7 SOILS, GEOLOGY AND HYDROGEOLOGY

7.1 INTRODUCTION

1 This chapter evaluates the impacts on soils, geology and hydrogeology arising from the proposed development as set out in Chapter 6, **Volume 3B** of the EIS. The information contained within this chapter is concerned with the description of the geological and hydrogeological character of the Meath Study Area (MSA).

2 The soils, geology and hydrogeology evaluation of the MSA considers an area in excess of 500m either side of the proposed route alignment. The geological material existing along the alignment has been generated by the deposition of detritus over millions of years. The geological material underlying the study area, both the glacial mineral subsoil and the bedrock are concealed below ground. The nature, extent and complexity of the geological material are detailed, from the surface downwards through the mineral subsoil to the bedrock.

3 The potential impacts on the ground conditions and on the existing soil, geology and groundwater conditions are considered for both the construction, operational and decommission phases of the proposed development. Mitigation measures that will form part of the development are described and any residual environmental impacts identified and their significance evaluated.

4 Chapter 6**, Volume 3B** of the EIS describes the full nature and extent of the proposed development including elements of the overhead line (OHL) design and the towers. It provides a factual description, on a section by section basis, of the entire line route. The principal construction works proposed as part of the development are set out in Chapter 7, **Volume 3B** of the EIS and are included in the outline *Construction Environment Management Plan* (CEMP) (refer to Appendix 7.1, **Volume 3B Appendices** of the EIS).

7.2 METHODOLOGY

5 This chapter has been prepared using the recommendations set out in the Environmental Protection Agency's (EPA) *Guidelines on the Information to be contained in Environmental Impact Statements* (March 2002). The guidelines and recommendations of the Institute of Geologists of Ireland (IGI) publication *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) were also taken into account in the preparation of this chapter.

6 The information contained in this chapter has been divided into sub-sections, so as to describe the various aspects pertaining to soil, geology and hydrogeology. In the preparation of this chapter, relevant information was collated and evaluated. The information sources are detailed further in this chapter.

7 The principal objectives of this chapter are to identify:

- Geological and groundwater factors which might affect the technical viability of the proposed development;
- Impacts that the proposed development may have on soils, geology and groundwater geological heritage and on contaminated land along the proposed development route and in the adjacent area;
- Constraints that these features may place on the proposed development;
- Mitigation measures which may be required to minimise any adverse impacts related to the proposed development; and
- Evaluation of significance of any residual impacts.

8 The information included in this chapter is considered to meet the data requirements suggested in the EPA *Guidelines on the Information to be contained in Environmental Impact* (2002).

9 The following is a list of published geological references and data used in this chapter:

- An Foras Talúntais (1980). *General Soil Map of Ireland;*
- An Foras Talúntais (1983). *Soils of County Meath;*
- Clarke, A, Parkes. M, Gately. S, (2007). *Geological Heritage of Meath.* Geological Survey of Ireland, Dublin*;* Environmental Protection Agency and Geological Survey of Ireland (2009). *Historic Mine Sites - Inventory and Risk Classification;*
- Geological Survey of Ireland (1997). *1:100,000 scale Sheet 8 – Geology of Monaghan –Carlingford*;
- Geological Survey of Ireland (2001). *1:100,000 scale Sheet No. 13 – Geology of County Meath*; Historical Geological 6 inch:1 mile maps;
- Historical OSI 6” and 25” maps;

- Meehan, R.T., Warren W.P. and Gallagher, C.J.D. (1997). *The sedimentology of a late Pleistocene drumlin near Kingscourt, Ireland;*
- Meehan R.T. (1999a). *Directions of ice flow during the last Glaciation in counties Meath, Westmeath and Cavan;*
- Meehan, R.T. and Warren, W.P., (1999b). *The Boyne Valley in the Ice Age;*
- Meehan, R.T., (2000). *Kells and adjacent areas, County Meath, Ireland;*
- MCOS / RPS Clonee – North of Kells M3 EIS (2002);
- OSI 1:50,000 scale maps, Sheets 35, 42, 43, 49 and 50; and
- Rudland, D.J., Lancefield, R.M. and Mayell, P.N. (2011). *Contaminated Land Risk Assessment, A Guide to Good Practice.* CIRIA C552 London.

10 For a list of reports referenced in this chapter refer to the bibliography in this volume of the EIS. Numerous online datasets were referenced in relation to the soil, subsoil and geology in the MSA including data from the Geological Survey of Ireland (GSI), Department of Communications, Energy and Natural Resources (DCENR) and the EPA. Consultation was undertaken with statutory and non-statutory organisations and include details on consultation with the GSI (refer to Chapter 3, **Volume 3B** of the EIS for details on scoping and statutory consultation).

11 The scoping opinion received from An Bord Pleanála (refer to Appendix 1.3, **Volume 3B Appendices** of the EIS) identified the following issues as being relevant to this chapter of the EIS:

- An assessment of potential soil erosion, particularly where it affects priority habitats, designated conservation areas, and in the vicinity of surface water bodies;
- Submission of a construction method statement, identifying areas of particular sensitivity which require specific construction mitigation measures, including areas of peat; and
- Identification and assessment of potential impacts on sites of geological heritage interest, including Altmush Stream and Galtrim Moraine.

12 Site visits of the MSA were conducted in February 2009, July 2009, April 2011, and June 2013 to September 2013. Site walkover and site investigation surveys were conducted where access was granted by the landowner. Fieldwork focused on verifying the accuracy of national datasets. Site specific details were recorded and included logging of subsoil types, vegetation

indicators, springs, drainage details and general trafficability of soils. Where access was granted to proposed tower locations, subsoil deposits and selected exposures / sections were logged according to the British Standard Institute *Code of Practice for Site Investigations* (BS 5930:1999).

13 Whilst all projects and developments that require an EIA are of a scale or nature that they have the potential to have an impact on the environment, with respect to the construction of a transmission line and the use of temporary access routes and stringing areas, the impact on the soils, geology and hydrogeological environment is considered low in comparison to other linear projects such as road or pipeline developments.

14 In this chapter, the potential impact on the geological environment resulting from the proposed development is evaluated and mitigation measures are proposed to reduce any significant impacts. Based on the mitigation measures proposed the significance of the residual impact on the geological environment is predicted.

15 Criteria for evaluating impact level are shown in **Table 7.1**. Terminology for impact significance and duration follows that set in the EPA's *Guidelines on the Information to be contained in Environmental Impact Statements* (March 2002). The magnitude of any effects considers the likely scale of the predicted change to the baseline conditions resulting from the predicted effect and takes into account the duration of the effect i.e. temporary or permanent. Definitions of the magnitude of any effects are provided in **Table 7.1**.

Table 7.1: Impact Magnitude Definitions

Magnitude	Criteria
Very High	An impact, which obliterates sensitive characteristics of the soil or geology environment
High	Fundamental change to ground conditions, groundwater quality or flow regime
Moderate	Measureable change to ground conditions, groundwater quality or flow regime
Low	Minor change to ground conditions, groundwater quality or flow regime
Negligible	No measureable impacts on ground conditions, groundwater quality or flow

Source: EPA's *Guidelines on the Information to be contained in Environmental Impact Statements* (March 2002)

16 Impact ratings may have negative, neutral or positive application where:

- Positive impact – A change which improves the quality of the environment;
- Neutral impact – A change which does not affect the quality of the environment; and
- Negative impact – A change which reduces the quality of the environment.

17 Terms relating to the duration of impacts are as described in the EPA's *Guidelines on the Information to be contained in Environmental Impact Statements* (March 2002) as:

- Temporary Impact - lasting one year or less;
- Short term Impact - lasting one to seven years;
- Medium term Impact - lasting seven to fifteen years;
- Long term Impact - lasting fifteen to sixty years; and
- Permanent Impact - lasting over sixty years.

18 A qualitative approach was used in the evaluation generally, following the significance classification in **Table 7.2** and through professional judgement. The significance of a predicted impact is based on a combination of the sensitivity or importance of the attribute and the predicted magnitude of any effect. Effects are identified as beneficial, adverse or negligible, temporary or permanent and their significance as major, moderate, minor or not significant (negligible).

Table 7.2: Assessment of Criteria

Sensitivity	**Magnitude**				
	Very High	**High**	**Medium**	**Low**	**Negligible**
High	Major	Major	Moderate	Moderate	Minor
Medium	Major	Moderate	Moderate	Minor	Negligible
Low	Moderate	Moderate	Minor	Negligible	Negligible
Negligible	Minor	Minor	Negligible	Negligible	Negligible

19 In order for a potential impact to be realised, three factors must be present. There must be a source or a potential effect, a receptor which can be adversely affected and, a pathway or connection which allows the source to impact the receptor. Only when all three factors are present can an effect be realised.

7.2.1 Legislative and Policy Content

20 An evaluation of the proposed development was carried out in relation to the relevant European and National legislation and other statutory policies and guidance. The following legislation was considered as part of this impact evaluation.

- Consolidated EIA Directive 2011/92/EU;
- *European Communities (Water Policy) Regulations 2003* [S.I. No. 722/2003]*;*
- *Waste Management Acts 1996-2013;*
- *European Communities Environmental Objectives (Groundwater) Regulations 2010* [S.I. No. 9/2010]; and
- *European Communities (Environmental Impact Assessment) (Amendment) Regulations, 2001* [S.I. No. 538/2001].

7.3 CHARACTERISTICS OF THE PROPOSED DEVELOPMENT

21 The main potential impacts on the soils, geology and hydrogeology in the MSA occur during the construction phase. Details of the potential impacts are included in **Section 7.5**. Overall the construction programme is anticipated to last approximately three years. The proposed development entails the construction of towers as individual sites separated by approximately 340m. In general, the construction phase can be broken down into the following: site preparation (including the laying of temporary rubber matting or aluminium road panels, removal of fences and erection of temporary fencing where required); all works associated with modifications to existing 110 kV transmission OHL, installation of tower foundations and works at the existing Woodland Substation; erection of towers; guard poles, tree looping, stringing of conductors, commissioning of the line and reinstatement of land.

7.4 EXISTING ENVIRONMENT

7.4.1 Topography and Geomorphology

22 Refer to Figures 7.1 – 7.4, **Volume 3D Figures** of the EIS. The topography along the alignment varies approximately from:

- 50m to 160m Above Ordnance Datum (AOD) in the northern section (Towers 237 - 257);
- 50m and 100m AOD in the central area (Towers 257 - 395); and

- 90m and 130m in the southern section (Towers 395 - 410).

23 The morphology is shaped principally during the last glacial age (the Midlandian), with subsequent modification throughout the post glacial Holocene period. Most of the Quaternary sediments in the MSA were deposited during the last glaciation, directly from the huge ice sheets that moved from north-west to south-east.

24 The geomorphology of the MSA is divided between the northern drumlin landscape and the southern Carboniferous Limestone lowland area. The drumlin region is situated to the north of the alignment (north of Moynalty and Castletown Towers 237 – 251). Drumlins take a variety of forms with the majority elongated in the direction of ice flow. Some drumlins have sharp crests, whereas others are more whaleback in profile. Although most drumlins are composed of glacial or tills, a small number are rock-cored. Some of ridges are aligned transverse to the ice flow direction (known as Rogen 'ribbed moraines') and were streamlined and overprinted by subsequent drumlin development, while others remained unaffected.

25 Elevations above sea level (OD) here range from approximately 60m along the Altmush Stream to approximately 160m to the north-west of Kilmainhamwood. Kames and outwash deposits occur in several places in north Meath, notably around Kilmainhamwood at the base of the Kingscourt Valley and Castletown / Clongill.

26 The southern limestone lowland is generally characterised by gently undulating lowlands underlain by diamictons[26], with occasional gravel hillocks, eskers and alluvial flats. Moraine deposits at Galtrim and Kells are considered to be the remains of a pause in ice retreat.

7.4.2 Soils

27 The MSA varies in terms of its soil, subsoil and bedrock geology. General information concerning soil types is contained in *General Soil Map of Ireland* (An Foras Talúntais 1981), *Soils of Co. Meath; (*An Foras Talúntais 1983), *Geology of County Meath* (GSI, 2001) and on the EPA website www.epa.ie. There are a range of soils in the MSA between Clonturkan and Woodland Substation.

28 The principle soil groups are:

- AminPD – Deep poorly drained mineral soil, derived from mainly non-calcareous parent materials. Surface water gleys and groundwater gleys are included in this category;
- AminDW – Deep well drained mineral soil, derived from mainly non-calcareous parent materials. Acid brown earths and Brown podzolics will be included in this category;

[26] tills

- BminDW - Deep well drained mineral soil derived from mainly calcareous parent materials. Grey brown podzolics and brown earths (medium high base status) are included in this category; and

- BminSW - Shallow well drained mineral soil, derived from mainly calcareous parent material. Renzinas and lithosols are included in this category.

29 The following soil groups also occur but are less widespread and found in minor formations:

- BminPD – Deep poorly drained material soil derived from mainly calcareous parent materials. Surface water gleys and ground water gleys are included in the category;

- BminPDPT – Poorly drained mineral soils with peaty topsoil, derived from mainly calcareous parent materials. Peaty gleys are included in this category;

- AminSW – Shallow well drained mineral soil, derived from mainly non-calcareous parent materials. Lithosols and regosols are included in this category;

- AminSP – Shallow poorly drained mineral soil, derived from mainly non-calcareous parent materials. Surface water and groundwater gleys are included in this category;

- BminSP – Shallow poorly drained mineral soil, derived from mainly calcareous parent materials. Surface water gleys and ground water gleys are included in this category;

- AlluvMIN – Alluvial undifferentiated;

- AminSW - Shallow well drained mineral, derived from mainly non-calcareous parent materials. Lithosols and regosols are included in this category; and

- Lac – Lacustrine Deposits (undifferentiated).

30 Alluvial soils are evident along the course of the main surface water features in the MSA. In particular, alluvial soils are evident along the River Boyne and its tributaries. Minor areas of cutover peat (Cut) are evident in the MSA. An area of cutover peat and lacustrine deposits are located near Carlanstown, approximately 5km north-east of Kells (west of Towers 286-297).

7.4.3 Geology

7.4.3.1 Quaternary Geology

31 General information concerning the Quaternary (Subsoil) Geology is contained in *Geology of County Meath* (GSI, 2001) and on the EPA website (www.epa.ie). Most of the Quaternary sediments were deposited during the Ice Age itself, either directly from the huge ice sheets that

moved from north-west to south-east or from the meltwater following the slowly melting ice sheets. Refer to Figures 7.1– 7.4, **Volume 3D Figures** of the EIS.

32 With reference to the EPA online mapping (http://maps.epa.ie/), the subsoils comprise primarily of Carboniferous limestone till (TLs) and Namurian shales / sandstone tills (TNSSs) while Glaciofluvial sands and gravels (GLs / GNSSs) are also present. Bedrock at the surface was noted by the EPA and the GSI in a small area along the alignment.

33 Till derived from various rock formations is the principal material encountered along the alignment. Till is an unsorted sediment derived from the transportation and deposition of by or from a glacier. Glacial till is composed of a heterogeneous mixture of clay, sand, gravel and boulders.

34 The following four subsoil groups are dominant along the alignment:

- TNSSs – Tills derived from Shales and Sandstones (Namurian);
- GLS – Sands and Gravels derived from Limestone (Carboniferous);
- TLS – Till derived from Limestone (Carboniferous); and
- TLPSsS – Till derived from Sandstone and Shale (Lower Palaeozoic).

35 The following subsoil groups also occur along the alignment, but are less dominant:

- A – Alluvial undifferentiated;
- Rck – Bedrock at Surface;
- L – Lake Sediment Undifferentiated;
- GNSSs - Sands and Gravels derived from Shales and Sandstones (Namurian);
- BASESK – Basic Esker Sands and Gravels;
- CUT – Cutover Peat; and
- GLPSsS –Gravel derived from Sandstone and Shales (Lower Palaeozoic).

36 A summary of the proposed tower locations within each subsoil group is outlined in **Table 7.3** and shown in Figures 7.1 – 7.4, **Volume 3D Figures** of the EIS.

Table 7.3: Subsoil Classifications at Tower Locations

Subsoil Group[27]	**No. of Towers within subsoil category**	**% of Towers within subsoil category**
Alluvium (Undifferentiated)	5	3.0%
Glaciofluvial sands and gravels	26	15.8%
Glaciolacustrine deposits (undifferentiated)	2	1.2%
Bedrock at or near surface	4	2.4%
Peat	3	1.8%
Till	125	75.8%
TOTAL	**165**	100%

7.4.3.2 Bedrock Geology

37 Refer to Figures 7.5 – 7.8, **Volume 3D Figures** of the EIS. Reference to the relevant geological information in *Geology Map of County Meath* (GSI, 2001) and *Geology Map of Monaghan – Carlingford* (GSI, 1997) indicates that the bedrock geology along the alignment is varied.

38 Reference to the published geological map for this area, the 1:100,000 scale *Sheet No. 13 – Bedrock Geological Map of County Meath* (GSI, 2001) and the 1:100,000 scale *Sheet 8 – Bedrock Geological Map of Monaghan – Carlingford* (GSI, 1997), indicates that this area is principally underlain by Namurian Deposits (320-290 million years ago) between Towers 387-404. Namurian (undifferentiated) (NAM) beds are composed of sandstones, siltstone and shales with thin coal bands and occur south-west of the town of Dunshaughlin.

[27] Based on GSI Data www.gsi.ie

39 Ordovician-Silurian age deposits (Towers 237-259 and 290-303) are located to the north of Navan with Carboniferous aged (355 million years to 290 million years ago) deposits located between Towers 260-290, 304-386 and 404-410. The mid-section of the proposed development (Towers 260-386 and 403-410) is predominantly underlain by the Lucan 'Calp' Formation (Lu). The undifferentiated Navan beds (SD), Cruicetown Group (undifferentiated) (CRT), Fingal Group (undifferentiated) (FNG), which are found all north of Navan, County Meath.

40 The distribution of geological units, along the proposed route alignment is based on published information from the GSI; it is shown on Figures 7.5 – 7.8, **Volume 3D Figures** of the EIS. The composition and the characteristics of the various rock units are discussed herein.

41 Ordovician / Silurian Deposits (Salterstown Formation, Clontail Formation and Castlerahan Formation). The Ordovician deposits along the alignment are comprised of greywackes, sandstones and mudstones. These rocks were formed from sands, muds and silts deposited by turbiditic currents in deep marine setting at the edge of the ancient Iapetus Ocean. These rocks were partially metamorphosed by subsequent folding, faulting and subduction events.

42 The different geological formations that make up the MSA include the following formations:

- Navan Beds. The Navan Group is primarily comprised of argillaceous limestones, shales and sandstones. Within the Navan Group a number of members are present including the Rockfield Sandstone Member.

- Meath Formation. The Meath Formation is typically comprised of varied lithologies including micrite, oolite, sandstone, argillaceous limestone, and shale. The Meath Formation is the main host ore body to the Tara Mines Lead Zinc ore body.

- Calp Limestone (Lucan Formation). Underlying the mid-section of the proposed development area, the bedrock is comprised of the Calp Limestones. The term 'Calp' is used to refer to the various basinal limestone and shales occurring in these successions. The Calp units generally consist of dark grey, fine grained, impure limestone with interbedded shales and veins of white calcareous spar. The variation in bed thickness, grain size, colour and proportion of shale is a feature of the depositional environment.

- Cruicetown Group & Fingal Group. The Cruicetown Group and Fingal group occur in the Moynalty Basin (between Moynalty, Carlanstown and Nobber). The Cruicetown and Fingal Group are structurally controlled by a syncline present within the Moynalty Basin trending north-east / south-west. The Cruicetown Group is primarily comprised of Ballysteen and Waulsortian Limestones. The Fingal Group is primarily comprised of Calp limestones.

- Namurian Sandstones and Shales. Thick sequences of sandstones, siltstones and marine shales were deposited later during the Upper Carboniferous Period (approximately 340 million years ago). Several different lithologies are present within the Namurian Sandstones and Shales, but due to poor exposure in the area, a general classification is given to the rocks in the area. The Namurian shales typically consist of siltstones, mudstones interbedded with fine – medium grained sandstones, calcareous mudstone / siltstone and argillaceous limestone.

43 The distribution of geological units, along the alignment is based on published information from the GSI. They are shown in Figures 7.5 – 7.8, **Volume 3D Figures** of the EIS. The composition and the characteristics of the various rock units are discussed herein.

7.4.3.3 Karst Features

44 The muddy limestones of the Lucan 'Calp' Formation and the Ballysteen Formation are less susceptible to karst solution than pale, purer limestones (present in East Meath, Navan Beds and the Drogheda Platform). Exposures in the Fingal Group and Calp Limestones do not indicate any major Karst solution features. The Karst database held by the GSI was consulted. This database holds records of locations and types of reported Karst features. No recorded karst features from the GSI database exist within 1km of the proposed route alignment. Karst features were noted at former Gibstown Castle (Gibstown House) located approximately 1.2km from the proposed route alignment. Anthropogenic sources have modified the original setting at Gibstown House. Within the Navan group occasionally paleokarst features are present, with, some dolomitisation and fracturing.

7.4.3.4 Depth to Bedrock

45 A small fraction of the surface of the area (<2%) comprises bedrock outcrop, with a deep cover of Quaternary deposits in the MSA. Subsoil depths in the Bohermeen area to the west of Navan above the Tara Mines SWEX B extension vary from 10m to 70m below ground level (bgl). Bedrock outcrop are mainly confined to the streams along the proposed line route including Kilmainham Stream and Altmush Stream. Bedrock outcrops are more prevalent above the Namurian bedrock in the Culmullin area to the south of the proposed alignment. Additional information was obtained from the GSI well database which is included in **Appendix 7.1, Volume 3D Appendices** of the EIS.

7.4.4 Hydrogeology

46 The evaluation of the groundwater environment is concerned with water contained below the ground surface, within the soil and bedrock environment. Soils and bedrock along the MSA are widely variable in their hydrogeological characteristics. Ordovician greywackes and Namurian shales beneath the northern end of the OHL route are generally of low permeability, and lack groundwater except at shallow depth in the transition zone / upper weathered bedrock. The impure limestones, alluvial and sand and gravel parent materials that occur along parts of the MSA are moderate to high permeability. Glacial clays are generally of low permeability, although they may be locally interspersed with more permeable granular deposits.

47 Groundwater is present in these strata and groundwater generally is limited to fractures and to the upper weathered zone of the strata. There are no existing public water supply boreholes in close proximity to the proposed development. Information was obtained from the GSI well database which is included in **Appendix 7.1, Volume 3D Appendices** of the EIS.

7.4.4.1 Aquifer Classification

48 The section of the proposed development near the town of Trim is composed of Dinantian Upper Impure Limestones and is classified as a Locally Important Aquifer, which is generally moderately productive. The same formation south-west of Kells is classified as a Locally Important Aquifer - moderately productive in local zones only. Silurian Metasediments and Volcanics between Navan and Ardee and north-west of Kells are classified mainly as Poor Aquifers (Pl) – unproductive except for local zones and Poor Aquifers (Pu). An aquifer classification by the GSI describes the Lucan Formation as a Locally Important Aquifer, bedrock which is Generally Moderately Productive (Lm). According to the GSI, the Calp is dominated by moderate permeability, fine grained and argillaceous limestones and shales. A summary of the aquifer classification is included in **Table 7.4**. Refer to Figures 7.9 ‐ 7.12**, Volume 3D Figures** of the EIS for aquifer maps.

49 The Quaternary sediments play an important role in the groundwater flow regime of the region. The permeability of the glacial tills, which occur along the alignment, is variable but generally moderate. The high permeability gravels and sands and moderate permeability till allow recharge of the bedrock unit and provide additional storage to the underlying bedrock aquifer.

7.4.4.2 Groundwater Flow Direction

50 In general terms the groundwater gradient follows the topographic variation in an area. Flow paths and distance is dependent on the characteristics of the aquifer type. Most groundwater flow is confined to the upper 10m of weathered bedrock and will discharge to the nearest watercourse. An evaluation of the topographic contours displayed on the Ordnance Survey

1:50,000 scale Discovery Series Map for the region, indicates that the predominant groundwater flow direction in the MSA is likely to be towards:

- The River Tolka and its tributaries (Towers 410-400);
- The Boyne River and its tributaries (Towers 400-276); and
- The Dee River and its tributaries (Towers 273-237).

51 It is noted that a catchment divide is located between Towers 274 and 275 and groundwater flow direction may vary seasonally, however based on topography and subsoil mapping data, groundwater flow is likely towards the River Boyne and its tributaries.

7.4.4.3 Water Usage

52 Water usage within the MSA is primarily supplied by Meath County Council from their surface water abstractions at the River Boyne (Trim and Dowdstown supplies) and supplemented by Meath County Council groundwater abstraction boreholes. There are no public water supplies within 200m of the proposed line route.

53 Along the alignment a number of private wells are used by individual landowners. A search of the GSI well database shows there are a number of wells in the area with uses varying from private to agricultural use. The GSI Well Database is a record of reported wells drilled in Ireland. Refer to **Appendix 7.1, Volume 3D Appendices** of the EIS.

Table 7.4: Aquifer Definitions

Aquifer Code[28]	Aquifer Description	% of Towers located within Aquifer type
Pl	Poor Aquifer Bedrock which is generally unproductive except for local zones	30.9%
Ll	Locally important aquifer, which is Moderately Productive only in Local Zones	34.6%
Lm	Locally Important Aquifer - Bedrock which is Generally Moderately Productive	26.6%
Pu	Poor Aquifer - Bedrock which is Generally Unproductive	7.9%

[28] Based on GSI Data www.gsi.ie

7.4.4.4 Groundwater Vulnerability

54 The (formerly titled) DoEHLG, EPA and GSI have produced guidelines on groundwater vulnerability mapping that aim to represent the intrinsic geological and hydrogeological characteristics that determine how easily groundwater may be contaminated by human activities. Vulnerability depends on the quantity of contaminants that can reach the groundwater, the time taken by water to infiltrate to the watertable and the attenuating capacity of the geological deposits through which the water travels.

55 The DoEHLG, EPA and GSI vulnerability mapping guidelines allow for the assignment of vulnerability ratings from 'extreme' to 'low', depending upon the subsoil type and thickness. With regard to sites where low permeability subsoils are present, the following thicknesses of unsaturated zone are specified in **Table 7.5.**

Table 7.5: Groundwater Vulnerability Categories

Vulnerability Rating	Hydrogeological Conditions				
	Subsoil Permeability (Type) and Thickness			Unsaturated Zone	Karst Features
	High Permeability (Sand and Gravel)	Medium Permeability (Sandy Subsoil)	Low Permeability (Clayey Subsoil/ Peat)	Sand and Gravel aquifers only	<30 radius
Extreme	0 – 3.0m	0 – 3.0m	0 – 3.0m	0 – 3.0m	-
High	>3.0m	3.0 -10.0m	3.0 – 5.0m	> 3.0m	N/A
Moderate	N/A	>10.0m	5.0-10.0m	N/A	N/A
Low	N/A	N/A	>10m	N/A	N/A

Notes: N/A Not Applicable; Precise Permeability values cannot be given at present; Release point of contamination is assumed to be 1-2m below ground surface. The principal vulnerability classes included are High and Moderate. All sand and gravel subsoils are classified as high.

56 The principal vulnerability class is extreme. Refer to Figures 7.13– 7.16, **Volume 3D Figures** of the EIS.

Table 7.6: Groundwater Vulnerability along the Line Route

Groundwater Vulnerability[29]	Number of Towers	% towers per Vulnerability category
Extreme	9	5.5%
Extreme Vulnerability with rock at Surface (<1m)	3	1.8%
High	75	45.5%
Moderate	72	43.6%
Low	6	3.6%
TOTAL	**165**	**100**

7.4.5 Areas of Geological Heritage Importance

57 The GSI provides scientific appraisal and interpretative advice on geological and geomorphological sites and is responsible for the identification of important sites that are capable of being conserved as Natural Heritage Area (NHA). The National Parks and Wildlife Service (NPWS) of the Department of Arts, Heritage and the Gaeltacht (DAHG) has the responsibility of designation and management of sites, with appropriate advice from GSI. Refer to Figures 7.17– 7.20, **Volume 3D Figures** of the EIS.

58 At present, the GSI has compiled a list of sites proposed for designation as Natural Heritage Areas (pNHAs). The GSI has also determined a secondary list of County Heritage Areas, which may be considered for protection at local authority functional control level (i.e. maybe included in county development plans). The Meath County Geological Sites (CGS) are incorporated into the *Meath County Development Plan* 2013-2019 (the Meath CDP).

59 The GSI was consulted as part of the route selection process with regard to areas that may have geological and geomorphological importance. There are five sites identified by the GSI located along the route alignment, all five are proposed as CGS. Refer to **Table 7.7** for details.

[29] Based on GSI Data www.gsi.ie

Table 7.7: Geological Heritage Areas along the Line Route

Site Name[30]	Location	Distance from Tower location	IGH Theme
Altmush Stream (CGS)[31]	(NGR E278770 N286830)	Tower 261 located in CGS boundary	IGH8 Lower Carboniferous and IGH9 Upper Carboniferous Theme
Gibstown Castle (CGS)	(NGR 283100 273100	1.4km east of line route	IGH1 Karst theme
Boyne River (CGS)	(NGR 284350 258560)	<50m from Towers 355 and 356	IGH14 Fluvial / Lacustrine Geomorphology theme
Galtrim Moraine (CGS)	(NGR 286000 256000)	Tower 381 located in CGS boundary	IGH7 Quaternary theme
Trim Esker (CGS)	NGR 285000 253100)	0.8km west of Tower 381	IGH7 Quaternary theme

60 **Altmush Stream** comprises a continuous section of natural rock outcrops of the Lower Carboniferous (Visean) to Upper Carboniferous (Namurian) limestone, and shale of the Fingal Group and Ardagh Shale Formation respectively along the banks of a stream over a distance of 1.5km, and has been proposed under IGH8 Lower Carboniferous and IGH9 Upper Carboniferous Themes as a CGS. The potential impact on the CGS is low and is discussed further in **Section 7.5**. The line route passes over the CGS, with Tower 261 located on the boundary of the CGS.

61 **Gibstown Castle** comprising a natural rock outcrop of Lower Carboniferous (Courceyan) Limestone of the Ballysteen Formation and spring, has been proposed under the IGH1 Karst theme for designation as a CGS site as there are very few naturally exposed karst features seen within the limestone of Meath. No towers are located in the CGS. Gibstown Castle is located 1.4km from the proposed line route.

62 **Boyne River** a section of the Boyne River comprising one of the few examples of anatomising (distributary) channel system in Meath, has been proposed under IGH14 Fluvial / Lacustrine Geomorphology theme for designation as a CGS site as anatomizing channels are not common nationally. The line route passes over the CGS. No towers are located in the CGS. The nearest towers, Towers 355 and 356, are located outside the eastern boundary of the Boyne CGS.

63 **Galtrim Moraine** comprising an example of an esker crossing a moraine. The site has been proposed under the IGH7 Quaternary theme for designation as a CGS as it is unique in Ireland. The deposition of the Galtrim Moraine is considered to be the remains of a prolonged pause in ice retreat during the Midlandian age. The Galtrim Moraine is comprised of fans and deltas of

[30] Based on GSI Data www.gsi.ie.
[31] Currently Altmush is categorised as a County Geological site but may be upgraded to NHA status at a later date.

gravel built at the ice margin into glacial Lake Summerhill. This lake formed when water was trapped between the ice front and the high shaly ground at Summerhill. The building outwards of successive deposits is evident and above them, a later horizontal layer. Tower 381 is located on Galtrim Moraine.

64 **Trim Esker** comprising a 14.5km long section of a predominately wooded esker ridge made of Quaternary sand and gravel deposits. It was formed by a sub-glacial river which flowed beneath an ice sheet, covering this area during the last ice age. As this subglacial river flowed beneath the ice it deposited material which remained to form a long linear ridge, which stands out from the surrounding landscape. No towers are located in the CGS.

7.4.6 Current and Historical Mining Sites

65 The main mining area adjacent to the proposed development is Tara Mines, near Navan, County Meath. Tara Mines have been actively mining Lead and Zinc for over 30 years. The current mining area extends to west of Navan and is present beneath the alignment particularly in the Irishtown, Betaghstown and Ongenstown area. This area is referred to as the SWEX B extension. The SWEX B mineralisation is a significant depth below surface approximately 650m to 900m below ground level (mbgl). The geology of this area has been extensively investigated as a consequence of mining. A geological summary is given in **Table 7.8**.

Table 7.8: Soil / Bedrock Profile at SWEX B

Horizon[32]	Depth (mbgl)	Unit Thickness (m)
Overburden (glacial till)	5 -70	5-70m
Upper Dark Limestones	10-650	<600
Pale Beds / Ore	650 -c900	<10

66 No other major mines were noted in the MSA. The alignment does not cross the Kingscourt Gypsum Formation, which is located approximately 1km to the east of the alignment. There are no active quarries or sand and gravel pits located under the alignment.

[32] Based on Tara mines data.

7.4.7 Contaminated Land

67 An evaluation was undertaken to determine the presence and extent of potentially contaminated land in the MSA is based on the identification of potential sources pathways and receptors along the line route. If all three elements (source, pathway and receptor) are present, there is a contaminant linkage and there is a potential for the contamination to represent a risk to the receptor(s) and for the site to be considered as contaminated.

68 A number of sites have been identified as having a potential for land contamination in the immediate area of the alignment. The identified sites have not been fully investigated and, where a potential for contamination has been identified but no evidence of actual contamination has been confirmed (such as a pit/quarry which may or may not have been infilled), "a worst case" analysis has been adopted. The evaluation has been undertaken on the assumption that all of the sites are contaminated unless there is evidence to the contrary.

69 The distance to the nearest tower has been used, as the OHLs would have no impact on the underlying ground conditions. On a precautionary basis, only sites within 200m of the route of the proposed development have been considered; refer to **Table 7.9**.

Table 7.9: Potential Contaminated Land Sites within 200m of the Proposed Overhead Line Route

Tower and Associated Development	Approximate Distance (m) and Direction from Nearest Tower	Description
393	60m south-west of Tower 393	Reclaimed land (borrow pit)
389	120m south-east of Tower 389	Reclaimed land (borrow pit)
363	80m south of Tower 363	Railway land (Athboy Branch of Midland Great Western Railway)
350	120m east south of Tower 350	Reclaimed land (gravel pit)
344	20m north-west of Tower 344	Reclaimed land (borrow pit)
327	50m east of Tower 327	Reclaimed land (borrow pit)
316	15m north-east of Tower 316	Railway land (Athboy Branch of Midland Great Western Railway)
262	200m east of Tower 262	Reclaimed land (quarry)
261	100m west of Tower 261	Reclaimed land (quarry)
256	80m north to Tower 256	Reclaimed land (quarry)
245	150m south south-west of Tower 245	Reclaimed land (borrow pit)

Source: Aerial Photos and historical maps.

70 A review was undertaken of potentially contaminated land sites located in close proximity to the route of the proposed development. The detailed reviews are based on an evaluation of historical Ordnance Survey plans of the sites; LiDAR (Light Detection and Ranging) and aerial photographs of all the sites listed in **Table 7.9** and, a site walkover in July / August 2013 where access was granted.

71 In addition to specific sites, it should be noted that there is a general potential for pollution from agricultural chemicals on present and past agricultural land, and from buried material which may occur almost anywhere along the proposed development.

7.4.8 Former Railways

72 Tower 316 is located at approximately 1km south of Finnegan's Cross roads and the N3 Navan-Kells Road. The tower is located close to an abandoned railway embankment which runs south-east to north-west, 15m north of this proposed tower location. The embankment is slightly raised above the local topography by approximately 0.5m. The former railway ran between Kells and Navan.

73 The geological map shows that the site is underlain by superficial deposits consisting of alluvium and boulder clay (till). The superficial deposits are underlain by Carboniferous Limestones. The thickness of the superficial deposits as mapped by the GSI is >10m in this location (moderate vulnerability, moderate permeability).

74 The earliest OS 6" plan for 1841 shows the site undeveloped. The railway was not constructed until 1853. The OS 25" map dated 1927 shows that the line had been developed as a single track railway. The Navan to Kells line was decommissioned in 1963.

75 Tower 363 is located at approximately 2.6km west of Kilmessan. The tower is located close to an abandoned railway embankment which runs south-west to north-east, less than 70m south of the proposed tower location. The railway is marked as level with the surrounding topography and the former railway has since been removed from the field. The former railway was a branch off the Dublin Meath Railway at Kilmessan serving the Athboy area.

76 The geological map shows that the site is underlain by superficial deposits consisting of till derived from limestone. The superficial deposits are underlain by Carboniferous Limestones. The thickness of the superficial deposits as mapped by the GSI are >3m in this location (high vulnerability, moderate permeability).

77 The earliest OS 6" plan for 1841 shows the site undeveloped. The railway was not constructed until 1864. The OS 25" map dated 1927 shows that the line had been developed as a single track railway. The Navan to Athboy section was decommissioned in 1953.

78 Contaminants associated with railway lines typically include ash (heavy metals), hydrocarbons, creosote from sleeper treatment and sulphates from track ballast and herbicides. Many of the contaminants associated with railway land are volatile and are likely to have evaporated, and the heavier fractions such as metals and (Polycyclic Aromatic Hydrocarbons) PAHs are sealed within the track route by organic matter.

79 Whilst there are plausible contaminant linkages, such linkages have existed ever since the railway was constructed in the 1860s. Since the closure of the railways in the 1950s and 1960s there have been no additional contaminant sources and impacts, if any, would be limited to residual contaminants present from the operation of the railway. It is likely that the majority of the mobile contaminants would have migrated from the site over the past 50 years and that any residual contaminants are present in immobile forms. Accordingly, it is considered unlikely that there are any sources of significant residual contamination associated with the former railway line remaining on the site.

80 Towers 316 and 363 will be located to the south of the former railway lines and the footprint of the tower will not include the former railway line.

7.4.9 Disused Quarries

81 As outlined in **Table 7.9**, a number of disused quarries and soil excavation works occur along the line route. The excavations appear to be minor and have been largely undertaken in the last 20 years for use in construction activities in the local area. Excavations appear to be localised and limited in area / extent (<0.5 acres). The soil excavations shown appear to be disused and due to the distance from the tower locations, it is considered that they will not be disturbed by tower excavation works. Potential sources of contaminants include the disposal of agricultural related waste material in the excavations. Significant contamination has occurred in Ireland where open excavations were backfilled with waste materials. Based on the site visits, where feasible, LiDAR imagery and a review of aerial photographs there is no visual evidence of contamination.

82 In the absence of excavation of the former quarries / pits (the potential 'source' of any contamination) it is concluded that the construction works will not disturb any potential contamination and that the works will not alter the existing ground conditions. As the construction of the tower would not affect the excavations, it is considered that any contaminant pathways will not be realised as part of the proposed development.

7.5 POTENTIAL IMPACTS

7.5.1 Do Nothing

83 The 'Do Nothing' alternative describes the circumstance where no development occurs. Under a 'Do Nothing' scenario, no likely significant implications arise in respect of soil, geology or hydrogeology.

7.5.2 Construction Phase

84 During the preparation of the EIS, there were a number of constraints in terms of site access, however, notwithstanding these constraints, a robust evaluation of the likely significant effects of all aspects of the proposed development, both in respect of the line and the towers, has been undertaken for the purpose of this EIS. This section should be read in conjunction with the construction methodology as outlined in Chapter 7, **Volume 3B** of the EIS. The proposed development will have potential impacts on the soil, geology and hydrogeology of the MSA. Impacts of the construction works on the surface water environment in relation to silt runoff are considered in **Chapter 8** in this volume of the EIS.

85 The significance of potential impacts associated with contaminated land has been evaluated broadly based on guidelines in *Contaminated Land Risk Assessment, A Guide to Good Practice (CIRIA,* 2011). Potentially contaminated land has been identified along the proposed development. No significant potential contamination risk was identified along the line route. The potentially contaminated land sites identified along the line route of the proposed development do not pose a significant risk of contamination or a constraint to the proposed development. Accordingly, it is concluded that the sites of potentially contaminated land in proximity to the proposed development would not be disturbed by the construction process and do not pose a constraint to the proposed development. If contamination is unexpectedly encountered mitigation measures are incorporated into **Section 7.6**.

86 The construction phase of the proposed development will impact on the ground and geological conditions through the use of temporary access routes and excavations required for the tower bases and the substation. The extent of the excavations required for the tower bases will vary depending on the precise geological conditions at each tower. The working area for construction of a 400 kV tower will extend to 30 x 30m all around the footprint of the base of the tower. As noted in Chapter 7, **Volume 3B** of the EIS, tower foundations typically range from 2m to 3.5m in depth to the invert level of the foundation and anywhere from 2 x 2 metres squared to 9 x 9 metres squared, in plan area depending on tower type. Each of the four corners of the tower stubs (i.e. lower part of the tower leg) will be separately anchored below ground in a block of concrete. The standard ESB practice is to use a concrete pipe lining in the foundation holes as an integral part of the foundation. Approximately 14,200m^3 of material will

be excavated as part of the line route and approximately 3,500m^3 of material will be excavated as part of the substation development.

87 It is considered that the construction works only would have minor effects on the geomorphology of the area, as the tower construction would not materially change the local slopes and topography.

88 The tower locations have been selected to avoid known areas of lacustrine deposits, intact peat and cutover peat where possible. Intact peat was not identified at any tower location along the line route. Accordingly, it is considered that the excavations required for the construction of the principal elements of the proposed development (towers and the substation) will have no adverse impacts on the more-sensitive peat ecosystem. Cutover peat is mapped at three tower locations (Towers 269, 287 and 292). Lacustrine deposits are mapped at two tower locations (Towers 297 and 379). In the unlikely event that piled foundations may be required at these locations, the potential impacts are not significant. Mitigation measures are incorporated in **Section 7.6**.

89 It is considered that the vast majority of excavated material will consist of sub soil and naturally excavated soils and rock. The surplus excavated material from substation excavations will be approximately 3,500m^3 and tower excavations will be approximately 14,200m^3. Assuming a worst case scenario, all material will be taken off-site and recovered / deposited at an appropriately licensed / permitted waste management site. As it is anticipated that the excavated materials would comprise natural uncontaminated soils, there would be no contamination restrictions on the ability of licensed / permitted waste management sites to accept the materials. Mitigation measures will be in place should contamination be encountered as outlined in **Section 7.6**.

90 The ground conditions in the vicinity of the proposed development are considered to be of low sensitivity with one Groundwater Dependent Terrestrial Ecosystem (GWDTE), the Boyne and Blackwater cSAC located along the line route. No tower is within 60m of the Boyne / Blackwater rivers and mitigation measures incorporated into **Section 7.6** and **Chapter 6, Section 6.6** of this volume of the EIS.

91 Impacts on existing ground conditions will be restricted to the tower locations, temporary access tracks (i.e. temporary rubber matting or aluminium road panels), guarding locations and stringing locations. The magnitude of the impacts at the tower locations is considered to be low. Temporary access tracks will comprise of aluminium road panels or rubber matting. Placing of temporary access tracks will be required at a number of tower locations. Potential impacts arise where temporary access routes cross areas of cutover peat and alluvial soils. Approximately 5 temporary access tracks will be required on the MSA line route, where

temporary access tracks traverse cutover peat, lacustrine soils or alluvial soils and if weather conditions are very poor (refer to Chapter 7, **Volume 3B** of the EIS). It is not proposed to use stone roads or wooden sleepers as part of the proposed development. Mitigation measures are detailed in **Section 7.6**.

92 The line route will utilise the existing substation at Woodland thereby minimising the potential impact on the soils, geology and hydrogeology environment.

93 During the construction phase, the digging of foundations for the towers may lead to an increase in soil erosion. In addition topsoil, subsoil removal and rock excavation will be required. Topsoil removal has the potential for silt and clay to be removed by rainfall and surface water runoff. Siltation of nearby watercourses may be a potential impact and careful removal and storage of subsoil should be considered. Any topsoil that is removed will be used for regrading at a later stage. Potential impacts and mitigation measures in relation to soil erosion are addressed in **Sections 7.6** and **7.7**.

94 Alterations to existing OHL structures will be required on the Arva – Navan 110 kV line, to ensure there are adequate electrical safety clearances maintained between the proposed 400 kV circuit and the existing Arva – Navan 110 kV line. No significant potential impacts arise from these construction works. Mitigation measures in relation to soil erosion are addressed in **Section 7.7**.

95 During the construction phase, machinery on site will include diesel powered trucks, excavators and the use of either a derrick or mobile crane. The potential impacts to the underlying soil and geology from the proposed development could derive from accidental spillages of fuels, oils and solvents which could impact the soil, bedrock and groundwater quality, if allowed to infiltrate to ground during construction.

96 The proposed development has the potential to impact locally on groundwater flow and quality. All impacts that are realised would be of a temporary nature for the construction period. The principal potential impacts include a reduction in groundwater level and modification in groundwater flow as a result of dewatering; deterioration in groundwater quality as a result of suspended solids and contaminant (oils and chemicals) spills / leaks during construction and operation.

97 The evaluation of the significance of potential impacts on groundwater is based on the source-pathway-receptor approach and is determined from a combination of the sensitivity of the receptor and the magnitude of any impact. Groundwater receptors include poorly productive aquifers, GWDTE and water abstraction boreholes. No tower is located within 200m of a public water supply or the inner source protection of public groundwater supply schemes.

98 The tower excavations will vary between approximately 2m and 3.5m in depth, subject to the precise ground conditions at each tower location. In low lying areas groundwater may be encountered in excavations. If excavations for tower bases encounter groundwater, such inflows may need to be pumped, resulting in short term localised drawdown of the water table and discharges to the surface water channels.

99 Due to the limited drawdown and pumping required, it is considered that any significant impacts on the groundwater level will be realised only in close proximity to the point of abstraction. Any impacts will be restricted to the short period of pumping. Drawdown decreases exponentially away from the point of abstraction. The majority of the tower locations are remote from properties and hence it is unlikely that any dewatering of the excavations would impact on existing wells and boreholes as these tend to be located in close proximity to the user's property however, a precautionary approach will be followed where groundwater is encountered in excavations. The need for dewatering to construct the tower footings will be confirmed at the construction stage. Where groundwater is identified in excavations within 100m of houses, monitoring and evaluation of groundwater and water levels will be undertaken.

100 Water pumped from the excavations may contain suspended solids and contaminants. In the absence of any treatment, the disposal of this water to ground or to the surface water system could cause deterioration in water quality of the receiving system. Mitigation measures are outlined in **Section 7.6.**

101 There will be a risk of soil and groundwater pollution from site traffic through the accidental release of oils, fuels and other contaminants from vehicles. Mitigation measures are outlined **Section 7.6**.

7.5.2.1 Geological Heritage Impacts

102 Potential short term impacts during the construction phase include activities associated with the movement, excavation and disposal of soils, contaminated materials (if present) and bedrock, compaction of soils.

103 The alignment passes close to five sites identified as CGS or pNHAs. These have been identified as Altmush Stream, Gibstown Castle, Boyne River, Galtrim Moraine and Trim Esker.

104 The alignment does not go through the following two sites: Gibstown Castle or Trim Esker. Hence these sites will not be affected by the proposed development.

105 The alignment passes close to the Boyne River CGS but no towers are present within the CGS boundaries. Two towers will be located towards the boundary of the Boyne CGS and over 60m

from the Boyne River. Hence the Boyne CGS will not be affected by the proposed development. The potential impacts were discussed with the GSI and mitigation measures are proposed in **Section 7.6**. No significant impact was identified in consultation with the GSI.

106 It is proposed to locate one tower within the Altmush Stream CGS boundary. This tower is located over 30m from the Altmush Stream within an agricultural field. The geological interest at the Altmush site is the bedrock exposures within and along the banks of the stream, which expose rocks of the Carboniferous period. The potential impacts were discussed with the GSI and mitigation measures are proposed in **Section 7.6**. No significant impact was identified in consultation with the GSI.

107 It is proposed to locate Tower 381 within the Galtrim Moraine CGS boundary. This tower is located in an agricultural field towards the centre of the Galtrim Moraine section. The main geological interest at the Galtrim site is the cross section. The potential impacts were discussed with the GSI and mitigation measures are proposed in **Section 7.6**. No significant impact was identified in consultation with the GSI Operational Phase.

108 The proposed development will connect into the existing substation at Woodland thereby minimising the impact on the existing environment (compared to the requirement for a new additional substation build).

7.5.3 Operational Phase

109 Due to the nature of the development, there will be machinery periodically on the site at a given time. This may lead to occasional accidental emissions, in the form of oil, petrol or diesel leaks, which could cause contamination if they enter the soil and bedrock environment.

110 It is not proposed to discharge wastewater to groundwater as part of this development.

7.5.4 Decommissioning

111 The proposed development will become a permanent part of the transmission infrastructure. The expected lifespan of the development is in the region of 50 to 80 years. This will be achieved by routine maintenance and replacement of hardware as required. There are no plans for the decommissioning of the OHL. In the event that part of, or the entire proposed infrastructure is to be decommissioned, all towers, equipment and material to be decommissioned will be removed off site and the land reinstated. Impacts would be expected to be less than during the construction phase and would be of short term duration.

7.6 MITIGATION MEASURES

112 In identifying the route of the proposed development, 'avoidance of impact' measures were employed. Due to the nature of the proposed development, the scale of impact on the soils, geology and hydrogeology is low.

7.6.1 Construction Phase

113 Measures to minimise the impact of the proposed development on local geology include reuse of in situ material and importation of additional material from local sources. The placement of towers has avoided areas of intact peat, therefore the hydrology of peat masses in the general vicinity of the alignment will not be affected.

114 It is proposed to mitigate the potential impacts on the Altmush CGS, Galtrim CGS and the Boyne CGS. Soils and bedrock will be encountered during the site investigation works / construction of the towers. The GSI have been consulted at all stages of the application. The mitigation measures include the following:

- Continued consultation with the GSI;
- Limiting excavation by only excavating the required footprint at Galtrim moraine;
- Maintaining an adequate distance from the Altmush Stream; and
- The GSI will be notified by the developer about any significant new section / feature that is exposed within the tower footprint.

115 All construction waste will be stored, managed, moved, reused or disposed of in an appropriate manner by appropriate contractors in accordance with *Waste Management Act 1996 (as amended)* (refer to Chapter 7, **Volume 3B** of the EIS). Excess soils / subsoils will be disposed of at licensed / permitted waste management facilities. Excess steel will be disposed of / recovered offsite at a licensed facility. All waste material will require the necessary waste permits and documentation as part of the construction programme and the CEMP. An outline CEMP has been included in **Appendix 7.1, Volume 3B** of the EIS, and forms part of the application documentation. All relevant mitigation measures set out in the EIS are included in the outline CEMP and will be incorporated into the final CEMP.

116 Excavated soil and subsoil will be stored adjacent to the excavation area. Excavated material will be reused in situ where possible. Typically 34m^3 of soil / rock will be excavated at each intermediation tower location with approximately 230m^3 of soil / rock excavated from angle towers. In the event no material is suitable / wanted for reuse by landowners, subsoil will be disposed of at a licensed / permitted facility in accordance with the *Waste Management Act*

1996 (as amended) and associated regulations. Where subsoil is retained, an evaluation by the onsite ecologist is required to minimise potential ecological impacts. Typically subsoil is reused by landowners however, assuming a worst case scenario, surplus material will be disposed of at licensed/permitted facility. Further details of the facilities considered are provided at **Appendix 7.2, Volume 3D Appendices** of the EIS.

117 All excavated materials will be visually evaluated 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 dealt with appropriately as per the *Waste Management Act 1996 (as amended)* and associated regulations. As noted above, any contaminated material that may potentially be encountered would be disposed of at a licensed facility, in accordance with the *Waste Management Acts* and associated regulations.

118 To minimise any potential impact on the underlying subsurface strata from any material spillages, all oils and fuels used during construction will be stored on temporary proprietary bunded surface (i.e. contained bunded plastic surface). These will be moved to each tower location as construction progresses. Refuelling of construction vehicles and the addition of hydraulic oils or lubricants to vehicles will take place away from surface water gullies or drains. No refuelling will be allowed within 50m of a stream / river. Spill kits and hydrocarbon absorbent packs will be stored in this area and operators will be fully trained in the use of this equipment.

119 Controlling working practices by, for example, minimising land take, avoiding repetitive handling of soils, minimising vehicle movements off road and limiting the size of stockpiles will reduce the compaction and erosion of material. Once all works are complete, the temporary access route and the construction areas which have been disturbed around the towers during the tower foundation installation and tower erection phases will be reinstated. Any impacts are considered likely to be minor and of short term nature.

120 The presence of the 400 kV in Bohermeen will not impact on the operation of Tara mines. All mining in the SWEX 2 deposit is at >750m below ground level. The significance of effect for the line is predicted to be negligible. Liaison will be undertaken with Tara mines during the construction / operational phases to ensure no conflicts arise.

121 Any vehicles utilised during the operational phase will be maintained on a weekly basis and checked daily to ensure any damage or leakages are corrected. The potential impacts are limited by the size of the fuel tank of the largest plant / vehicles used on the site. Precautions will be taken to avoid spillages. These include:

- Use of secondary containment e.g. bunds around oil storage tanks;
- Use of drip trays around mobile plant;
- Supervising all deliveries and refuelling activities; and
- Designating and using specific impermeable refuelling areas isolated from surface water drains.

122 The majority of the tower locations are remote from dwellings and hence it is unlikely that short term dewatering of the excavations will impact on existing wells and boreholes. Where it is necessary to dewater to construct the tower foundations in close proximity of wells, monitoring will be carried out of wells within 100m of the tower locations.

123 Water pumped from the excavations may contain suspended solids. Standard methods of dewatering including ejectors, wellpoints or submersible pumps will be used. Settlement may be required to reduce the suspended solids concentrations to protect the quality of the receiving water system. Settlement will be undertaken by a standard water filtration system to control the amount of sediment in surface water runoff. Direct discharge to stream or rivers will not be permitted.

124 The mitigation measures outlined in relation to soils, geology and hydrogeology will be implemented as part of the CEMP. This plan will incorporate the mitigation measures indicated in the EIS, and any others deemed necessary, and shall provide details of intended construction practice for the proposed development. An outline CEMP can be found in Appendix 7.1, **Volume 3B Appendices** of the EIS.

7.7 RESIDUAL IMPACTS

125 The nature of the development dictates that the greatest potential impact for geological impact (including soil, subsoil and bedrock) associated with the proposed development will be in the construction phase. It is predicted that the geological impact associated with the construction phase of the development is negligible and short term.

126 With regard to the operational phase of the development, no significant impacts on the local geological or hydrogeological environment are predicted with the implementation of the prescribed mitigation measures. Application of the identified mitigation measures for the predicted impact on soils, geology and hydrogeology will ensure that the residual impact is negligible.

7.8 INTERRELATIONSHIPS BETWEEN ENVIRONMENTAL FACTORS

127 The potential for interrelationships arises with the environmental topics of water and flora and fauna. Soils, geology and hydrogeology have an important interrelationship with the water and ecological environment, as a determinant of water chemistry, river flow regimes, water storage capacity and watercourse location. It also has an impact on water quality through the ability of bedrock and surface deposits to filter potential pollutants. Potential ecological impacts could occur through the mishandling of soils or through the deposition of excavated soils in ecologically sensitive areas. These potential impacts have been identified and mitigations proposed in **Sections 7.5** and **7.6** above.

128 An evaluation was undertaken based on the identification of potential sources pathways and receptors along the line route. If all three elements (source, pathway and receptor) are present, there is a linkage and there is a potential impact to the receptor(s). In term of surface water and ecology, a groundwater dependent terrestrial ecosystems (GWDTE), the Boyne and Blackwater cSAC is oversailed by the line route, no towers are located in the cSAC. A negligible impact is predicted to occur as part of this proposed development.

129 This chapter should be read in conjunction with **Chapters 6** and **8** of this volume of the EIS and Chapter 7, **Volume 3B** of the EIS.

7.9 CONCULSIONS

130 The subsoil underlying the alignment is primarily composed of unsorted till deposits, while glaciofluvial sands and gravels are also present. Minor quantities of soft sediments including peat and alluvial deposits are also located along the proposed alignment. The construction phase of the proposed development will impact on the geological conditions through the use of temporary access routes and excavations required for the tower bases and the substation.

131 The nature of transmission line development dictates that the greatest potential impact for geological impact (including soil, subsoil and bedrock) associated with the development will be in the construction phase. During construction the potential impacts to the underlying soil and geology from the proposed works could derive from accidental spillages of fuels, which could impact the soil, bedrock and groundwater quality, if allowed to infiltrate to ground. Sensitive receptors include the Boyne / Blackwater SAC. As described in Section 7.7, application of the identified mitigation measures for the predicted impact on soils, geology and hydrogeology will ensure that the residual impact is negligible.

132 The tower locations have been selected to avoid known areas of lacustrine deposits, intact peat and cutover peat where possible. Intact peat was not identified at any tower location along the line route. Accordingly, it is considered that the excavations required for the construction of the

principal elements of the proposed development will have no adverse impacts on the more-sensitive peat ecosystem.

133 No significant adverse effects are predicted on the geological or hydrogeological environment as a result of the construction and operational phase of the proposed development.

134 The predicted impact on the soils and geology is considered to be imperceptible.