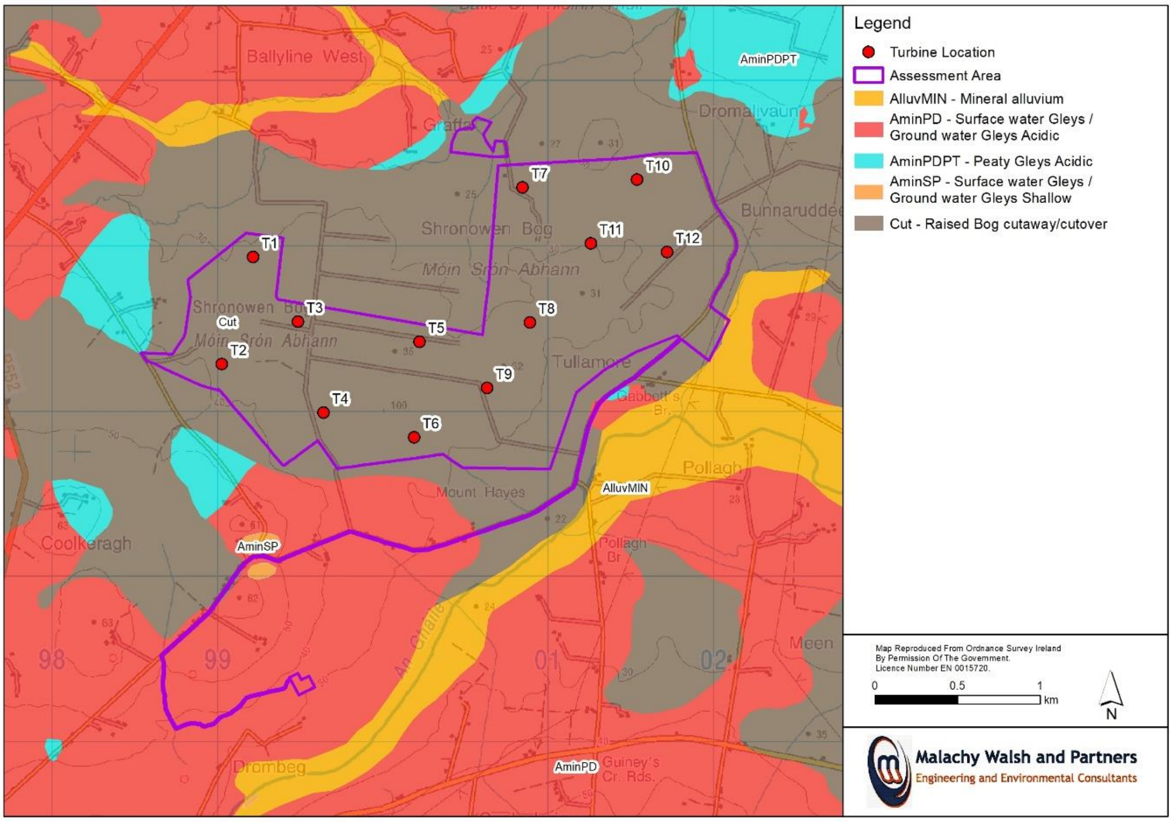

Figure 9-5: Soil Descriptions

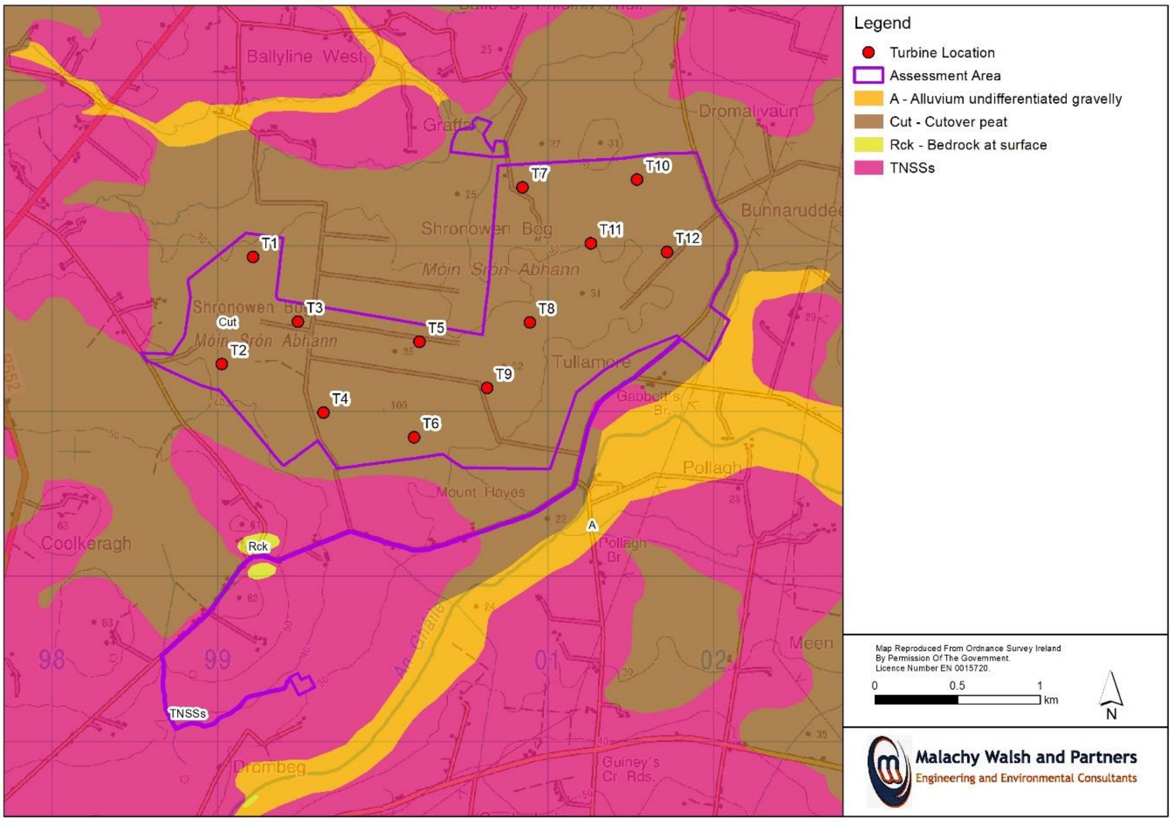

Figure 9-6: Subsoils

(A)
Photograph of existing floated road at the existing eastern entrance the bog. Proposed location of T12 to the left of the photograph. Note the flat nature of the landscape

(B) Photo taken in the centre of the site facing north. Note the flat nature of the landscape

(C) Photo taken in the centre of the site facing north. Note the flat nature of the landscape and existing deep drainage ditched.

(D) Photograph taken approximately 100m to the east of T9 facing south west. Note tension crack in acrotelm of peat due to existing peat movement.

Figure 9-7: Photographs from Site Visit on 25-06-2019

9.2.7 Geological Heritage

The Irish Geological Heritage (IGH) Programme identifies and selects a complete range of sites that represent Ireland's geological heritage under a variety of themes ranging from Karst features to Hydrogeology. The IGH Programme is a partnership between the GSI and the National Parks and Wildlife Service (NPWS) and sites identified as important for conservation are conserved as Natural Heritage Areas (NHA). Review of the GSI Geological Heritage Database available on the GSI online mapping system indicates that there are no Geological Heritage Sites within the assessment area. The nearest mapped Geological Heritage Sites are located approximately 12km north of the assessment area (See Figure 9-8).

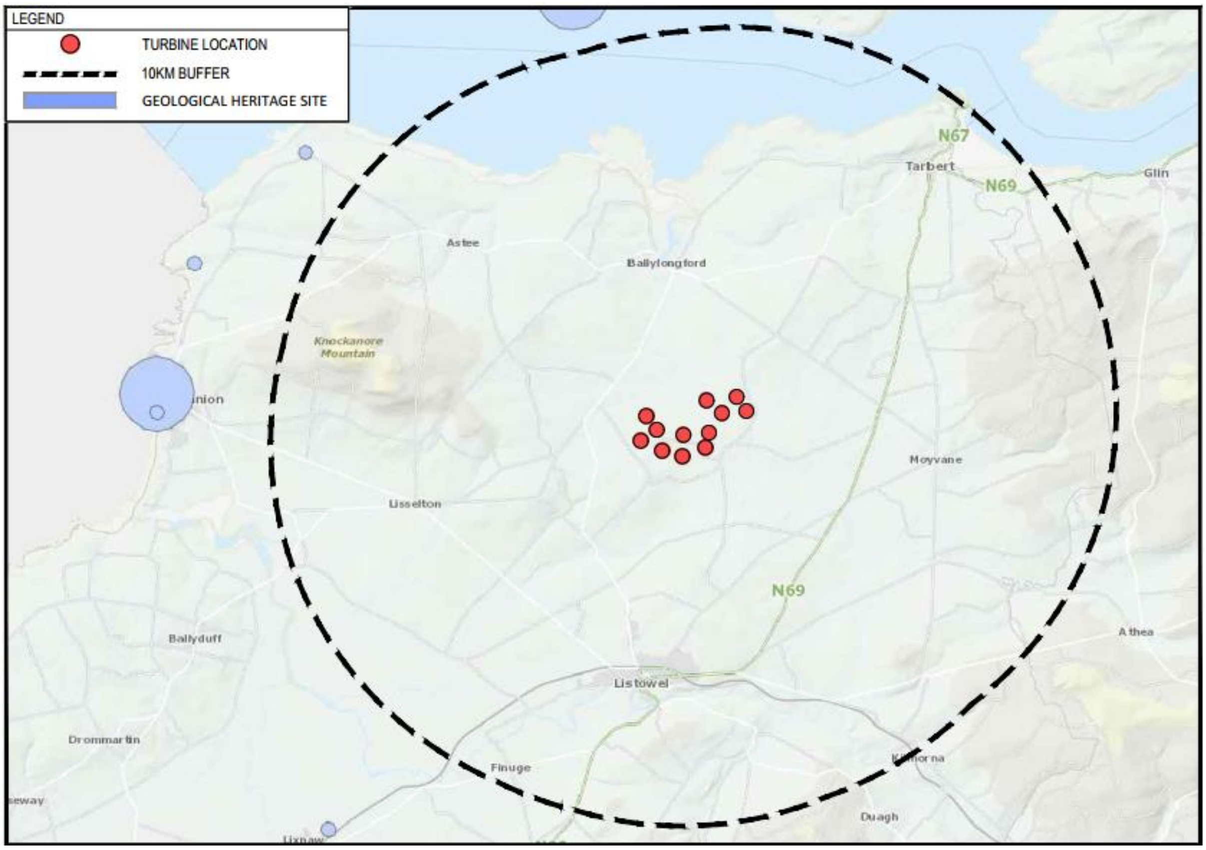

Figure 9-8: Geological Heritage Sites within 10km of Site

9.2.8 Economic Geology

The GSI records for Active Quarries operating in the area are shown on Figure 9-9.

Recorded mineral locations have the potential to be used for future mineral extraction. According to the GSI, there are a number of recorded metallic mineral locations in the area (Figure 9-10). None of these locations are within the assessment area. The closest is approximately 2km from the assessment area therefore the development of this site will not impact on any potential future mineral extraction location.

Areas of the site are being harvested for peat on a relatively small scale (see example in Figure 9-7). Peat harvesting will no longer be possible within the immediate footprint (meaning the disturbed ground) of the proposed wind farm infrastructure.

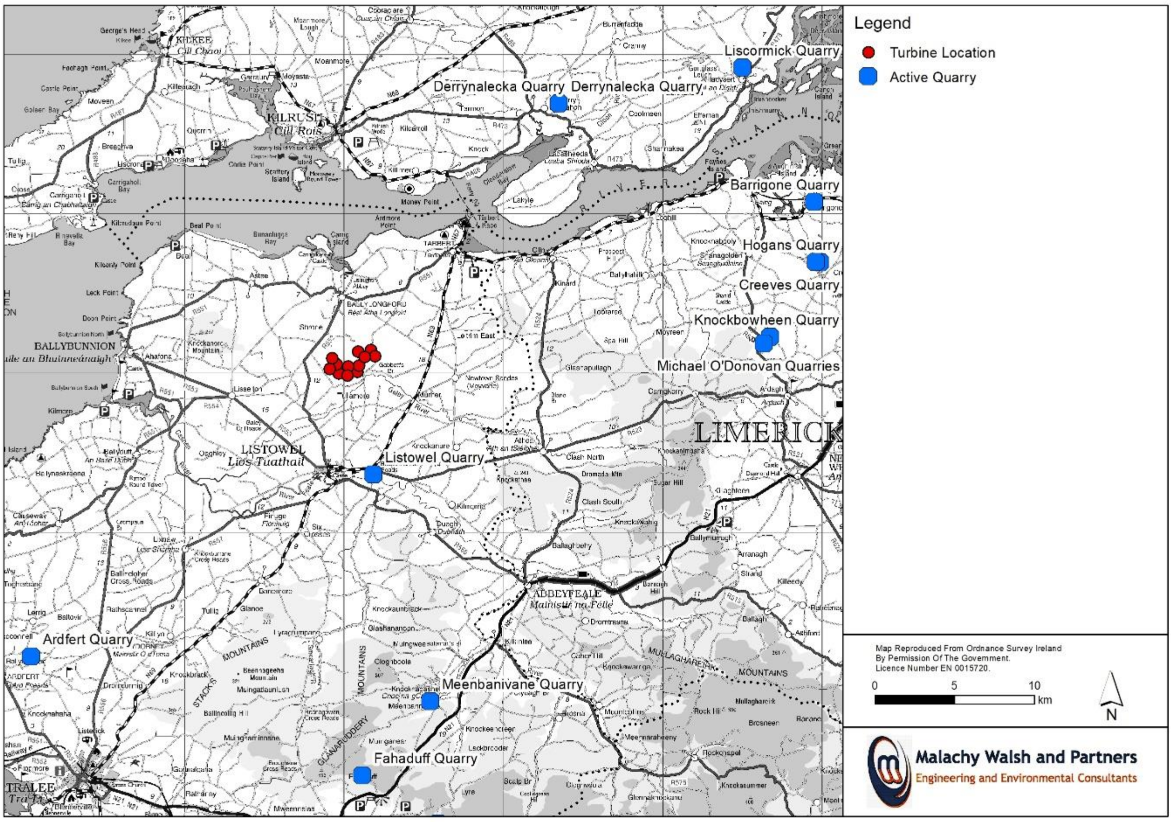

Figure 9-9: Active Quarries (from GSI Online Mapping)

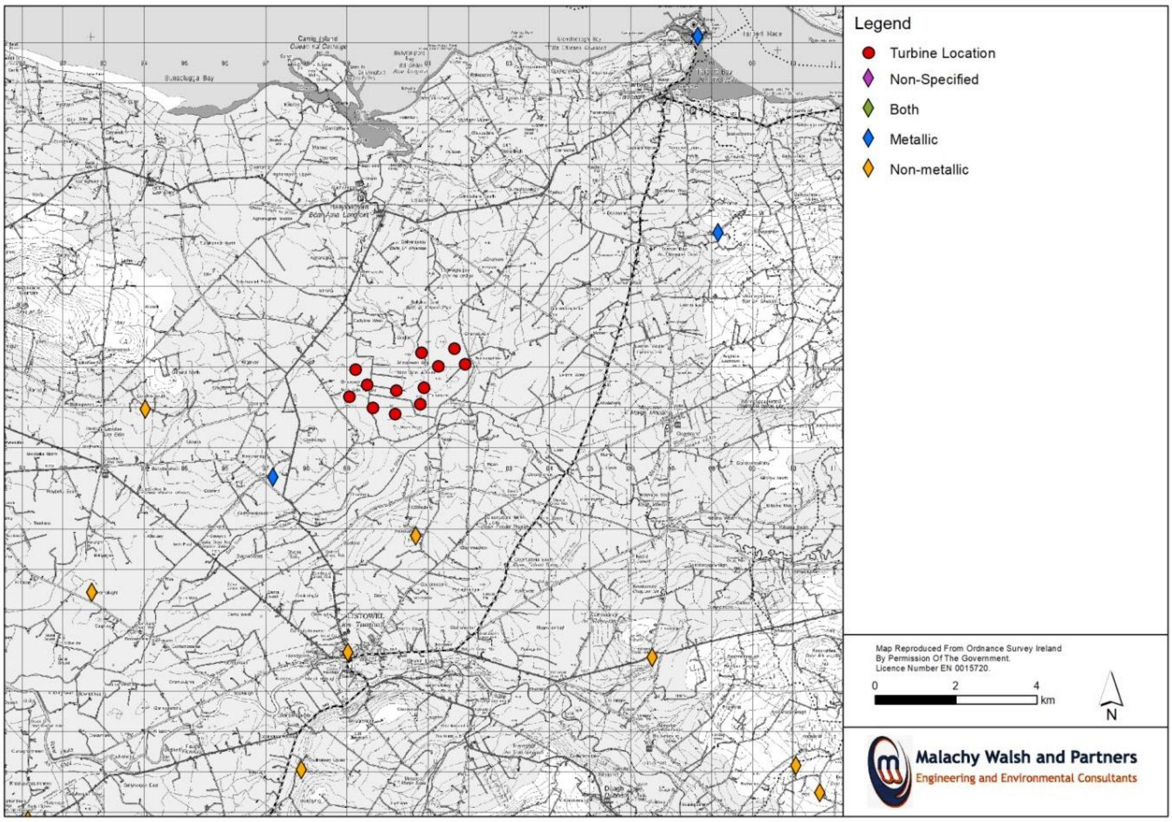

Figure 9-10: Mineral Localities in proximity of the site (Source GSI)

9.2.9 Peat Depth and Stability

MWP completed extensive peat probing and hand shear vane testing of within the proposed wind farm and substation sites between March 2019 and November 2020.

In total, 126 peat probes were taken across the study area. The maximum peat depth encountered was 7.4m deep, the minimum depth of peaty cover was 0.0m at T1. The average depth for the data set across the study area was 3.2m.

Peat stability at the proposed wind farm and substation site has been assessed in the Peat Stability Risk Assessment Report which is included in **Appendix 9-1 Volume 3** of the EIAR. The report includes information from desk study, site reconnaissance, peat probing and peat stability assessment. It has been completed in line with the recommendations of the Energy Consents Unit Scottish Government, Peat Landslide Hazard and Risk Assessment: Best Practice Guide for Proposed Electricity Generation Developments (2017). The conclusion of the Peat Stability Risk Assessment Report is provided below:

The finding of the Peat Stability Risk Assessment is that all of the turbines have been placed in areas of low residual risk of peat instability. The mitigation measures required to achieve a low risk of peat instability have been detail.

The site is generally flat in terms of overall topography. Maximum slope on the site is under 10.5% (Approx 6 degrees) with the slope across the site being generally under 5.24% (Approx 3 degrees), with the exception of localised areas where the face of peat banks have been cut at near vertical angles.

A peat survey was carried out in areas of proposed infrastructure across the site. Peat depths were found to range from 0m to 7.4m in parts of the site.

A quantitative risk assessment of the slope stability at the site was carried out using infinite slope analysis. This is in line with best practice recommendations from the Scottish Government Peat Landslide Hazard Risk Assessment (2nd Ed 2017) guidelines. The quantitative risk assessment found that the worst-case factor of safety against peat instability was 1.9 in an area to the west of T11. The vast majority of the site has a factor of safety greater than 4.

A number of mitigation measures to further reduce the risk of peat instability have been provided. These must be adopted by the appointed contractor into their construction methodologies.

Mitigation measures associated with Peat Stability are detailed in Section 9.4.1.3

9.2.10 Soils and Bedrock at Replacement Forestry Lands

Forestry will be removed within the Shronowen site as part of the development of the proposed wind farm. Replacement lands are proposed to be planted with forestry to replace the forestry felled as part of this development. These lands are situated to the west of the proposed location of T7. The soils and bedrock at the proposed location for the replacement forestry are shown in Figure 9-4 to Figure 9-6.

9.2.11 Do Nothing Scenario

If no development associated with the proposed wind farm took place on this site, the land and soils environment would remain unchanged. It should be noted that peat cutting, forestry operations and agricultural activities will continue within the vast majority of the site regardless of whether the wind farm development proceeds. Should the development go ahead, peat harvesting will no longer be possible within the immediate footprint (meaning the disturbed ground) of the proposed wind farm infrastructure. This only represents a small portion of the overall assessment area.

9.3 LIKELY SIGNIFICANT EFFECTS

The proposed works require the construction of turbine bases, hardstands, permanent met mast, material storage areas, peat deposition areas, internal roads, internal cable trenches, grid connection cable trenches and a proposed new substation. The removal of peat and subsoil from turbine bases, internal roads and cable trenches in addition to the interference with existing site drainage, is a direct permanent effect that, without mitigation, could alter the existing land and soils environment at the site. It could also impact on the hydrological and hydrogeological balance of the site. This is addressed in more detail in **Chapter 8 - Water**. Removal of some minor quantities of bedrock at turbine base excavations may be required. If bedrock is encountered within the turbine base excavations, only minor quantities will require removal to create a level platform from which the turbine foundation will be constructed. No mass excavation of bedrock, hydraulic breaking of rock or blasting will be required.

The natural land and soils environment at Shronowen has been modified in large areas of the site as a result of predominately peat cutting operations but also by agricultural practices and commercial forestry activity. These existing activities have disturbed the peat and subsoils in large portions of the site. Areas which have not been highly modified by peat cutting, agricultural and commercial forestry activities have been avoided where feasible during the design process for Shronowen Wind Farm.

The potential impacts of the project on the land and soil environment discussed in the following sections are considered to be the worst case for all possible impacts if unmitigated.

9.3.1 Construction Phase

The predicted impacts on land and soils for the proposed development are discussed in the following sections. The activities that can cause damage to the existing geological environment, and may subsequently indirectly impact on the aquatic environment, include:

- Felling of Trees;
- Roads and Drainage;
- Excavation Works;
- Storage of Materials;
- Soil Erosion; and
- Waste Generation.

9.3.1.1 Land Use

The land area within the footprint of the proposed turbines, hardstandings, access roads, cable trenches, substation, permanent met mast and all other associated infrastructure will be changed from their existing land use for the duration of the wind farm's operational life.

The land within these areas can be reinstated at the end of operational life of the wind farm such that it can be used again for agricultural/ forestry purposes. The impact on land use is considered a slight negative direct long-term impact. Mitigation measures for land use are discussed in Section 9.4.1.2

9.3.1.2 Roads and Drainage

Approximately 11,280m of internal access roads with a typical running width of 5m on straight sections of road with wider areas at bends (as shown in the planning drawings) are required within the site (6,850m of new access roads and 4,430m of upgrading the existing access tracks on the site). Full details are provided in Chapter 2 of this EIAR.

A combination of new and upgraded drainage network will be installed within the site. The existing drainage network will be upgraded and settlement ponds and sediment traps installed at key locations. The drainage network has a twin system of water management separating out clean water from dirty water. This network and design approach are outlined in the Chapter 3 of this EIAR.

The construction of the roads and drainage network will involve both excavation and importation of soil/peat and crushed rock respectively. The impacts of the construction of roads and drainage are the same as for excavations discussed in 9.3.1.3. The design of the layout has utilised existing tracks within the site as much as possible to reduce the material volumes and minimise impacts associated with road and drainage construction. Given the modified nature of the land and soils environment at large parts of the site and the mitigation by avoidance approach adopted in the design, the construction of roads and drainage represent a moderate negative permanent impact.

Mitigation measures for roads and drainage construction are discussed in Sections 9.4.1.1 and 9.4.1.4.

9.3.1.3 Excavation Activities

The construction of the proposed development will result in the removal of soil, subsoil, peat and bedrock in parts of the site in order to facilitate the construction of the new access roads, turbine bases, crane hardstand areas, substation, cable trenches, permanent met mast and all other associated infrastructure. This removal of peat, soil and bedrock is a direct impact on the land and soil environment. However, it is not envisaged that the impact will have a significant effect. The volume of material to be excavated will be managed, reused and stored locally on site. Two options for the construction of hardstands are presented in the Civil Engineering Chapter (fully excavated and piled). The worst-case option in terms of excavation volumes (i.e. fully excavated hardstands) has been assessed in this report.

The peat depths encountered at the site ranged from 0.0m to 7.4m. Mitigation by avoidance or mitigation through design was applied when choosing the proposed layout. This was done by selecting locations for development infrastructure within the cut-away peat where possible. This approach reduces earthworks volumes and minimises impacts on the existing nature of the site. The proposed road construction technique in peat areas of the site is to float the road order to further reduce excavation volumes and the impact on the land and soils environment. The infrastructure proposed within raised peat areas was also minimised in the design with preference given to placing infrastructure in areas already disturbed by peat harvesting and/or conifer plantation. The total volume of excavated material for the proposed development is approximately 146,700m^3 of which peat accounts for approximately 131,200m^3.

The excavated materials, including peat and subsoil material, will be reused on site as described below. Excavated peat will be reused in a number of ways onsite:

1. In the first instance, excavated peat and soil will be used for the construction of roadside berms which isolate clean water and divert dirty water to appropriate treatment systems (silt trap, settlement ponds etc).

2. Any remaining excess peat and soil will then be placed in dedicated storage areas.

The management of peat during construction is described in the EIAR Chapter 3 which includes a Peat Management Plan.

Excavated materials, other than peat, will be re-used on the site for landscaping, drainage berms and can be used to backfill turbine foundations as appropriate. Material from the public road pavement excavated during installation of the grid connection cables will be removed to suitably licenced/permitted facilities. The locations of the proposed peat storage areas and peat deposition areas are shown on **Planning Drawings 5005 to 5011**.

Stone required for the construction of new roads, crane hardstandings, drainage, met mast foundation and turbine foundations will be imported from local quarries as no suitable borrow pit has been identified onsite.

The volumes involved are typical of a construction project of this nature and size and do not represent a significant impact on the land and soils environment.

Vibrations caused by construction traffic or excavation activities near deep peat deposits, or the unsupported excavation of roads, turbines and hardstands through areas of saturated and weak peat can trigger peat slides. This site is flat and low-lying which greatly reduces the risk of peat slides. A detailed peat stability assessment has been undertaken and is included in the Peat Stability Risk Assessment Report in Volume 3 of the EIAR. Best practice construction stage mitigations have also been described in the Peat Stability Risk Assessment Report.

Excavations associated with the development, if left unmitigated, represent a moderate long-term negative impact on the Land and Soils Environment. Mitigation measures for excavations for this scheme are discussed in Section 9.4.1.4.

9.3.1.4 Storage and Stockpiles of Excavated Materials

The handling, storage and re-use of excavated materials are of importance during the construction phase of the project. The Peat Stability Risk Assessment Report, available in **Appendix 9-1 Volume 3** of the EIAR, addresses the risk of peat slippage and how excavated peat should be managed on site, stored temporarily and re-used in landscaping.

The largest scale excavations on this site will be for the crane hardstands. Two options for the construction of hardstands are presented in the Civil Engineering Chapter (fully excavated and piled). The worst-case option in terms of excavation volumes (i.e. fully excavated hardstands) has been assessed in this report.

Excavated peat will not be stored in excessive mounds on the site and will be managed in a manner that will not cause a risk of peat movement or sedimentation from runoff. The surplus peat will be deposited in a number of dedicated peat deposition areas.

The top layer of peat (acrotelm) can be set aside and re-used for natural re-vegetation onsite. Seeding of the work-affected areas with indigenous species should proceed only where natural re-vegetation is unsuccessful. The re-vegetation of these areas promotes stability, reduces desiccation, run-off erosion and susceptibility to freeze/thaw action.

There is potential for a slight negative medium-term impact on watercourses or water bodies as a result of the erosion of soil and the inappropriate temporary and permanent storage of excavated materials. However, any risk from the erosion of soil or stockpiling of excavated materials can be managed through good site practice. Furthermore, a robust Sediment and Erosion Plan has been included in the Civil Engineering & Design Chapter which reduces any risk of sediment release to surface waters. The Water chapter of this EIAR outlines the impacts and mitigation measures relevant to Hydrology.

Mitigation measures for storage and stockpiling of material for this scheme are discussed in 9.4.1.6.

9.3.1.5 Impacts to Ground/Peat Stability

The approach to, and method of, excavation of in-situ peat, rock and earth materials is very important for ground stability. Interference with the existing ground stability conditions, by inappropriate excavation methods, such as continuous vehicular movement over excavated peat, must be mitigated by appropriate construction methods, suitable for peat environments.

In order to address any concerns with peat stability, a detailed assessment of peat stability has been undertaken on this site. (Refer to **Appendix 9-1 Volume 3** of the EIAR). The peat stability assessment including desk study and fieldwork was completed between March 2019 and November 2020. Extensive fieldwork was undertaken including peat probing and gouge-coring. Higher risk peat stability areas identified in the Peat Stability Risk Assessment Report were avoided when designing the site layout and as such, it can be concluded that the risk of instability is low for the layout shown on the planning drawings.

Overall, it can be concluded the impact to ground stability is a slight negative short-term impact as a result of the proposed development.

Mitigation measures for ground stability are detailed in Section 9.4.1.3 and the Peat Stability Risk Assessment Report.

9.3.1.6 Vehicular Movement

The main vehicular movements relate to the following phases of development;

- Site mobilisation and temporary compound set up;
- Installation of the drainage network on new internal site service road and integration with the existing network;
- Delivery of construction materials;
- Vehicular traffic for employees;
- Excavation and formation of the roads network;
- Construction of the substation
- Excavation and construction of turbine bases and hardstands; and
- Delivery of turbines and commissioning.

It is not envisaged that vehicular activity will have a negative effect on the existing peat and soil regime on site.

Vehicular movement will be contained on constructed tracks and roads and therefore will not impose a risk on peat areas on site in terms of stability risk. Roads will be constructed by advancing them from the existing or newly constructed sections of road to avoid tracking over peat. Specialised wide tracked machinery and excavators will be used in the limited circumstances where access over peat is necessary prior to road construction.

9.3.1.7 Hydrocarbon Release

Wherever there are vehicles and plant in use, there is the potential for hydrocarbon release which may contaminate the soil and subsoil. A spill has the potential to indirectly pollute water, if the soil and subsoil act as a pathway from any source of pollution. Any spill of fuel or oil would potentially present a slight long-term negative impact on the land and soils environment.

Good site practice and mitigation measures for hydrocarbon release are discussed in Section 9.4.1.8

9.3.1.8 Materials and Waste

Inappropriate management of waste materials onsite has the potential to harm the land and soils environment. Construction materials, Waste Generation and Management are discussed briefly below. Further details on waste types and management are given in the Material Assets Chapter of the EIAR (See Chapter 15)

<u>Construction Materials</u>

Excavated materials will be re-used on the site and can be used to backfill turbine foundations as appropriate. Dedicated material storage areas and peat deposition areas will be used for excess peat. Additional materials will be imported, as required, and this includes crushed stone and hardcore, quarry run, ready-mix concrete, capping material for the roads, services ducts, pipe work and steel. The handling, storage and management of excavated spoil will be carried out in line with the Construction Environmental Management Plan (CEMP).

<u>Waste Generation and Management</u>

During the construction phase, waste will be generated from the following activities:

- Construction waste from building materials such as cabling, ducts, concrete and any materials from the construction of the substation;
- Mixed organic waste from the temporary canteen and staff facilities;
- Mixed dry recyclables from the staff facilities;
- Toilet waste from the temporary welfare facilities; and
- Unused oil, diesel and building materials.

All waste will be managed, collected, stored and segregated in separate areas and removed off site by a licensed/permitted waste management contractor at regular intervals during the works.

The level of waste generated on site will be minimal. It is considered a slight negative impact during the temporary construction phase of the works.

Mitigation measures for materials and waste are discussed in Section 9.4.1.7 and 9.4.1.8.

9.3.1.9 Replacement Forestry Lands

The impacts envisaged during the construction phase for the replacement lands will be similar to the wind farm site. The planting of the replacement lands will involve construction of access tracks and installation of a drainage network. These elements of the works will involve the same construction processes as the construction works at the wind farm site as described in the Chapter 3 - Civil Engineering & Design. The impact to the soils environment from planting forestry on replacement lands is considered a slight negative long-term reversible impact.

Land use at these sites will be altered from agricultural land to forestry land. The impact to the land environment from planting forestry on replacement lands is considered a neutral long-term reversible impact.

Mitigation measures relevant to the construction of access tracks and installation of drainage networks associated with the plantation of replacement lands are discussed in Sections 9.4.1.4, 9.4.1.6, 9.4.1.7, and 9.4.1.10.

9.3.2 Operational Phase

The potential impact on the land and soils of the site due to excavations will be much lower during operation and maintenance, as the majority of excavations will have been reinstated. There is some potential for excavations associated with drainage, road and cable maintenance however these will be small in scale and infrequent in comparison to the construction phase. Maintenance works on turbines will be carried out from the roads and hardstands. Some erosion of soil will continue into the operation phase, however, as vegetation becomes established and equilibrium is achieved, erosion rates will reduce to pre-construction levels.

All vehicular movement during operation and maintenance will be restricted to the areas of hardstanding and existing/newly constructed access roads. Traffic levels will be very low during the operational phase in comparison to the construction phase.

The impact due to operation and maintenance of the wind farm, grid connection, substation and all other infrastructure associated with the development represent slight medium-term negative impacts on the land and soil environment.

The mitigation measures appropriate to the operation and maintenance of the wind farm are presented in Section 9.4.2.

9.3.3 Decommissioning Phase

If it is decided to decommission the wind farm, turbine components will be removed however it is envisaged that access roads will remain in place. Hardstand and turbine foundation areas will be left in situ and covered with soil to match the existing landscape. Cables for the grid connection will be removed from the ducts through the joint bays without reopening the trenches. As such, the decommissioning phase of the project will require minimal earthworks. The potential impacts associated with decommissioning will be similar to those associated with construction but of a reduced magnitude because extensive excavation and wet concrete handling will not be required. The impact of the development on land and soils at decommissioning phase is considered a slight negative long term impact.

Mitigation measures for the decommissioning phase are discussed in Section 9.4.3

9.3.4 Cumulative Effects

The cumulative impacts due to the interaction with other nearby developments and activities have been considered. Projects identified and considered to potentially result in cumulative impacts would include: land-use change, continued growth in wind energy development, afforestation, peat harvesting and agricultural intensification. These developments and activities include ongoing forestry activity and maintenance/upgrades existing public roads in the area.

Due to the localised nature of the proposed construction works which will be kept within the proposed development site boundary, there is no potential for significant cumulative effects in-combination with any other local developments (refer to Chapter 2) on the land, soils and geology environment. The only way the proposed development can have in combination effects with other off-site projects and plans is via the drainage and off site surface water network and slope movement in the form of peat slides. The hydrological pathway is assessed in Chapter 8. The risk posed by peat slides at the site is considered low to medium when mitigation measures are applied as higher risk areas of the site have been identified and avoided as part of the layout design, for example T9 is located away from an area where previous movement of peat has occurred. (See Peat Stability Risk Assessment in **Volume 3 Appendix 9-1**).

9.4 MITIGATION MEASURES

Appropriate mitigation measures to avoid or reduce the potential impacts of the proposed development at Shronowen are outlined in this section. The design of the layout has incorporated consideration of the existing land and soils environment at the site.

Specific mitigation measures in respect of peat, subsoil and bedrock excavation and removal are addressed below in terms of:

- Design
- Land Use
- Slope Failure
- Excavations
- Storage and Disposal of Excavated Materials
- Waste Generation
- General Site Management
- Drainage
- Surface Water
- Replacement Forestry Lands

9.4.1 Construction Phase

9.4.1.1 Mitigation by Design

The design of the layout has incorporated consideration of the existing land and soils environment at the site. A mitigation by avoidance of potential impacts approach has been applied to the layout shown in the planning drawings. This has been discussed in the impacts section of this chapter.

Turbine locations, the alignment and rotation of the hardstands, and the routes of proposed new access roads were designed to optimise the balance between access criteria and the required volumes of excavated and imported materials. Floated road details are proposed in areas of peat to minimise excavation volumes.

The risk of peat instability within the proposed wind farm site has been assessed and used in the design of the layout of the wind farm. Higher risk areas have been avoided throughout the site. This can be seen on the peat stability risk maps in the Peat Stability Risk Assessment Report. Full details of the peat stability assessment process, investigations, analysis and results are presented in the Peat Stability Report included in **Appendix 9-1 Volume 3** of the EIAR.

9.4.1.2 Mitigation Measures for Land Use

The lands across the Shronowen site can be reinstated at the end of operational life of the wind farm such that it can be used for agricultural purposes. The area of land required to construct, operate, maintain and ultimately decommission the wind farm has been kept to the minimum reasonably practicable area as part of the design process. Existing access roads have been utilised in the design as much as possible such that the existing land use does not change in these areas of the site during the operational life of the wind farm. The public roads along the proposed grid connection can continue to be used as public roads throughout the life of the wind farm and grid connection. This approach minimises the area that will be changed from its current land use.

9.4.1.3 Mitigation Measures for Slope Failure/Ground Instability

In order to address any potential concerns with peat stability, a detailed assessment of peat stability has been undertaken on the proposed wind farm site. The Peat Stability Risk Assessment (PSRA) Report is included in **Appendix 9-1 Volume 3** of the EIAR. The peat stability assessment, presented in the Peat Stability Risk Assessment Report, identified areas of higher risk of instability within the site (such as the area to the east of T9 where evidence of peat movement was noted). The higher risk areas were used as a constraint when designing the layout of the wind farm and were actively avoided when designing the wind farm layout. This process has ensured that infrastructure was only placed in lower risk areas and hence it can be concluded that the risk of instability is low for the proposed infrastructure when appropriate mitigation measures are implemented by the appointed contractor.

Any construction upon the peat depths and topography encountered at the proposed infrastructure locations within this site generally presents a negligible to low level of risk for a peat environment. Localised areas of medium risk (in the unmitigated situation) have been identified to the north of T6, east of T9, south of T8 and near T11. When mitigation measures are applied, medium level risk reduces to low. A localised area of significant risk (in an unmitigated situation) has been identified to the west of T11. When mitigation measures are applied, significant level risk reduces to medium. Full details of the assessment and mitigations is given in the PSRA Report included in **Appendix 9-1 Volume 3** of the EIAR.

In order to manage construction risk within this site, the following shall be taken into account;

1. All site excavations and construction should be supervised by a suitably experienced engineer. The Contractor’s method statements for each element of work should be reviewed and approved by the engineer prior to site operations. Specific method statements should be developed for each turbine and hardstanding location within the site.

2. Particular emphasis should be placed in the Contract that only operators of proven experience in working in peatlands are employed for any work element involving excavation, handling or placement of peat.

3. Prior to excavation, drains should be established to effectively intercept overland flow prior to earthworks.

4. The existing network of drainage within the site should be utilised whenever possible.

5. Due to peats potential to have fluid-like properties once excavated, all peat excavated should be immediately removed from work areas. If peat is required for reinstatement, then acrotelm peat (<0.5m shallow, living layer) should be stripped off the surface of the excavated area and placed carefully at the margins of the work area along the access road and hardstand margins that are characterised by near-horizontal slopes (<3°).

6. From evidence of previous landslides (Derrybrien Landslide in Co. Galway (2003) and Pollatomish Landslide Co. Mayo (2003)) and historic occurrences, it is strongly recommended that construction activities should be assessed for impact after prolonged periods of heavy rainfall. Reference: Landslides in Ireland, GSI Landslide Working Group, 2006.

7. From examination of factual evidence to date, the majority of peat slides occur after an intense period of rainfall (Landslides in Ireland, GSI Landslide Working Group, 2006). It is recommended that an emergency response system be developed for the construction phase of the project, particularly during the early excavation phase. This, as a minimum, should involve 24 hour advance meteorological forecasting (Met Eireann download) linked to a trigger-response system. When a pre-determined rainfall trigger level is exceeded (e.g. 1 in 100-year storm event or very heavy rainfall at >25mm/hr), planned responses are undertaken. These responses should include cessation of construction until the storm event, including storm runoff, has passed over. This requirement is also included in the CEMP.

Construction methodologies for excavations in deep peat will need to consider that depths of over 7m are present in places. Turbines and crane hardstands cannot be constructed directly onto the peat due to its low strength. Loads from these structures will need to be on a firmer strata below the peat. This leads to large scale excavations being required. Temporary stabilisation measures at the sides of excavation will be required to prevent peat movements into the excavation. The risk of instability of peat during excavation work is a construction health and safety risk to those working on the construction of the scheme. Temporary works such as sheet pile cofferdams or granular berms will be required around the perimeter of the excavations to prevent movement of peat into the excavation. Alternatively, piled crane hardstands could be considered to remove the need for large scale excavations at the hardstands. Drainage works will need to be installed such that water is directed away from areas where there are steep banks of cut peat to avoid saturating the peat. This is a particularly important consideration in the area to the west of T9 where evidence of previous peat movement and tension crack was noted during the desk study and site walkover. Stockpiling of materials shall not be permitted on peat. Excavated material shall be removed to the designated deposition areas immediately following excavation.

At the area of significant risk to the east of T11, more stringent mitigation measures shall be applied. These are to include the following:

- No stockpiling of material in this area
- More frequent monitoring and inspection of the floated road
- The used of a log road construction
- Consider the use of logs to pile the section of road through this area to transfer loads to a firm strata below the peat.
- No excavation or removal of peat to be carried out in this area

Peat monitoring by sightline monitoring method shall be carried out by the appointed contractor for this development. Monitoring will be carried out at areas of deep excavations (e.g. turbine bases), material deposition areas and any area of works where peat is present.

Monitoring by sightlines entails driving a series of posts at approximately 5m centres, exactly aligned, across the section of bog being monitored. Any signs of distress or deformation in the bog will quickly manifest itself by some of the posts moving out of alignment. Early discovery of stress in the peat will give the developer an opportunity to implement emergency procedures to prevent the onset of a bog burst or localised peat slide. While the risk of such occurrence is low in this instance, the precautionary principle dictates that monitoring posts should be installed in work areas where there are areas with a risk rating higher than “low” or peat depths are greater than 2m.

Emergency procedures are the responsibility of the appointed contractor and are to be included in the appointed contractor’s method statements. As a minimum, the following shall be included in the contractor’s methodologies:

- Emergency response procedures to protect the health and safety of workers and to implement containment procedures for remoulded peat slurry on or off site.
- Identification of potential flow paths of peat slides to determine accessible intervention points on or off site to construct barrages, settlement ponds and silt traps to contain the peat slurry and to prevent downstream contamination of watercourses.
- Stockpiling of rockfill on or off site to use in the construction of emergency containment barrages in the event of a slide (noting that stockpiling of material on peat shall not be permitted).

The Construction Manager for the project should impart the philosophy that everyone on the site is aware of peat stability and report any sign of misalignment in monitoring posts. Vigilance is a fundamental requirement when working on peat where inappropriate construction methodology can cause instability in otherwise benign conditions.

A Geotechnical Engineer experienced in working in peat environments should be employed full-time to ensure the implementation of best practice in this environment. The methodology of all civil works should be reviewed by the Geotechnical Engineer and the monitoring posts should be the subject of a dedicated inspection on a weekly basis by the Geotechnical Engineer.

The following general measures incorporated into the construction phase of the project will assist in the management of the risks for this site:

- Appointment of experienced and competent contractors and detailed designers;
- The construction works on site will be supervised by experienced and qualified personnel;
- Ensure construction method statements are followed or, where agreed, modified/ developed;
- Allocate sufficient time for the project to be constructed safely with all peat stability mitigation measures included in the programme;
- Set up, maintain and report findings from monitoring systems, including sightline monitoring;
- Maintain vigilance and awareness through Tool-Box-Talks (TBTs) on peat stability;
- Prevent undercutting of slopes and unsupported excavations;
- No sidecasting of excavated material other than in areas selected for such activities by a suitably qualified environmental professional or site geotechnical engineer;
- Prevent placement of loads/overburden on marginal ground; and,
- Manage and maintain a robust drainage system.

9.4.1.4 Mitigation Measures for Excavation

One of the primary mitigation measures already employed at the design stage has been the minimisation of volumes of peat excavation and lengths of road construction by judicious design of access road and turbine locations which have been designed to avoid areas of deeper peat. Floated roads will be utilised in areas of the site where peat is present which also aids the minimisation of volumes of peat excavation.

Whenever possible, existing tracks have been utilised to access turbine locations. This reduces the volume of excavated material and imported crushed rock for road construction.

The peat excavated from turbine bases, hardstanding, roads, cable routes, grid connection, substation etc., during construction will be reused for localised landscaping and reprofiling with excess peat deposited in the peat deposition areas. Excavation will be carried out from access roads or hardstanding areas to reduce the compaction of peat. Machinery will not operate directly on excavated/stockpiled peat.

Drainage will be constructed in parallel with road construction and turbine excavation. Drainage (including drains, stilling ponds etc) will be constructed using bog mats or “bogmaster” excavators when working in peat areas. These are wide tracked excavators, specially designed for use in peat areas. The wide tracks reduce the pressure applied to the peat. This is likely to be required only in certain limited locations. All other vehicular movements will be restricted to new and existing roads and hardstands.

This approach will be used in combination with the installation of other drainage protection measures in advance of construction, such as the installation of silt fencing or other waterway protection measures. Further details are given in the Civil Engineering & Design (Chapter 3) and Water chapters (Chapter 8).

Excavations for turbine foundations and hardstands at turbine locations will be the largest scale excavations at Shronowen. This will involve creating safe side slope angles or installing temporary peat retention berms or sheeting piling as detailed in the Chapter 3. Installation of drainage around and within the excavation and installation of sediment control measures within the drainage system will also be carried out. Further detail is provided in the Civil Engineering & Design Chapter (Chapter 3)

Within excavations and around excavations, pore water pressure will be kept low by avoiding loading the peat with spoil or machinery and giving careful attention to the existing drainage and how structures could affect it. Removal of peat to approved peat deposition areas will avoid the need for storage adjacent to excavations.

All temporary cuts/excavations will be carried out such that they are stable or adequately supported. Cuts and excavations will be protected against ingress of water or erosion by the use of cut off drains around the excavation works. Temporary works will be such that they do not adversely interfere with existing drainage channels/regimes.

Plant and materials will be stored in approved locations only (such as the proposed site compounds) and will not be positioned or trafficked in a manner that would surcharge existing or newly-formed slopes (Refer to the CEMP for further details).

Excavated peat from the cable route will be used to landscape and reinstate the area around the cable trench following backfilling of the trench with approved materials. The angle of the peat reinstated at the top of the infilled trenches will not exceed 5^{o}.

9.4.1.5 Mitigation Measures for Excavation associated with Cable Trenching

The removal of soil, subsoil and bedrock is an unavoidable impact of the construction of the cable trenches within the wind farm and along the grid connection but every effort will be made to ensure that the amount of earth materials excavated is kept to a minimum in order to limit the impact on the land and soils aspects of the site. Some of the overburden material will be used in the re-instatement of turbine excavations and cable trenches. All other material will be removed to designated storage areas or suitably licenced/permitted facilities.

Temporary storage of material beside the trenches should be done in line with the CEMP. Site management should include the checking of equipment, materials storage and transfer areas, drainage structures and their attenuation ability on a regular basis during the construction phase of the project. The purpose of this management control is to ensure that the measures in place are operating effectively, prevent accidental leakages, and identify potential breaches in the protective retention and attenuation network during earthworks operations.

9.4.1.6 Mitigation Measures for the Storage and Management of Excavated Material

The risks associated with peat placement has and will be mitigated by the following measures:

- Reducing overall peat excavation by design of access road and turbine location;
- The planting and re-seeding of material storage areas and peat deposition areas will provide resistance against rainfall events and will minimise sediment and nutrient release until natural re-vegetation is established as discussed above.

Drainage measures will be provided for the reinstated peat deposition areas as presented in the EIAR Vol 2 Chapter 3; this will include drains, settlement ponds and silt fencing as required.

Any runoff from the peat deposition areas will be treated using the same design philosophy as that for the roads and hardstands. This includes the separation of clean and dirty water by the installation of berms, channelling dirty water to silt traps and settlement ponds and ensuring that the discharge rate of the drainage system is no higher than the existing condition by using engineered settlement ponds. The drainage system shall be installed prior to placement of peat. Refer to EIAR Vol 2 Chapter 3 for greater detail on the design philosophy behind each of the drainage measures.

The handling, storage and management of excavated spoil will be carried out in line with the Construction Environmental Management Plan (CEMP). Site management will include the checking of equipment, materials storage and transfer areas, drainage structures and their attenuation ability on a regular basis during the construction phase of the project. The purpose of this management control is to ensure that the measures in place are operating effectively, prevent accidental leakages, and identify potential breaches in the protective retention and attenuation network during earthworks operations.

9.4.1.7 Waste Management

A construction phase waste management plan has been developed to control all site generated construction waste and the storage and disposal of same (See Section 5 of the CEMP in **Appendix 2-1 of Volume 3** of the EIAR).

Any introduced semi-natural (road building materials) or artificial (PVC piping, cement materials, electrical wiring) materials must be taken off site at the end of the construction phase, except for material that forms part of the permanent works. Any accidental spillage of solid state introduced materials must be removed from the site by the appropriate means. This is detailed further in the Material Assets Chapter of the EIAR (Chapter 15).

9.4.1.8 General Site Management

The CEMP will include the checking of equipment, materials storage and transfer areas, drainage structures and their attenuation ability on a regular basis during the construction phase of the project. The purpose of this management control is to ensure that the measures in place are operating effectively, prevent accidental leakages, and identify potential breaches in the protective retention and attenuation network during earthworks operations.

Aa fuel management plan will be implemented and will incorporate the following elements:

- Mobile bowsers, tanks and drums will be stored in secure, impermeable storage area, 50m away from drains and open water;
- Fuel containers must be stored within a secondary containment system e.g. bund to 110% of volume for static tanks or a drip tray for mobile stores;
- Ancillary equipment such as hoses, pipes must be contained within the bund;
- Taps, nozzles or valves must be fitted with a lock system;
- Fuel and oil stores including tanks and drums will be regularly inspected for leaks and signs of damage;
- Only designated trained operators will be authorised to refuel plant on site;
- Procedures and contingency plans will be set up to deal with emergency accidents or spills;
- An emergency spill kit with oil boom and absorbers will be kept on site in the event of an accidental spill. All site operatives shall be trained in its use.

9.4.1.9 Drainage

The permanent road works will require a drainage network to be in place for the construction and operation phases of the wind farm. Fundamental to any construction phase is the need to keep clean water (i.e. runoff from adjacent ground upslope of the permitted development footprint) clean and manage all other run off and water from construction in an appropriate manner. This will necessitate the implementation of the Sediment and Erosion Plan, with associated settlement ponds and silt traps. The Sediment and Erosion Plan forms part of the CEMP for the site. The Sediment and Erosion Plan, included in the Civil Engineering & Design chapter, is included as a design feature thereby applying mitigation by design.

9.4.1.10 Surface Water

To ensure that there is no adverse impact on surface water flow or quality, a regular programme of environmental audit and site maintenance of the constructed drainage and attenuation structures (e.g. settlement ponds, buffered outfall) and drainage crossings is required to ensure attenuation performance to regulatory standards at the site. Mitigation measures for hydrology are fully described in Chapter 8 of this EIAR.

9.4.1.11 Replacement Forestry Lands Mitigation Measures

The mitigation measures for the replacement lands will be the same as those at the wind farm site as discussed in previous sections. These include mitigation measures for excavation, drainage, siltation control, hydrocarbon release and general site management and will be fully in line with any requirements identified in the Technical Approvals that have been provided for each site.

The land use at these locations will be changed to forestry. At the end of the forestry lifetime, the land can be converted back to its current agricultural use.

9.4.2 Operational Phase

The potential impact on the land and soils environment of the site due to excavations will be lower during operation and maintenance, as the majority of excavations will have been reinstated. Some erosion of soil may continue into the early stages of the operational phase as reinstated areas will initially have bare soil. However, as vegetation becomes established and equilibrium is achieved, erosion rates will reduce to normal levels. Sediment control measures will remain in place onsite during the above period.

All vehicular movement during operation and maintenance will be restricted to the areas of hardstanding and existing/newly constructed access roads. The volume of traffic during the operational phase will be greatly reduced in comparison with the construction phase. The potential impact on slope stability will therefore be small.

At the replacement lands, the potential impact on the land and soils environment of the site due to excavations will be lower during operation and maintenance, as the excavation work will have been completed during preparation of the site prior to planting trees. Some attendance at the replanted lands will be required during the operational phase. In these circumstances, all vehicular movement during operation and maintenance will be restricted to the areas of forestry tracks to avoid tracking over land and soils within the area.

At the wind farm development, the replacement lands and the grid connection the risks associated with sedimentation and contamination of the watercourses and aquifers due to erosion and runoff will be reduced to minimal levels as areas are revegetated and construction/forestry traffic ceases. Refer to EIAR Chapter 8 for further details in relation to hydrology and hydrogeology.

9.4.3 Decommissioning Phase

Decommissioning will comprise the removal of the turbines at the end of the operating lifetime of the wind farm. Access roads are likely to be left in place and hardstanding areas will be reinstated. Concrete bases will be left in the ground, covered with topsoil and allowed to naturally re-seed in line with IWEA best practises (IWEA, 2012). Cables for the grid connection will be removed from the ducts through the joint bays without reopening the trenches. The area around the bases will be rehabilitated by covering it with locally sourced soil in order to regenerate the vegetation. This will also reduce run-off and sedimentation effects. The mitigation measures for decommissioning form part of the environmental assessment required at the end of the design life of the wind farm.

At the end of the forestry lifetime in the replacement lands, the felling will be subject to the requirements of a felling licence and adherence to the environmental mitigation measures associated with the licence.

9.4.4 Cumulative Impacts

Based on the finding that the cumulative impact on land and soils arising from the proposed development and replacement lands is considered to be slight negative, and considering the static nature of the land and soils environment, no specific measures to mitigate against cumulative impacts are considered necessary. Implementation of the mitigation measures proposed for the construction, operational and decommissioning stages of the proposed development will mitigate against cumulative impacts associated with the land and soils environment

9.5 RESIDUAL IMPACTS

No significant impacts on the land and soils environment were identified in the assessment. Only slight to moderate impacts have been identified. The main risks to the land and soils environment have been identified and avoided as part of the design process. Mitigation measures have been proposed for the remaining slight to moderate impacts which further reduce these risks. Due to the modified nature of large parts of the site, and in light of the proposed works and the mitigation measures outlined above, it is considered that there will be no significant residual impact to land and soils environment due to the development and operation of this project.

9.6 CONCLUSION

The proposed development does not constitute a significant adverse effect on the land and soils environment *of the site and surrounding area,* having considered the cumulative effects with other existing and/or approved projects.

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