9. LAND SOILS AND GEOLOGY

9.1 INTRODUCTION

This chapter assesses the potential effects on land, soils and geology in relation to the proposed construction, operation and decommissioning of the proposed development.

The assessment has been undertaken in accordance with the EPA (2022) EIAR Guidelines and the Institute of Geologists of Ireland (IGI) EIA Guidelines (2013). This includes presentation of information on the existing land use, soil, and geological environment (i.e., the baseline for the site) to assess its importance or sensitivity.

The magnitude, probability and consequence of the potential direct, indirect and cumulative effects caused by the construction, operation and decommissioning phases of the proposed development are used to determine the overall significance of the predicted effect.

Where a significant negative effect is identified, mitigation measures are proposed, and any residual effects, once mitigation measures are implemented, are evaluated.

9.1.1 Statement of Authority

This chapter of the EIAR was prepared by Gavin & Doherty Geosolutions (GDG). GDG is a specialist engineering consultancy with an expertise in geoscience, environmental services and geotechnical engineering.

The company was founded in 2011 and is committed to supporting projects which contribute to the global sustainability agenda, such as enhancing infrastructure, supporting onshore and offshore wind farm developments and general civil infrastructure design.

The GDG engineers are intimately familiar with similar projects to the proposed development, having worked on wind farms at Cloncreen, Mount Lucas, Yellow River, and Bruckana set in similar ground conditions.

The members of the GDG EIA team involved in this assessment include:

- Paul Quigley (Project Director). Paul is a Chartered Engineer with 28 years of experience in geotechnical engineering and UK Registered Ground Engineering (RoGEP) Adviser. He has worked on a wide variety of projects for employers, contractors and third parties gaining a range of experience including earthworks for major infrastructure schemes in Ireland and overseas, roads, tunnelling projects, flood protection schemes, retaining wall and basement projects, ground investigations and forensic reviews of failures. Paul has published numerous peer reviewed technical papers and has acted as an independent expert for a number of legal disputes centred on ground related issues. He is a reviewer for the ICE Geotechnical Engineering Journal, a member of Eurocode 7 review panel at NSAI and a former Chairman of the Geotechnical Society of Ireland.
- John O' Donovan leads the onshore renewable sector at GDG. He completed his PhD in Imperial College investigating the use of DEM to model wave propagation techniques to measure small strain soil stiffness. Following completion of the PhD John spent 2.5 years working with Buro Happold's Ground Engineering Group. He has over 12 years' experience in engineering and nine years in his current role. At GDG John manages onshore wind farm projects and solar farm projects. John specialises in dealing with difficult ground conditions and providing robust designs

for projects in peat land areas. John also works on the landfall and onshore aspects of offshore windfarms including cable routing and onshore substation foundation design.

- Stephen Curtis is a senior engineering geologist on the onshore renewable team. He has over seven years of experience in both site investigation contracting and geotechnical consultancy environments. He is Chartered with the Institute of Geologists of Ireland (IGI) and the European Association of Geographers. Stephen has worked on multiple renewable energy projects; primarily solar and wind farm projects in Ireland and the UK for over four years. He has been involved in the feasibility study, planning, design and construction stages of wind and solar farm developments, with a particular focus on geotechnical risk management, and mitigation for construction in upland peat areas and Irish glacial ground conditions.
- Andria Loppas is a Chartered Geotechnical Engineer with over ten years of experience working on a variety of infrastructure (highway and railway), utility and onshore renewables projects with a proven ability of leading geotechnical packages and performing geotechnical design. At GDG Andria leads the geotechnical design of a number of onshore renewable projects from planning to construction stage.
- Chris Engleman is a Professional Geologist (PGeo, EuroGeol) with an MGeol from the University of Leeds. He is Chartered with the Institute of Geologists Ireland (IGI), and the European Federation of Geologists. Chris has five years of industry experience within the onshore renewables sector and the field of geological mapping; predominantly working on projects for peat stability and management (including PSRAs), ground investigation, rock and soil logging, GIS mapping and geotechnical design. He has experience in peat stability analysis, geological/geomorphological mapping (with a particular focus on Quaternary geology), site investigation, project management and GIS mapping. He has worked on several EIAR projects in both Ireland and Scotland, including Peat Stability Risk Assessments, Peat and Spoil Management Plans, and Soils and Geology Chapters.
- Johan van Niekerk is a design engineer working in the GDG Onshore Renewables team. He has over five years of experience in consultancy and has worked on a variety of projects in the energy and mining industry, mostly focussed on the geotechnical design of infrastructure.
- Brian McMeekin is an environment and sustainability professional with a proven track record in the environmental and regulatory sectors and 26 years of environmental compliance experience. He is a member of the Institute of Environmental Management and Assessment a Fellow of the Institute of Chartered Waste Management and sits on the CIWM steering group.
- Alan Shepherd is a chartered scientist (Institution of Environmental Sciences / Science Council) with 30 years of experience in industry, with a broad range of project management, technical and practical experience; including pollution and contaminated land management, environmental compliance and licensing, and the management of wastes.

9.2 METHODOLOGY

The methodology used to produce this chapter included the following steps:

- A review of relevant legislation and guidance;
- A review of project scoping documents and consultation responses from relevant parties;
- A desk study of existing information available for the site information and mapping available publicly (Refer to Section 9.2.3);
- Undertaking a site walkover;

- Undertaking the preliminary intrusive ground investigation and reviewing of the factual report;
- An assessment of the significance of potential effects;
- An identification of measures to avoid and mitigate likely significant negative effects; and
- An evaluation of residual effects.

9.2.1 Relevant Legislation and Guidance

This chapter has been prepared having regard to the following guidelines and policy documents:

- Groundwater Directives (80/68/EEC) and (2006/118/EC);
- EU Water Framework Directive (2000/60/EC);
- Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements (Institute of Geologists of Ireland (IGI), 2013);
- Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (EPA, 2022);
- Department of Housing, Planning and Local Government Wind Energy Development Guidelines (2006);
- Draft Revised Wind Energy Development Guidelines (Department of Housing, Planning and Local Government, 2019);
- British Standard Code of Practice for Ground Investigations, BS 5930:2015+A1:2020 Guidance on the Authorisation of Discharges to Groundwater. Environmental Protection Agency, 2011;
- Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (National Roads Authority (NRA), 2008);
- European Communities 2021. Assessment of plans and projects in relation to Natura 2000 sites – Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC; and
- Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments - Second Edition (Scottish Government, 2017).

9.2.2 Consultation

As part of the study, consultation specific to the topic was undertaken with the following parties:

- Bord na Móna for details of existing ground investigation data;
- Geological Survey Ireland (GSI) for details on background mapping, historic ground investigations (for mining exploration) and geological heritage;
- Environmental Protection Agency (EPA) for details on emission points and landfills, and,
- Irish Peatland Conservation Council (IPCC) for details on the Peatlands and Climate Change Action Plan 2030.

As part of the scoping process, scoping requests have been issued to key stakeholders, comprising several public bodies and private organisations. None of the responses received to date are pertinent to this chapter. Refer to Section 1.13 of Chapter 1 (Introduction) for a full list of the consultees.

9.2.3 Desk Study

A desk study was undertaken to collate and review background information in advance of the site survey. The desk study was carried out in September 2023. A subsequent review of these data sources in November 2024 confirmed that there were no significant changes since the original study. It involved consideration of with the following data sources:

- GSI mapping datasets pertaining to geological and extractive industry data and the GSI borehole database, including published geological, soil, groundwater, surface water, aquifer, recharge data (www.gsi.ie);
- Irish Geological heritage site map from the GSI;
- EPA database including soil and subsoils;
- Corine (2018) Land cover mapping;
- Waste and IPPC licensed facility data from EPA Geoportal;
- A review of Local Authority facilities and waste records;
- Peat mapping provided by Bord na Móna;
- National Parks and Wildlife Service (NPWS) nature conservation designations;
- LiDAR Topographic Mapping to a 0.5m pixel size (provided by Bord na Móna, from Bluesky, 2020 data);
- Preparation of site maps and suitable field sheets for the site survey;
- Aerial Photography from ESRI (ArcGIS), Google Earth, Bing Maps, and Ordnance Survey Ireland (OSI, 1995-2013); and,
- OSI 6-inch and 25-inch historic base mapping.

As outlined in the *Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters* of *Environmental Impact Statements* (IGI, 2013); the desk study datasets have been examined in both a local and regional scale. Guidelines state that geological and hydrogeological conditions that exist within a minimum of 2 km of the site boundary be examined. Given the complexity of the geological environment and the potential zone of influence of the proposed development the desk study area for the proposed development has been carried out at the following scales:

- **Local scale:** examines the area within the proposed wind farm site boundary and conditions of approximately 1 km from the site boundary. Local scale figures are presented at a scale of 1:25,000;
- **Regional scal**e: examines the regional scale of the proposed development to examine it's greater geological and hydrogeological setting. The regional desk study examines an area of approximately 6 km from the proposed wind farm site boundary and is presented in figures at a scale of 1:100,000.

Following the desktop study and the site survey, site specific geological maps were generated in GIS and are included in this chapter. The various ground investigations conducted in the proposed development area are outlined in Section 9.3.16 and included in full in Appendix 9.1.

9.2.4 Field Work

Site surveys relating to the soil and geological environment and ground investigations were undertaken in several phases between October 2016 to November 2023. These included:

- GDG - 28th of October 2016 to 11th of January 2017. Site walkover to review the ground conditions and assess the topography, geomorphology and requirements for further investigations and 25 no. Trial Pits presented in Appendix 9.1.1;
- Tobin - April 2017 – 8 no. Trial Pits at potential substation locations presented in Appendix 9.1.2;
- Tobin – December 2017- 35 no. trial pits at proposed borrow pits presented in Appendix 9.1.3;

- Tobin – March-April 2018- 49 no. trial pits at proposed turbine locations, along access roads/tracks and at potential borrow pits presented in Appendix 9.1.4;
- Hand shear vane tests on the material encountered in the trial pits, March 2017 – April 2018 presented in Appendix 9.1.3 and Appendix 9.1.4;
- Irish Drilling Ltd. - June 2017- 5no. Rotary core drillings to assess interconnectivity of the proposed development site with nearby turloughs; (this information informed the subsequent and separate borrow pit assessment) presented in Appendix 9.1.5;
- Irish Drilling Ltd. - April 2017 - 70no. peat probes at proposed turbine locations, along access roads/tracks and at potential borrow pits presented in Appendix 9.1.6;
- Tobin – March 2018- 131 no. peat probes at proposed turbine locations, along access roads/tracks presented in Appendix 9.1.7;
- Lab testing from 2017 GDG trial pits, presented in Appendix 9.1.8.
- Irish Drilling Ltd.- February-May 2021, presented in Appendix 9.1.9. An extensive ground investigation campaign carried out across the site. These ground investigation locations related to the previously approved proposed development layout as described in Section 2.3.1.1 of Chapter 2 (Background to the Proposed Development) of this EIAR. The ground investigation campaign was composed of the following:

  - 94 no. Cable percussion boreholes,
  - 90 no. Rotary boreholes for recovery of overburden and bedrock cores,
  - 336 no. Trial pits,
  - 343 no. Dynamic probes,
  - Geophysical investigation carried out by Minerex Ltd. composed of the following:
    - Electronic Resistivity Tomography (ERT),
    - Seismic refraction,
    - Multi-channel Analysis of Surface Waves (MASW),
    - Wenner Array.
  - A range of insitu tests were carried out including Standard Penetration Testing (SPT) and variable head testing,
  - Geotechnical and geochemical laboratory testing.

- Irish Drilling Ltd. – January-February 2023, resened in Appendix 9.1.10. An extensive ground investigation campaign carried out across the site. These ground investigation locations related to the revised turbine and substation layout of the proposed development as part of this planning application and EIAR. The ground investigation campaign was composed of the following:
  - 3no. Rotary core drillings,
  - 34no. trial pits.
  - Logging of the soil layers and sampling of each stratum encountered; and
- GDG - November 2023- 97no. peat probes and site inspections at the updated proposed infrastructure locations presented in Appendix 9.1.11

9.2.5 Evaluation of Potential Effects

During each phase (construction, operation and decommissioning) of the proposed development, a number of activities will take place on site which will have the potential to cause impacts on the geological regime at the proposed wind farm site and the associated soils, geology and hydrogeology.

The methods used for assessment of effects is based on a combination of the Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements (IGI, 2013), Guidelines on the Information to be Contained in Environmental Impact Assessment Reports published by the EPA (2022), and the Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes published by the National Road Authority in 2008.

The baseline environment is assessed by characterising the site topographical, geological and geomorphologic regimes from the data acquired. Following on from the identification of the baseline environment, the available data is utilised to identify and categorise potential effects on the soils and geological environment as a result of the proposed development. These assessments are undertaken by:

- Undertaking preliminary materials calculations in terms of volumetric soil and subsoil excavation and reuse associated with proposed development design;
- Assessing ground stability risks, in particular to peat stability;
- Assessing the combined data acquired and evaluating any likely effects on the soils, geology and ground stability; and
- Identifying effects and considering measures that would mitigate or reduce the identified effect.

The importance or sensitivity of soil, geological or hydrogeological receptors in the proposed development area will be determined using the criteria set out in Table 9-1. The quality descriptors for possible effects are outlined in

Table 9-2. The probability descriptors for possible effects are outlined in Table 9-3. The duration descriptors for possible effects are outlined in Table 9-4.

The magnitude of the potential effect will be as described as per Table 9-5, which when combined with the sensitivity of the receptor will allow an assessment of the significance of the effect following the matrix presented in Figure 9-1: Criteria for Determining Significance (taken from EPA, 2022).

The potential impacts of the proposed development are discussed in Section 9.4. Mitigation measures, where required, are presented in Section 9.5, whilst Residual Impacts are considered in Section 9.6.

Table 9-1: Sensitivity Criteria (following EPA, 2022)

Importance (Sensitivity)	Definition and Examples
High Receptors with a high quality and/ or rarity, regional or national scale	**Geology:** Geological resources (e.g. mineral reserves) within the study area are of very high value and importance (e.g. very rare or valuable minerals).
	Soils: Soils are very high and value and importance, e.g. peat, very highly productive agricultural soils, superficial soils of very high value or geological importance.

Importance (Sensitivity)	Definition and Examples
and limited potential for substitution/ replacement	**Hydrogeology:** Hydrogeological catchment area is of very high regional or national scale value and importance i.e., provides river baseflow and is used and limited potential for extensively for private and public water supplies, e.g. groundwater substitution/replacement abstractions for public or private drinking within 0-250 m of the proposed wind farm site (greater than 1 m depth excavations) or within 0-100 m (excavations less than 1 m depth), groundwater typically also has a vulnerability classification of Extreme.
Medium Receptors with a medium quality and/ or rarity, local scale and limited potential for substitution/ replacement or receptor with a low quality and rarity, regional or national scale and limited potential for substitution/ replacement.	**Geology:** Drift and solid geology underlying the proposed wind farm site is within a designated area and is of rare or of national importance. Geological resources (e.g. mineral reserves) within the study area are of high value and importance.
	Soils: Soils are of high value and importance, e.g. carbon rich soils, highly productive agricultural soils.
	Hydrogeology: Hydrogeological catchment area is of high value and importance i.e. provides baseflow to rivers, supports highly sensitive GWDTEs or used for local private water supplies, e.g. groundwater abstractions for private supply within 250 m of the proposed wind farm site (greater than 1 m depth excavations) or 0 - 100 m (excavations less than 1 m depth). Groundwater typically also has a vulnerability classification of High.
Low Receptors with a low quality and/ or rarity, local scale and limited potential for substitution/ replacement or receptor with a negligible quality and rarity, regional or national scale and limited potential for substitution/ replacement	**Geology:** Drift and solid geology underlying the study area is not within a designated area and deposits are of medium value and importance. Geological resources (e.g. mineral reserves) within the study area are of medium value and importance.
	Soils: Soils are of medium value, e.g. productive agricultural soils.
	Hydrogeology: Hydrogeological catchment area is of medium value and importance and is not generally used for public or private water supplies. Groundwater supports medium sensitivity GWDTE's. Groundwater typically also has a vulnerability classification of Moderate.
Negligible Receptors with a negligible quality and/ or rarity, local scale and potential for substitution/ replacement. Environmental equilibrium is stable and is resilient to changes that are greater than natural fluctuations, without detriment to its present character	**Geology:** Drift and solid geology underlying the proposed wind farm site is not within a designated area, and deposits are of low value and importance. Geological resources (e.g. mineral reserves) on the proposed wind farm site are of low value and importance.
	Soils: Soils are of low value and importance, e.g. general superficial soils of low value or geological importance.
	Hydrogeology: Hydrogeological catchment area is of low value and importance and is not used for public or private water supplies. Groundwater typically also has a vulnerability classification of Low.

Table 9-2: Criteria for Rating Quality of Effect (following EPA, 2022)

Quality of Effects	Criteria
Positive Effects	A change which improves the quality of the environment (for example, by increasing species diversity, or improving the reproductive capacity of an ecosystem, or by removing nuisances or improving amenities).
Neutral Effects	No effects or effects that are imperceptible, within normal bounds of variation or within the margin of forecasting error.
Negative Effects	A change which reduces the quality of the environment (for example, lessening species diversity or diminishing the reproductive capacity of an ecosystem, or damaging health or property or by causing nuisance).

Table 9-3: Criteria for Rating Probability of Effect (following EPA, 2022)

Quality of Effects	Criteria
Likely Effects	The effects that can reasonably be expected to occur because of the proposed development if all mitigation measures are properly implemented.
Unlikely Effects	The effects that can reasonably be expected not to occur because of the proposed development if all mitigation measures are properly implemented.

Table 9-4: Criteria for Rating Duration of Effect (following EPA, 2022)

Duration of Effects	Criteria
Temporary Effects	Effects lasting less than a year.
Short-term Effects	Effects lasting one to seven years.
Medium-term Effects	Effects lasting seven to fifteen years.
Long-term Effects	Effects lasting fifteen to sixty years.
Permanent Effects	Effects lasting over sixty years.
Reversible Effects	Effects that can be undone, for example through remediation or restoration.

Table 9-5: Criteria for Rating Magnitude of Effect (following EPA, 2022)

Quality of Effects	Magnitude of Effects	Criteria
Negative only	Profound	Results in loss of attribute, i.e. long term, or permanent change to receptors resulting from activities associated with the proposed development, e.g., major changes to the hydrogeological regime or complete loss of soils/carbon resource. Mitigation measures are unlikely to remove such impacts.
Positive or Negative	Significant	Impacts integrity of attribute or results in loss of part of attribute, i.e. medium-term change to receptors resulting from activities associated with the proposed development, e.g. non-significant alterations to the hydrogeological regime or substantial loss of soils/carbon resource. Mitigation measures (to design) will reduce but not completely remove the impact – residual impacts will occur.
Positive or Negative	Moderate	Results in moderate impact on attribute, i.e., detectable material but short-term changes to receptors resulting from activities associated with the proposed development, e.g. moderate loss of soils/carbon resource. Mitigation measures can mitigate the impact OR residual impacts occur, but these are consistent with existing or emerging trends
Positive, Negative or Neutral	Slight	Results in noticeable but temporary changes in the character of the environment but without significant consequences to receptors resulting from activities associated with the proposed development, e.g. minor loss of soils/carbon resource. Mitigation measures not required.
Positive, Negative or Neutral	Not Significant	Results in minor impact on attribute, i.e., detectable but non-material and brief changes to receptors resulting from activities associated with the proposed development, e.g. minor loss of soils/carbon resource. Mitigation measures not required.
Neutral	Imperceptible	Results in an impact on attribute but of insufficient magnitude to affect the use/integrity i.e. negligible changes to receptors resulting from activities associated with the proposed development. Typically impacts are beneath levels of perception. No mitigation measures required.

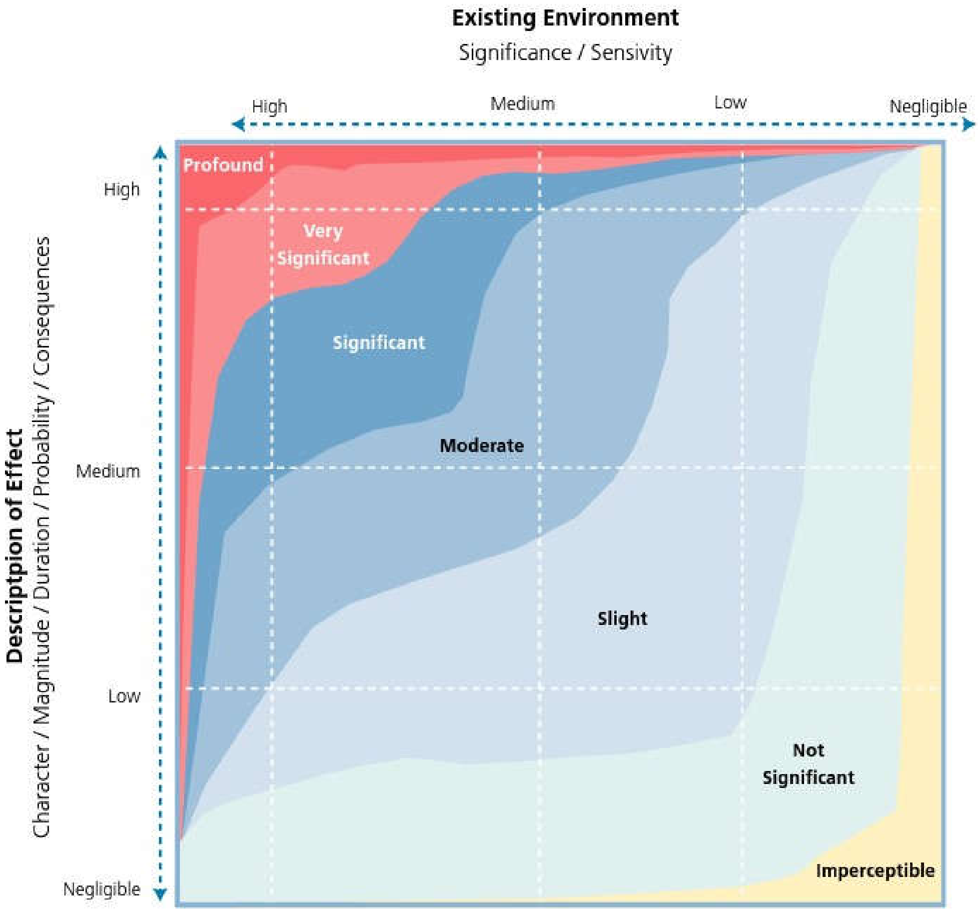


Figure 9-1: Criteria for Determining Significance (taken from EPA, 2022)

9.3 EXISTING ENVIRONMENT (BASELINE DESCRIPTION)

The existing environment is discussed in terms of geomorphology (landscape and topography), superficial and solid geology, and peat stability. The regional review of geological and hydrogeological conditions covers a zone of 2 km from the proposed development area, as suggested in the IGI guidelines. The proposed wind farm site is not a sensitive site in terms of the soils and geological environment, and the following Sections outline this.

9.3.1 Proposed Development

The proposed wind farm site is located on three bogs within the Mountdillon Bog Group; Derryaroge, Derryadd, and Lough Bannow cutaway bogs. These are located in south County Longford as shown in Figure 9-2 to Figure 9-4. There are works as part of the proposed development which will take place outside of the wind farm site along the turbine delivery route (TDR).

The proposed wind farm site has a total area of approximately 1,900 hectares and is located in an area surrounded by the towns and villages of Lanesborough, Derraghan, Keenagh, and Killashee. The surrounding landscape is a mixture of forestry, agricultural land and cutaway peatland, and is predominately flat.

Derryaroge Bog is approximately 1.20km south of the River Shannon which runs in a northwest direction to the proposed wind farm site. Lough Bannow Bog is approximately 0.5 km to the west of the Royal Canal which runs in a northwest to east direction.

The proposed development is described in Chapter 3 (Description of the Proposed Development) of this EIAR. The location and layout are shown in Figure 9-2 to Figure 9-4.

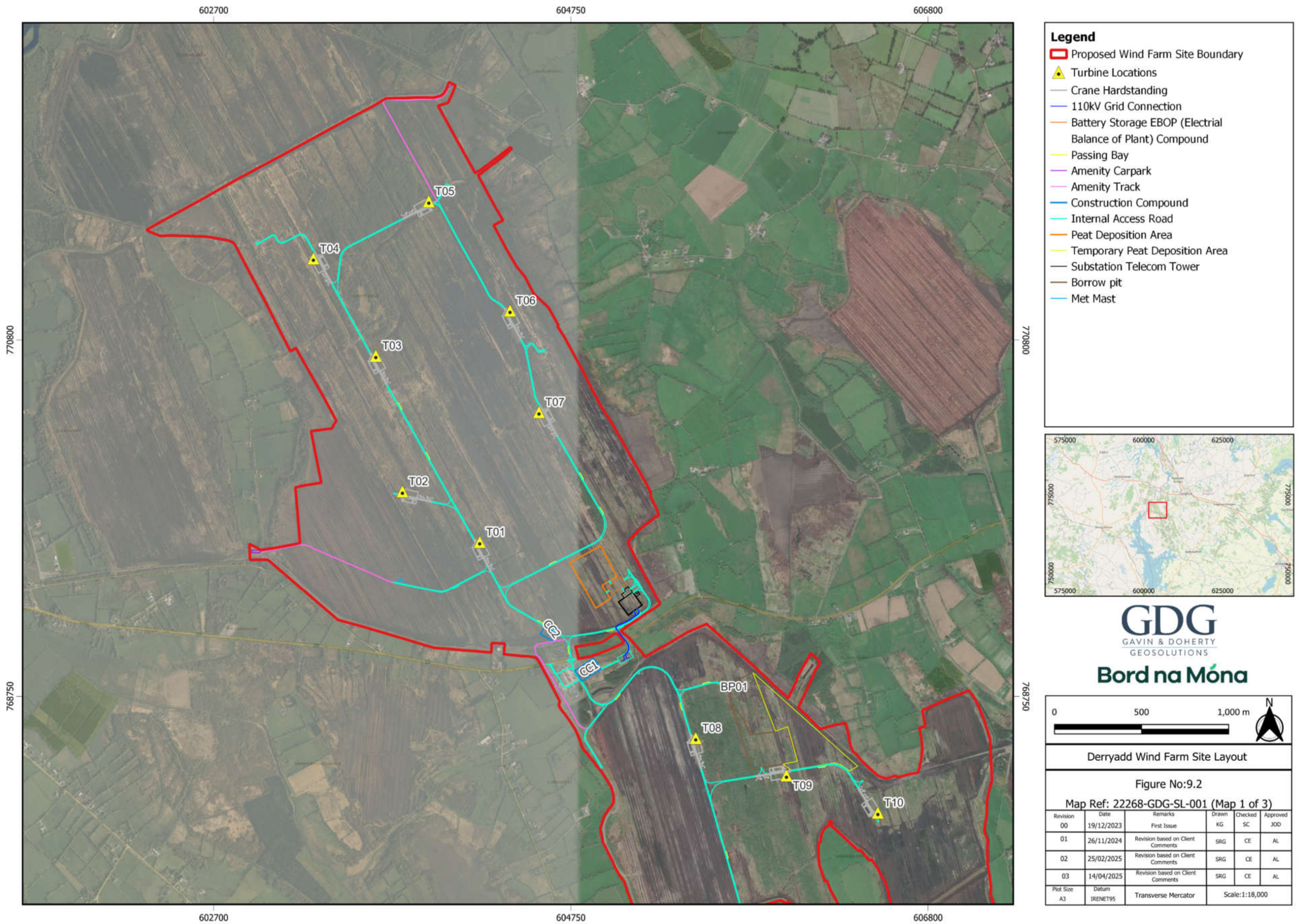


Figure 9-2: Derryadd Wind farm site layout (Map 1 of 3)

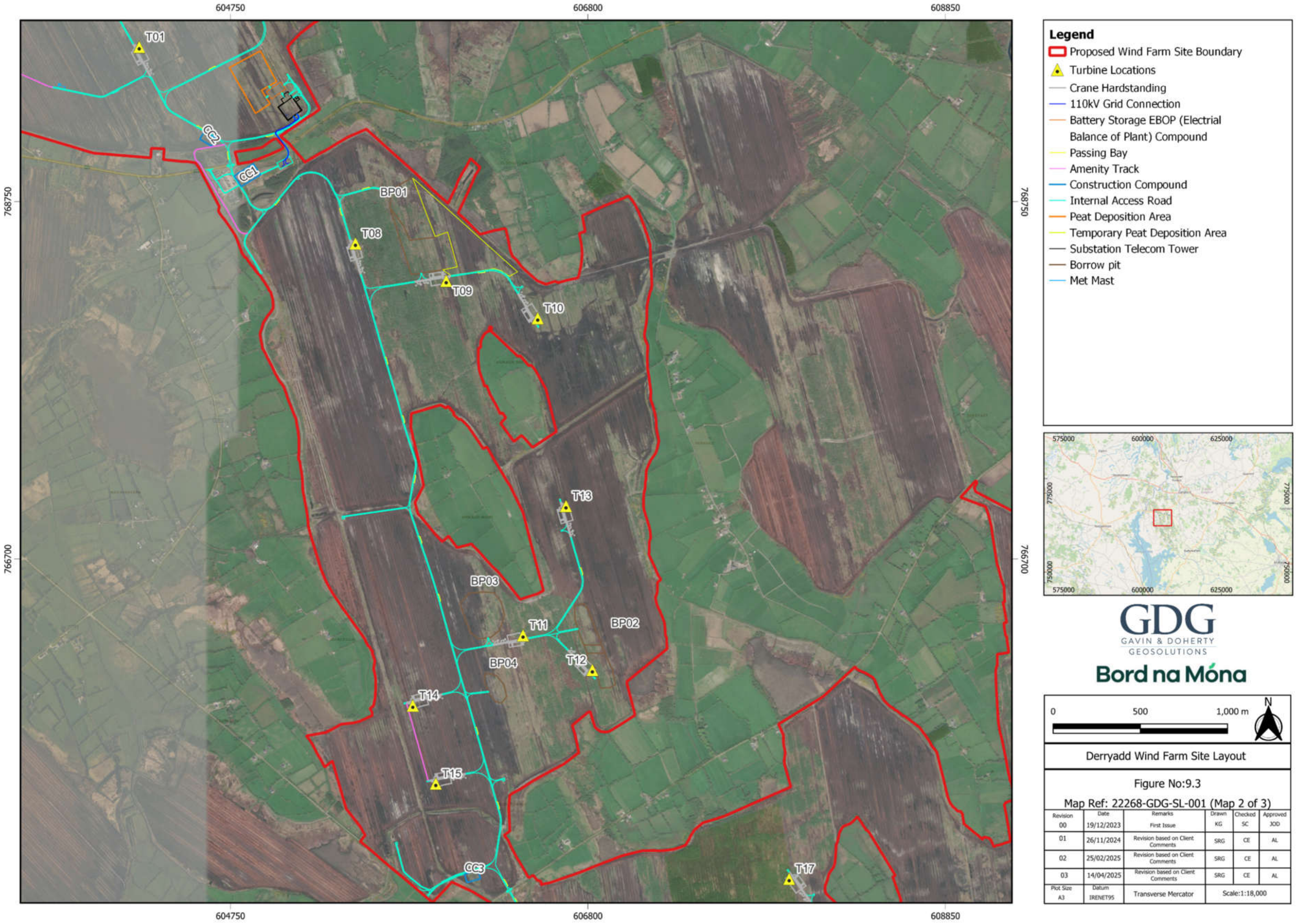


Figure 9-3: Derryadd Wind farm site layout (Map 2 of 3)

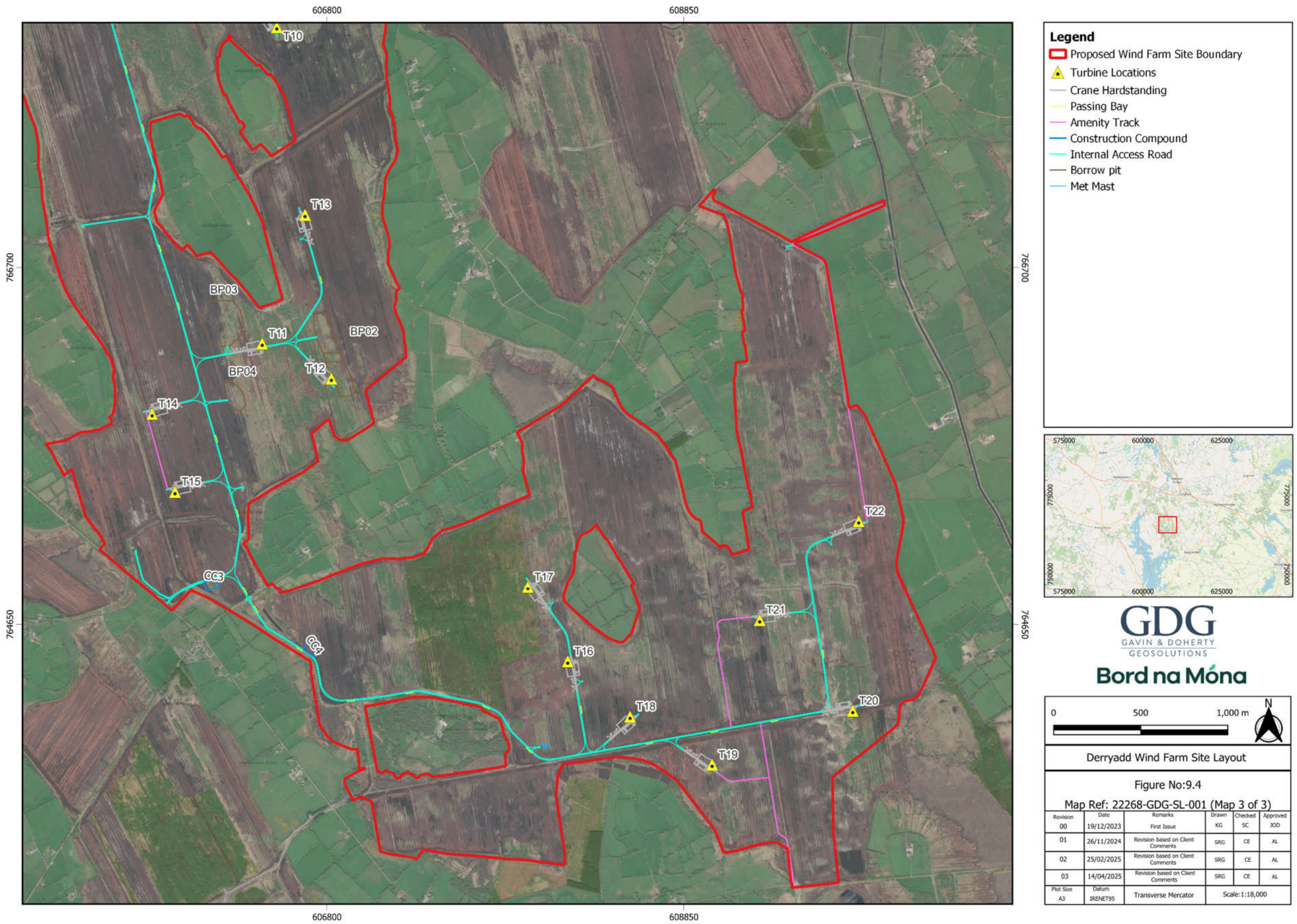


Figure 9-4: Derryadd Wind farm site layout (Map 3 of 3)

9.3.2 Land Use

9.3.2.1 Historic Land Use

Ordnance Survey Ireland (OSI) historic 6-inch and 25-inch mapping (Table 9-6 a and b) illustrates that in the late 19th and early 20th Century, the proposed wind farm site consisted of largely unaltered raised peat bog, with small islands of agricultural land and fields located on slightly raised ridges within the bog. These areas of agricultural land fall within small islands that are excluded from the proposed development boundary. The OSI aerial imagery (1995-2013- Table 9-6 c-f) show the widespread industrial peat extraction across the site, with deep drains and machine cutting in evidence. Google Earth (2018, Table 9-6 g) and Bing (2025 Table 9-6, h) aerial imagery shows that peat cutting has ceased across the proposed wind farm site, with re-vegetation starting to form across the areas of former peat extraction (Refer to Chapter 7 (Biodiversity – Flora and Fauna) for more detail).

The three bogs historically supplied fuel peat to the Lough Ree ESB Power Station in Lanesborough. Derryaroge Bog was in industrial peat extraction from 1952 to 2019. Much of the site was cutaway at various stages prior to 2019 with industrial peat extraction reducing on a phased basis. Industrial peat production commenced at Derryadd Bog in the 1960s and ceased in 2019 and industrial peat production commenced at Lough Bannow in the 1960s and ceased in 2019.

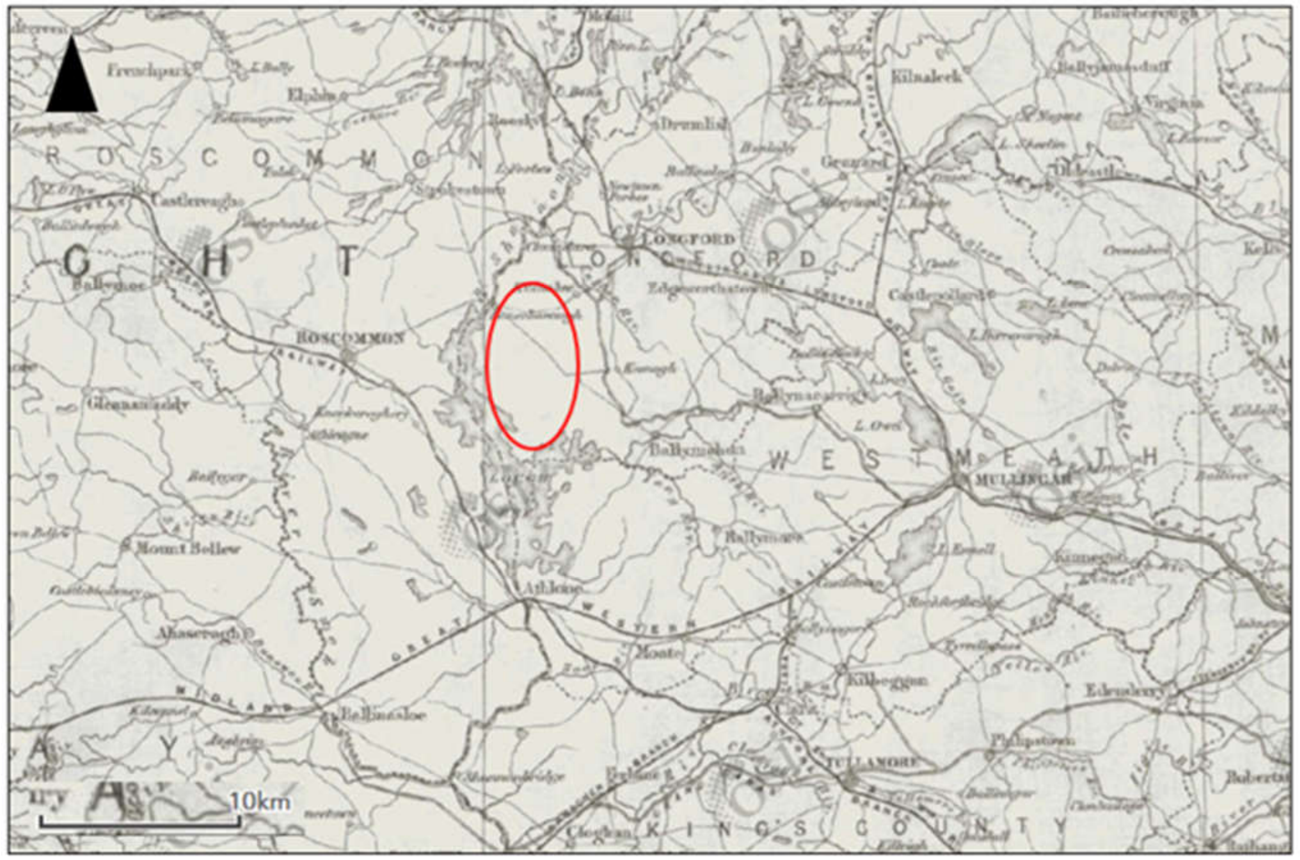
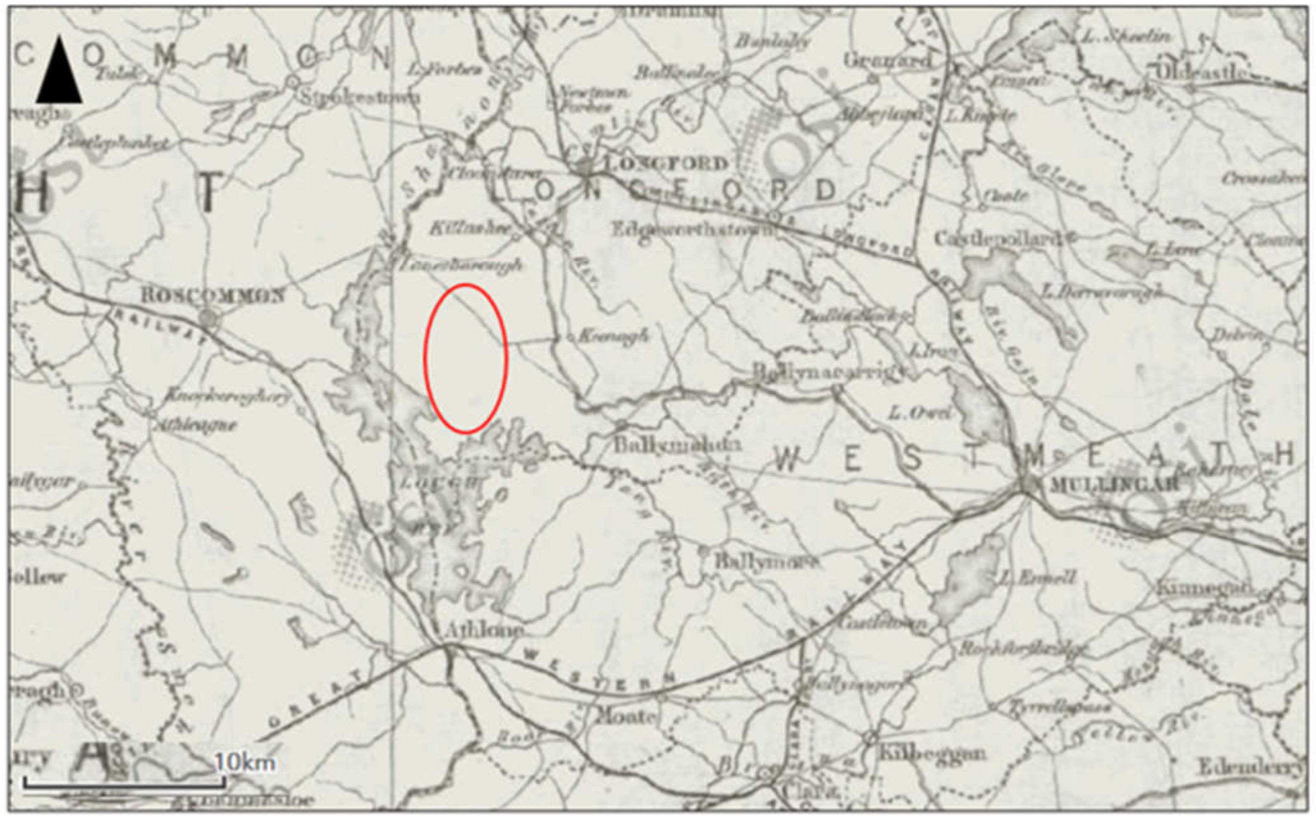
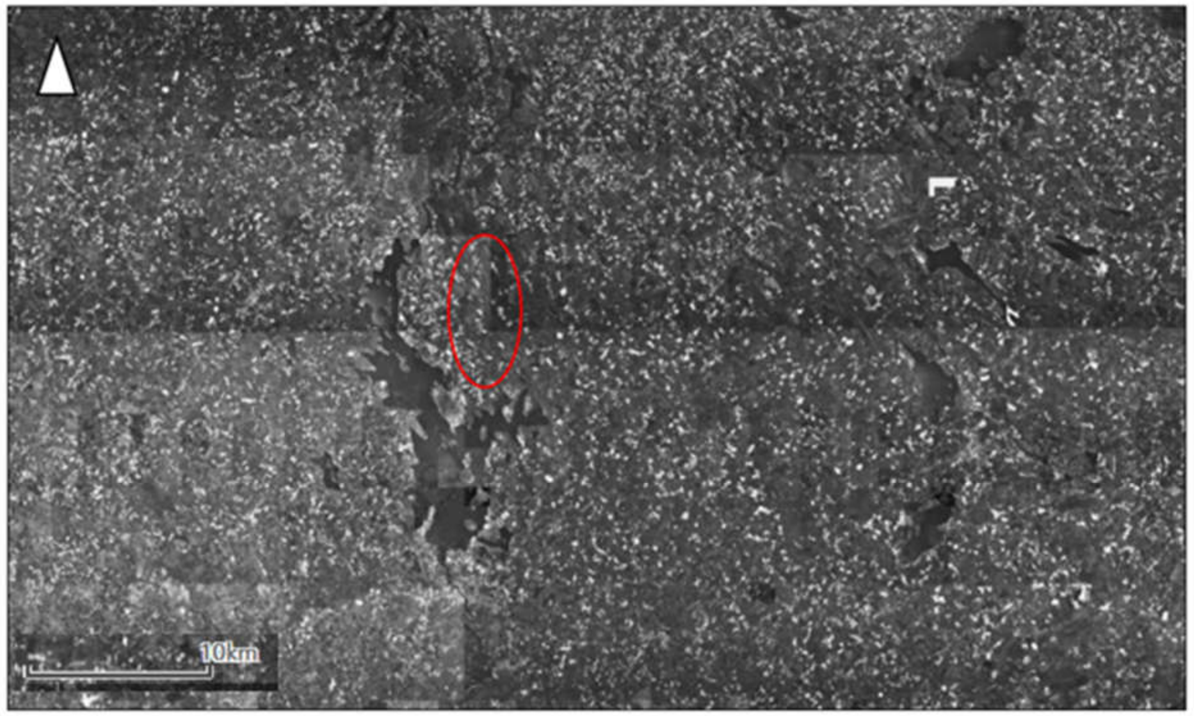
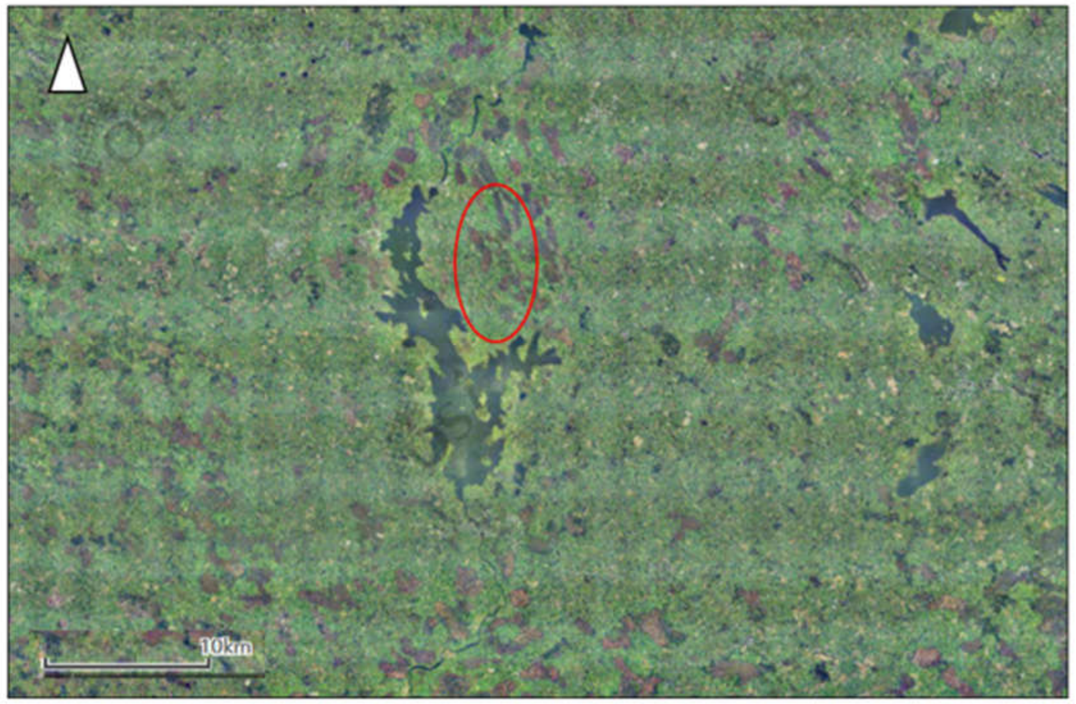
The main historic land use changes at the proposed site have been associated with the peat production operations, with the main changes linked to the initial drainage of the bog and the removal of vegetation in advance of peat extraction. Drainage and peat production was initiated at different times across the three bogs.

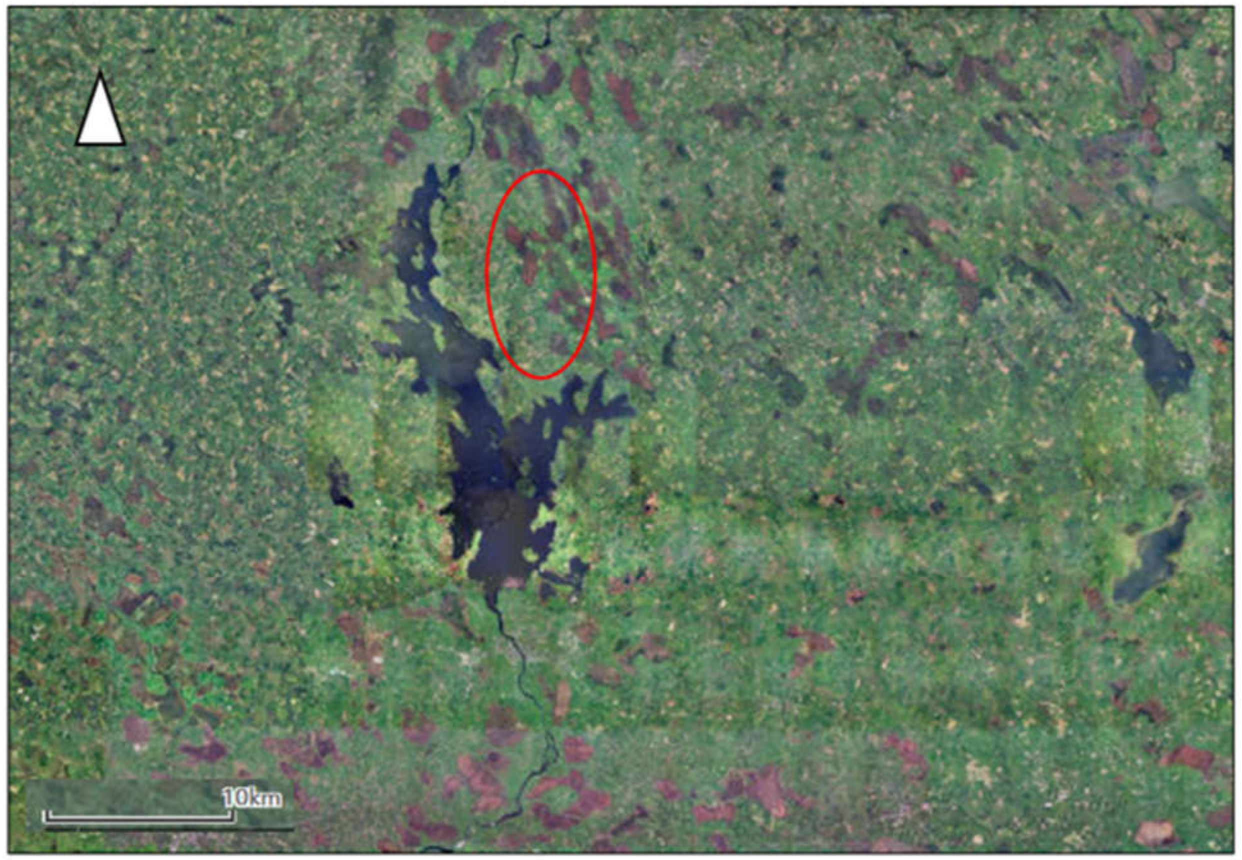
9.3.2.2 Current Land Use

The site currently operates in compliance with its IPC licence requirements (ref. no P0504-01). This involves the continuation of ongoing decommissioning activities associated with the removal of rail infrastructure, structures and materials from the site. Following the successful decommissioning of the site it is intended that the site would be rehabilitated in line with condition 10 of the IPC licence.

Land cover mapping by Corine (2018, Figure 9-5) indicates that almost the entirety of the proposed wind farm site is covered by peat bog, with small patches of transitional woodland-scrub mapped directly to the east and south of T08, and to the west and southwest of T17. Much of the land directly adjacent to the proposed wind farm boundary is recorded as pastureland, with small patches of coniferous and broad-leaved forest mapped close to the southern boundary. Overall, the proposed wind farm site varies greatly from areas that are re-vegetating rapidly since they came out of industrial peat production to bare peat areas that were still in peat production until 2019. The majority of the site is now developing pioneer cutaway habitats.. The drier sections of the site have developed areas of Birch dominated scrub (Refer to Chapter 7 (Biodiversity – Flora and Fauna) for more detail).

Table 9-6:Historic Maps

 a) OSI Map Genie 6 Inch	 b) OSI Map Genie 25 Inch
 c) OSI Aerial imagery 1995.	 d) OSI Aerial imagery 2001



e) OSI Aerial imagery 2006.

f) OSI Aerial imagery 2013

g) Google Earth Aerial imagery 2018.

h) Bing Aerial imagery 2025

9.3.3 Topography

The topography of the proposed wind farm site is relatively flat with elevations generally ranging from 34mAOD to 59mAOD. The proposed wind farm site covers three different bogs, from north to south: Derryaroge, Derryadd, and Lough Bannow. Each bog consists largely of flat, cut-over/cutaway bog, with low ridges trending NNW-SSE forming the local topographic highs. Localised, man-made changes in topography in the form of areas of shallow excavation are also present due to the peat production on site. Small islands encompassing low NNW-SSE trending ridges within the Derryadd and Lough Bannow Bog extents are excluded from the proposed wind farm site.

The Derryaroge bog is largely flat lying, ranging from topographic lows of 34mOD in drains at the north of the bog, to highs of 46m OD, in a small NNW-SSE trending low ridge in the centre of the bog. The Derryadd bog is largely flat lying cutaway bog, with low points of 39m OD in drains in the north of the bog, and topographic highs of 50m OD at the edge of the low ridges which are outside of the proposed wind farm site. The Lough Bannow bog also consists largely of flat, cut-over/cutaway bog, with topographic lows of 43m OD in the NW corner of the bog, and topographic highs of 59m OD in the SE corner, close to the proposed wind farm boundary.

9.3.4 Regional Bedrock Geology

The bedrock geology on the 1:100,000 scale mapping from the GSI indicates the regional geological setting of the proposed wind farm site and the surrounding environment. The regional setting of the proposed wind farm is characterised by 13 geological formations within 6 km of the proposed wind farm site boundary. The regional bedrock geology is shown in Figure 9-6: and a description of the relevant bedrock formations is presented in Table 9-7.

Table 9-7: Bedrock Geology Stratigraphy and Description

Geological Period	Formation	Abbreviation	Description
Carboniferous	Visean Limestone (undifferentiated)	VIS	Undifferentiated limestone
Carboniferous	Dolomitised limestone (Visean Limestones)	VIS	In Visean limestone Formation
Carboniferous	Lucan Formation	LU	Dark limestone and shale, calp
Carboniferous	Argillaceous Limestones	AL	Dark limestone and shale, chert
Carboniferous	Waulsortian Limestones	WA	Massive, unbedded lime-mudstone
Carboniferous	Ballysteen Formation	BA	Dark muddy limestone, shale
Carboniferous	Moathill formation	MH	Limestone, calcareous sandstone, shale

Geological Period	Formation	Abbreviation	Description
Carboniferous	Meath Formation	ME	Limestone, calcareous sandstone
Carboniferous	Fearnaght Formation	FT	Pale conglomerate and red sandstone
Carboniferous	Basal Clastics	BC	Basal clastics
Carboniferous	Darty Limestone Formation	do	Dolomitised Limestone
Carboniferous	Mudbank Limestone	mk	Mudbank Limestone
Ordovician	Carrickateane Formation	CT	Greywacke with argillite and black shale

9.3.5 Local Bedrock Geology

At Derryaroge and Derryadd within the proposed wind farm site, the underlying bedrock is predominantly Visean Limestone (Undifferentiated). The local bedrock geology is outlined in Figure 9-7 to Figure 9-9. Lough Bannow Bog is underlain by eight formations. The formations in this area are as follows:

- Visean Limestone (Undifferentiated);
- Argillaceous Limestones;
- Ballysteen Formation;
- Meath Formation;
- Moathill Formation;
- Rinn Point Limestone Formation;
- Waulsortian Limestones; and
- Lucan Formation.

The underlying bedrock for each proposed turbine location is presented in Table 9-8. This table shows four types of bedrock formation underlying the proposed infrastructure. Faults are shown on the geological mapping in Figure 9-7 to Figure 9-9 running through Lough Bannow close to turbines T16, T17, T21 and T22, and underneath the amenity trackway south of T19. No bedrock outcrops are indicated within the proposed wind farm site boundary in the geological mapping.

Table 9-8: Underlying bedrock formation of each proposed turbine and proposed infrastructure

Infrastructure Location	Bedrock Formation	Bedrock lithology
T1 to T15	Visean Limestones (Undifferentiated)	Undifferentiated Limestone
T16 and T18 to T21 and met mast	Moathill Formation	Limestone, calcareous, sandstone and shale

Infrastructure Location	Bedrock Formation	Bedrock lithology
T17	Argillaceous Limestones (Visean)	Dark limestone, shale and chert
T22	Ballysteen Formation	Dark muddy limestone and shale
Borrow Pit Location BP01 to BP04	Visean Limestone (Undifferentiated)	Undifferentiated Limestone
Substation (including grid connection)	Visean Limestone (Undifferentiated)	Undifferentiated Limestone
Battery Storage Area	Visean Limestone (Undifferentiated)	Undifferentiated Limestone
Construction Compound no.1	Visean Limestone (Undifferentiated)	Undifferentiated Limestone
Construction Compound no.2	Visean Limestone (Undifferentiated)	Undifferentiated Limestone
Construction Compound no. 3	Argillaceous Limestones (Visean)	Dark limestone, shale and chert
Construction Compound no. 4	Ballysteen Formation	Dark muddy limestone and shale
Amenity Car Park	Visean Limestone (Undifferentiated)	Undifferentiated Limestone
Security hut no.1 and no.2	Visean Limestone (Undifferentiated)	Undifferentiated Limestone
Security hut no.3	Argillaceous Limestones (Visean)	Dark limestone, shale and chert
Security hut no.4	Ballysteen Formation	Dark muddy limestone and shale

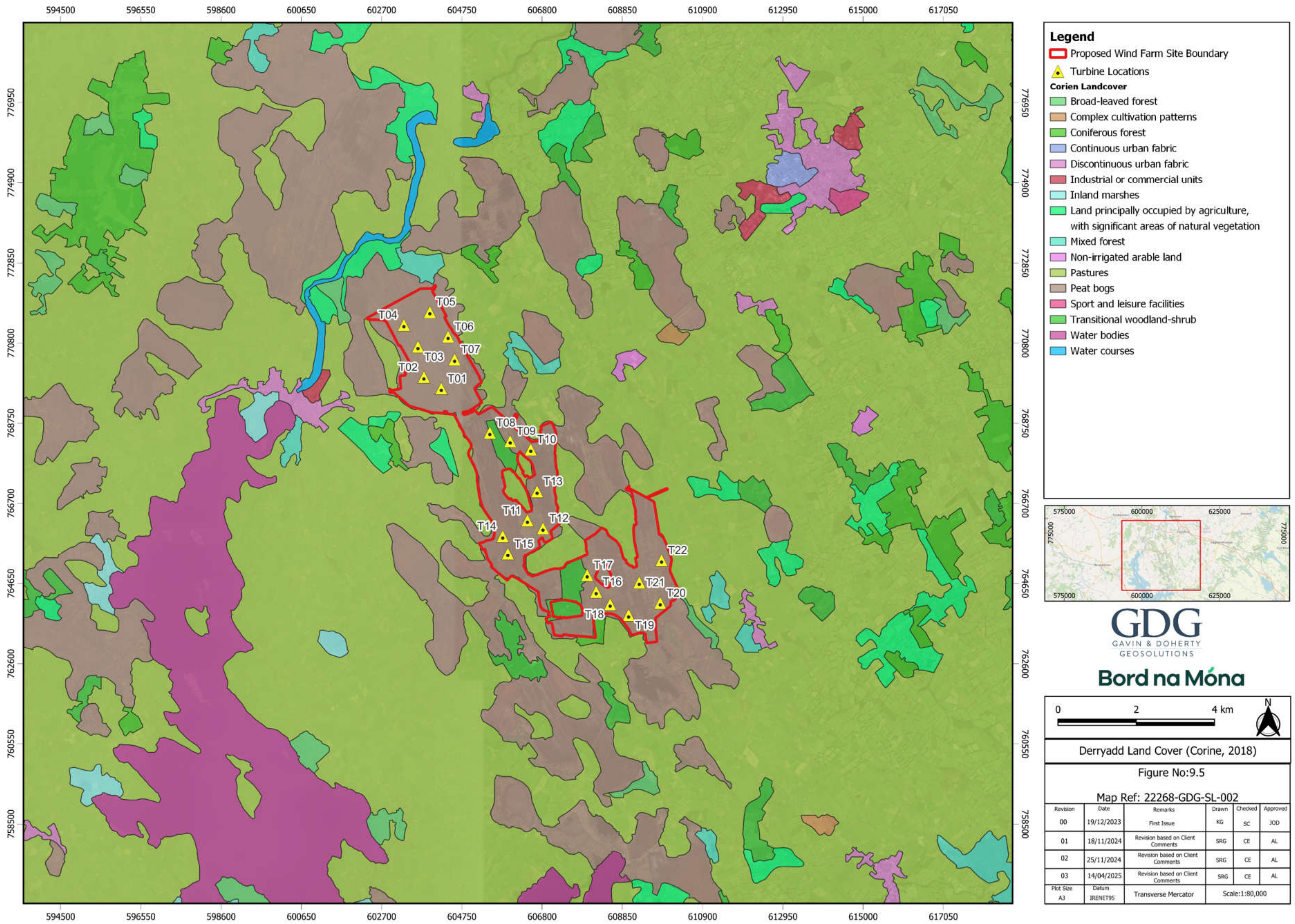


Figure 9-5: Derryadd land cover (Corine, 2018).

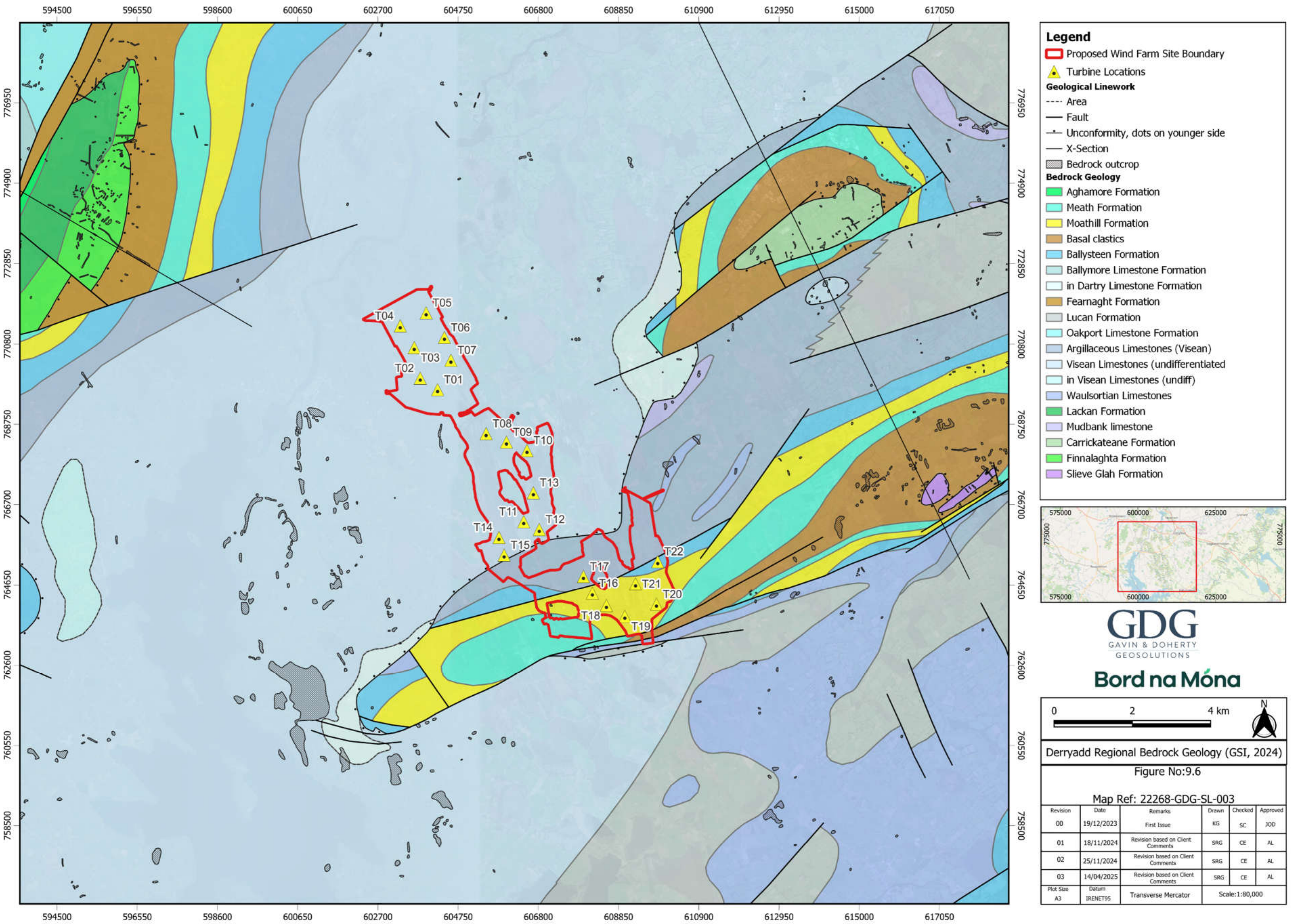


Figure 9-6: Derryadd Regional Bedrock Geology (GSI Bedrock 100k Mapping, 2024)

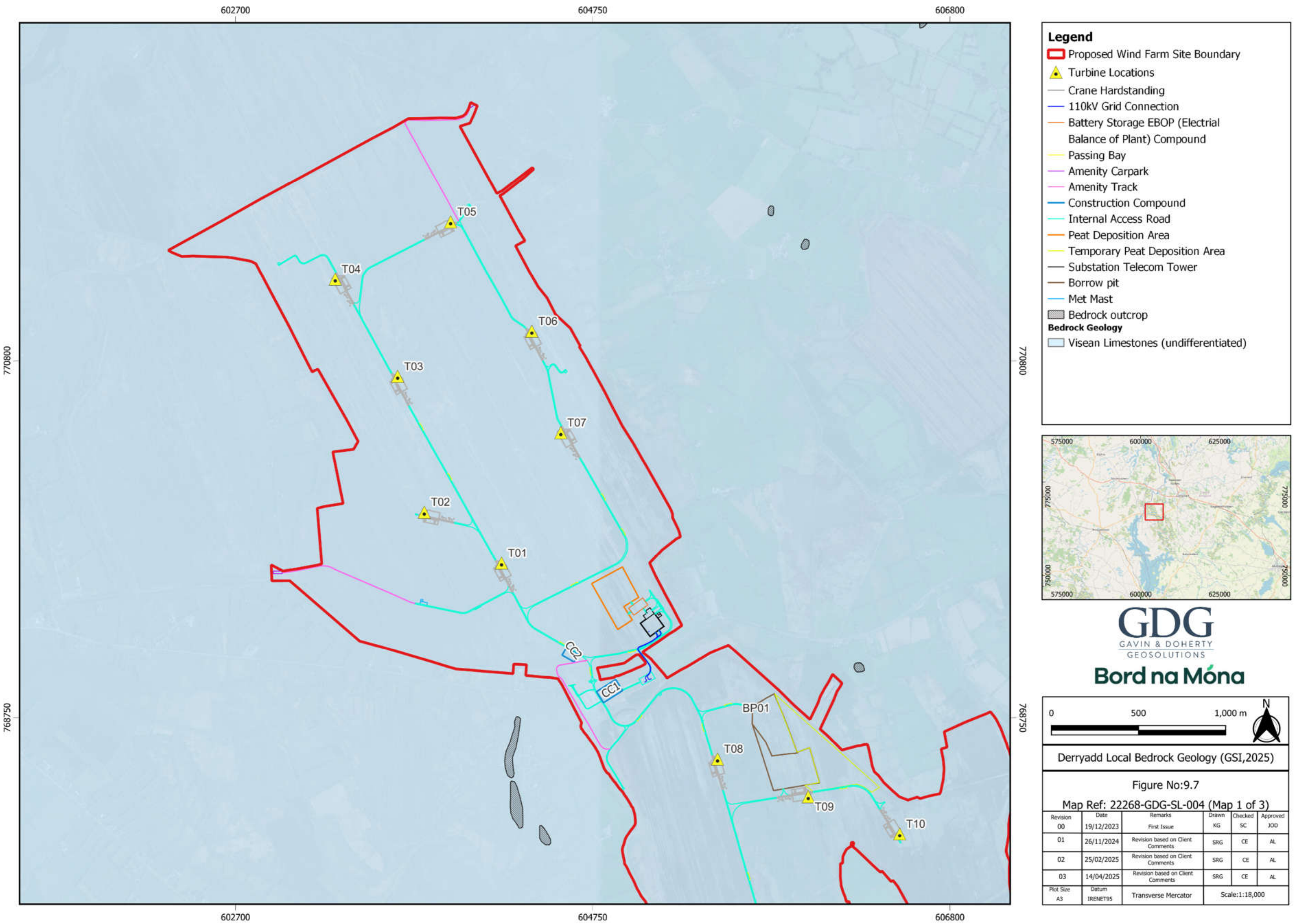


Figure 9-7: Derryadd Local Bedrock Geology (GSI Bedrock 100k Mapping, 2024) (Map 1 of 3)

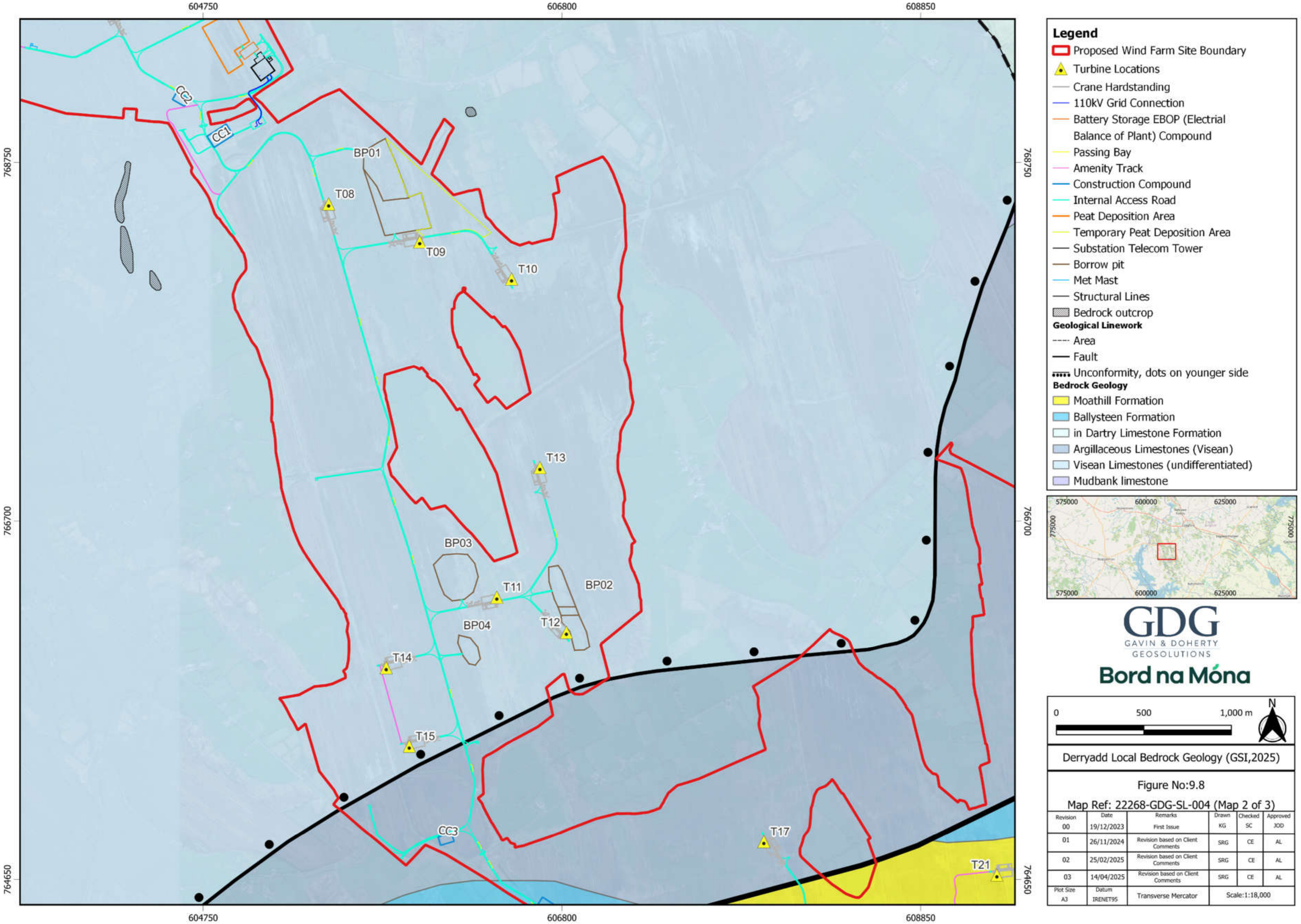
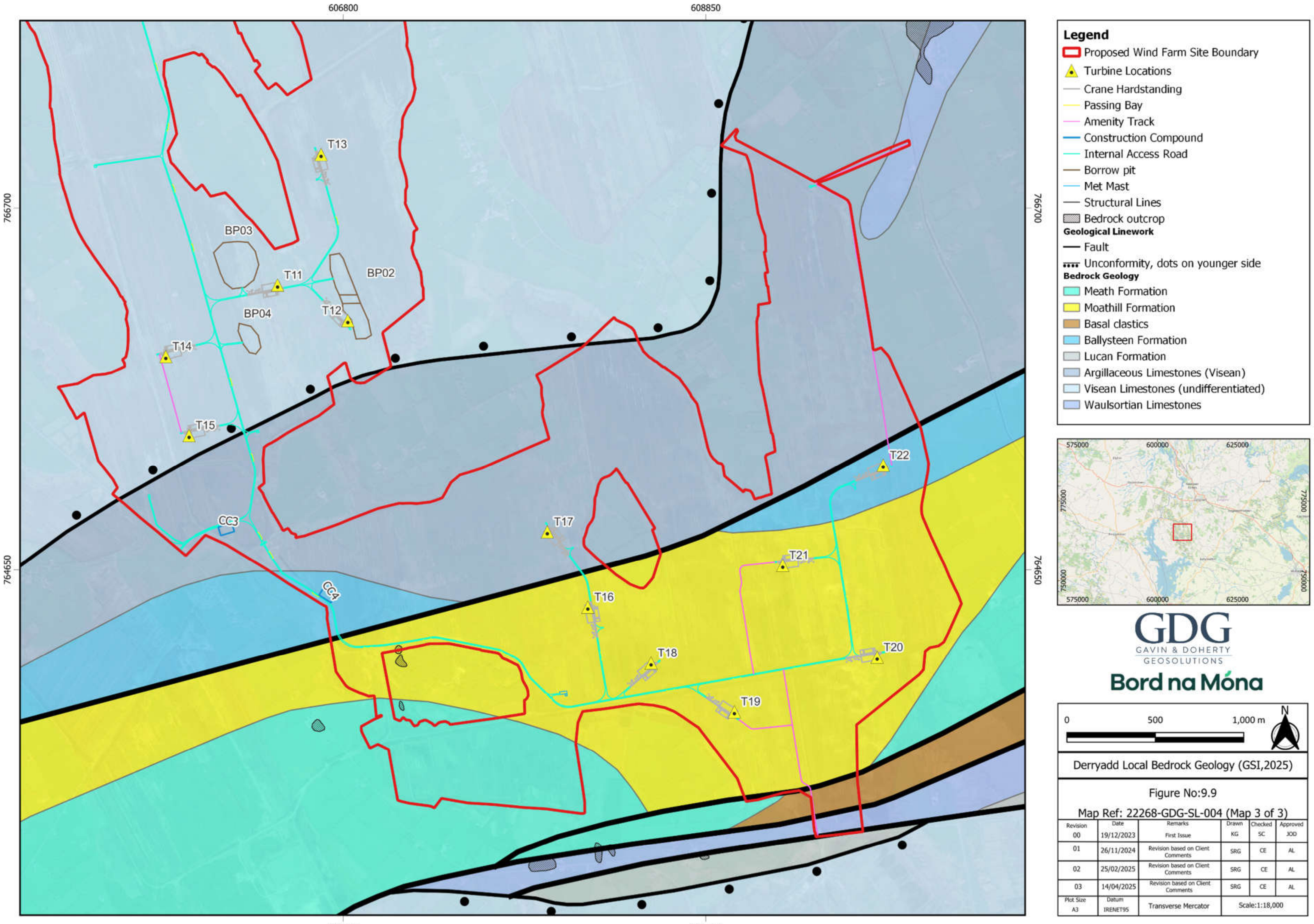


Figure 9-8: Derryadd Local Bedrock Geology (GSI Bedrock 100k Mapping, 2024) (Map 2 of 3)



Revision	Date	Remarks	Drawn	Checked	Approved
00	19/12/2023	First Issue	KG	SC	JOD
01	26/11/2024	Revision based on Client Comments	SRG	CE	AL
02	25/02/2025	Revision based on Client Comments	SRG	CE	AL
03	14/04/2025	Revision based on Client Comments	SRG	CE	AL
Plot Size A3	Datum IRENET95	Transverse Mercator	Scale:1:18,000		

Figure 9-9: Derryadd Local Bedrock Geology (GSI Bedrock 100k Mapping, 2024) (Map 3 of 3)

9.3.6 *Regional Soils*

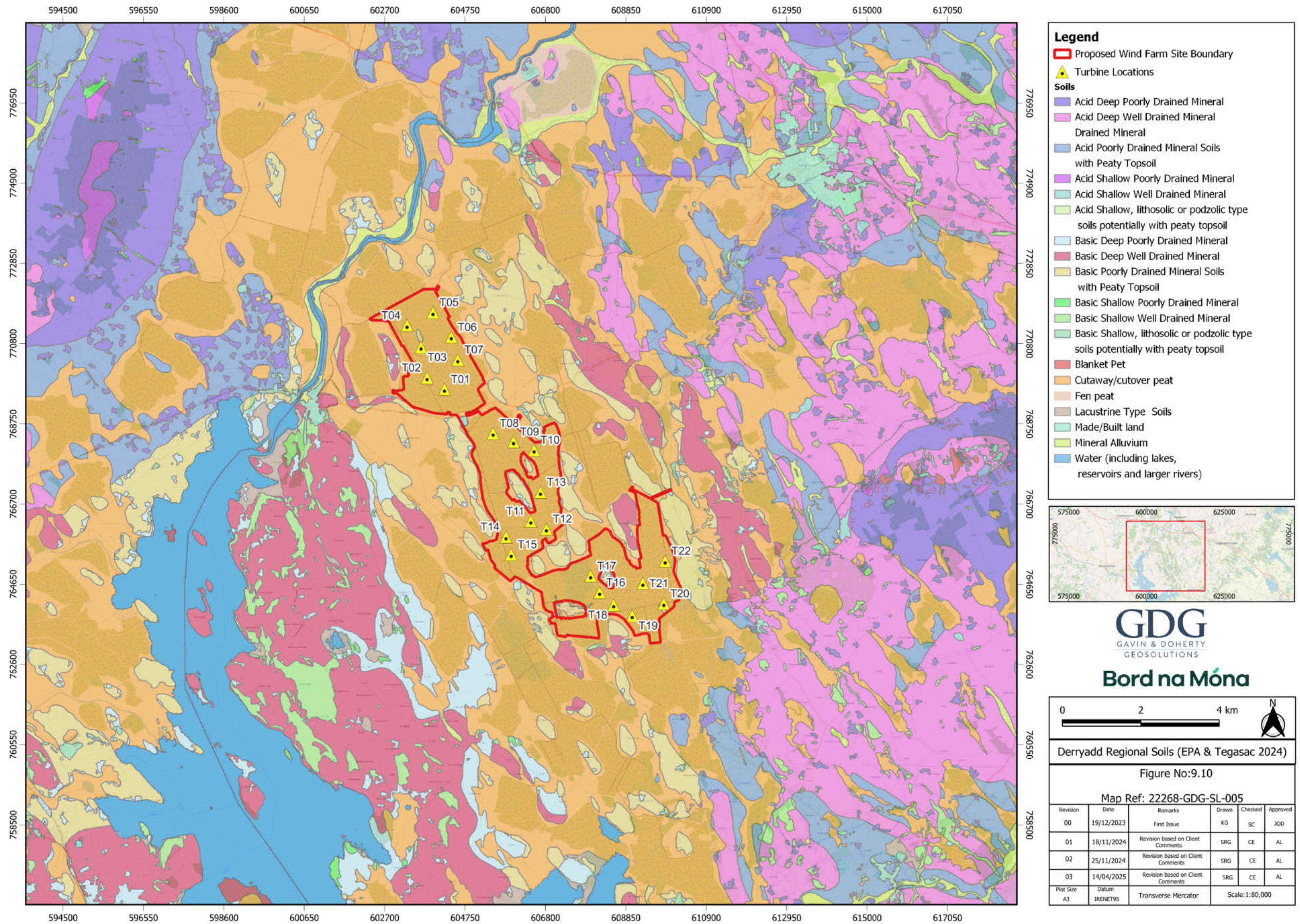
The regional soils shown in Figure 9-10 and mapped by the EPA/Teagasc (National Soils Map, 2018) indicate that this region consists of seven types of soil:

- Acid deep poorly drained mineral (AminPD);
- Acid deep well drained mineral (AminDW);
- Acid poorly drained mineral soils with peaty topsoil (AminPDPT);
- Basic shallow well drained mineral (BminSW);
- Cutaway/cutover peat (Cut);
- Made ground (Made); and,
- Mineral alluvium (AlluvMIN).

Made Ground is indicated in urban areas. Alluvium deposits and raised bog are indicated by the mapping along the watercourses.

9.3.7 *Local Soils*

The EPA/Teagasc (National Soils Map, 2018) databases indicate that the proposed wind farm is generally underlain by cutover raised peat. The peat, which is shown to form the superficial geology of all of the bogs within the proposed wind farm site, is Quaternary in age. It was formed as an extensive envelope of the landscape in the area since deglaciation approximately 7,000 – 10,000 years ago. The bogs were used for peat extractions by Bord na Móna. There is an area of made ground within the proposed wind farm site at the Mountdillon Works. There are two areas of Basic Poorly Drained Mineral Soils with Peaty Topsoil noted within the site extents: north of Turbine T03 and south of Turbine T20. Figure 9-11 to Figure 9-13 present the national soils map at the local scale.



Revision	Date	Remarks	Drawn	Checked	Approved
00	19/12/2023	First Issue	KG	SC	JOD
01	18/11/2024	Revision based on Client Comments	SRG	CE	AL
02	25/11/2024	Revision based on Client Comments	SRG	CE	AL
03	14/04/2025	Revision based on Client Comments	SRG	CE	AL
Plot Size A3	Datum IRENET95	Transverse Mercator	Scale:1:80,000		

Figure 9-10: Derryadd regional soils (EPA/Teagasc National Soils Map, 2018)

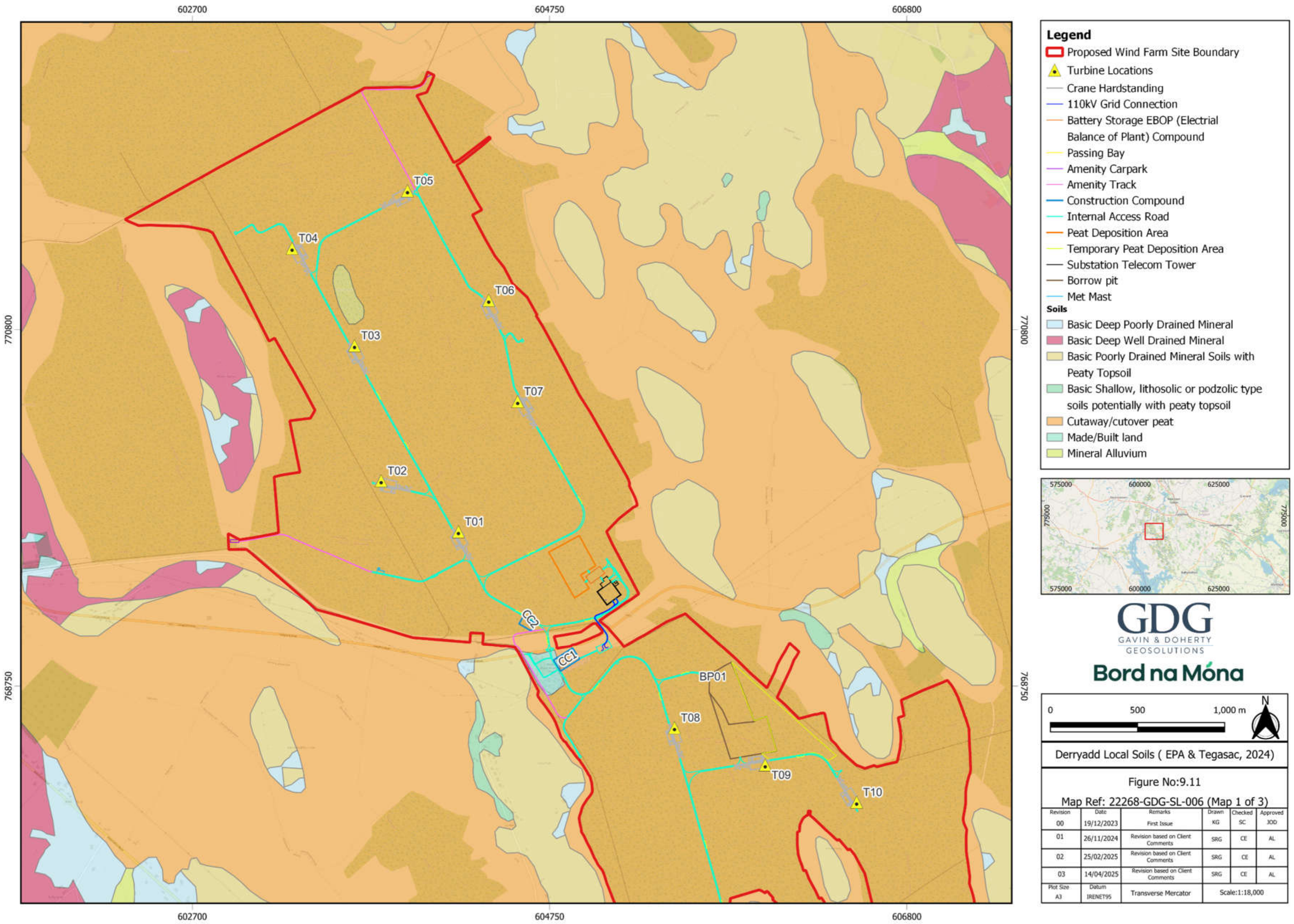


Figure 9-11: Derryadd local soils (EPA/Teagasc National Soils Map, 2024) (Map 1 of 3)

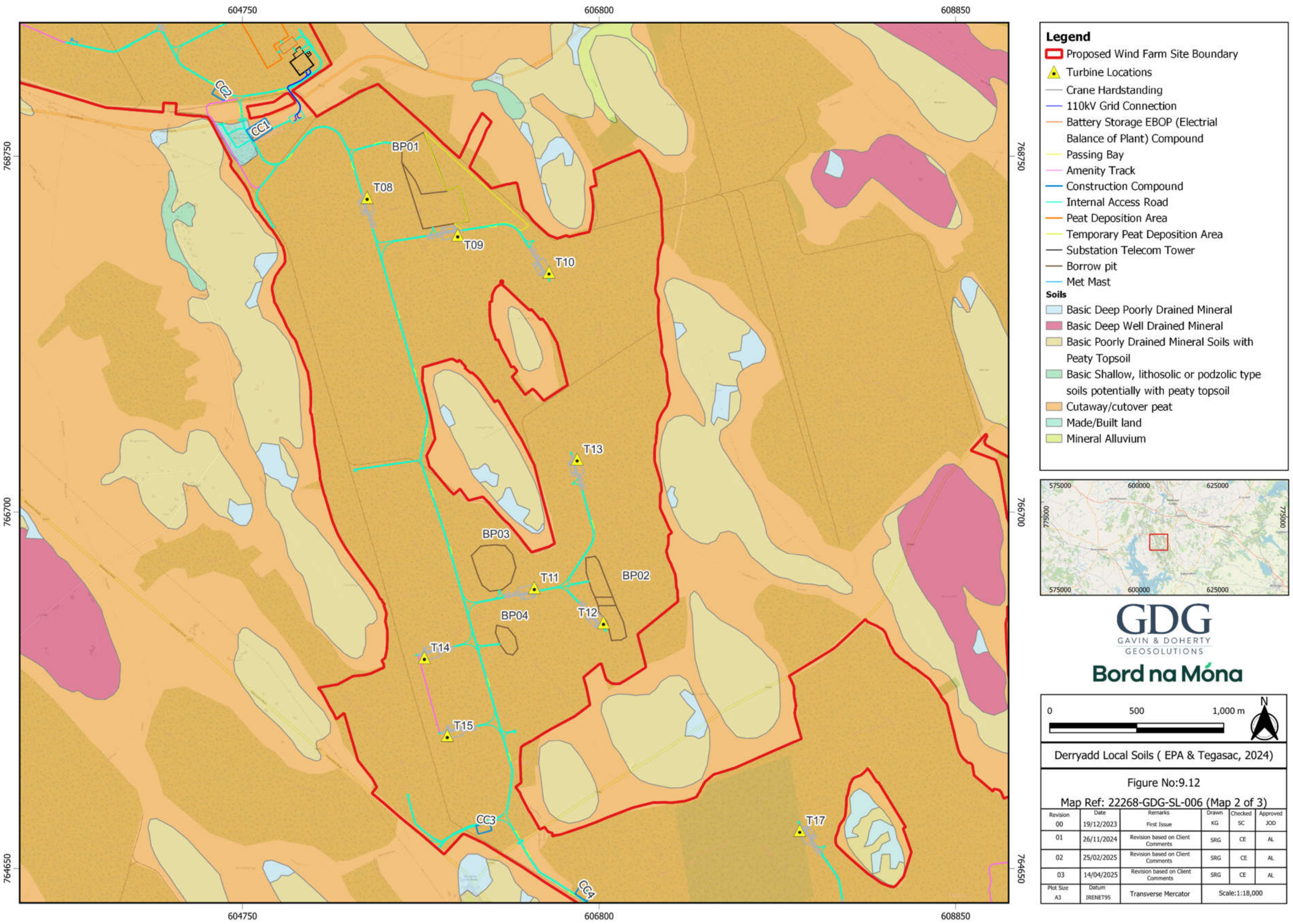


Figure 9-12: Derryadd local soils (EPA/Teagasc National Soils Map, 2024) (Map 2 of 3)

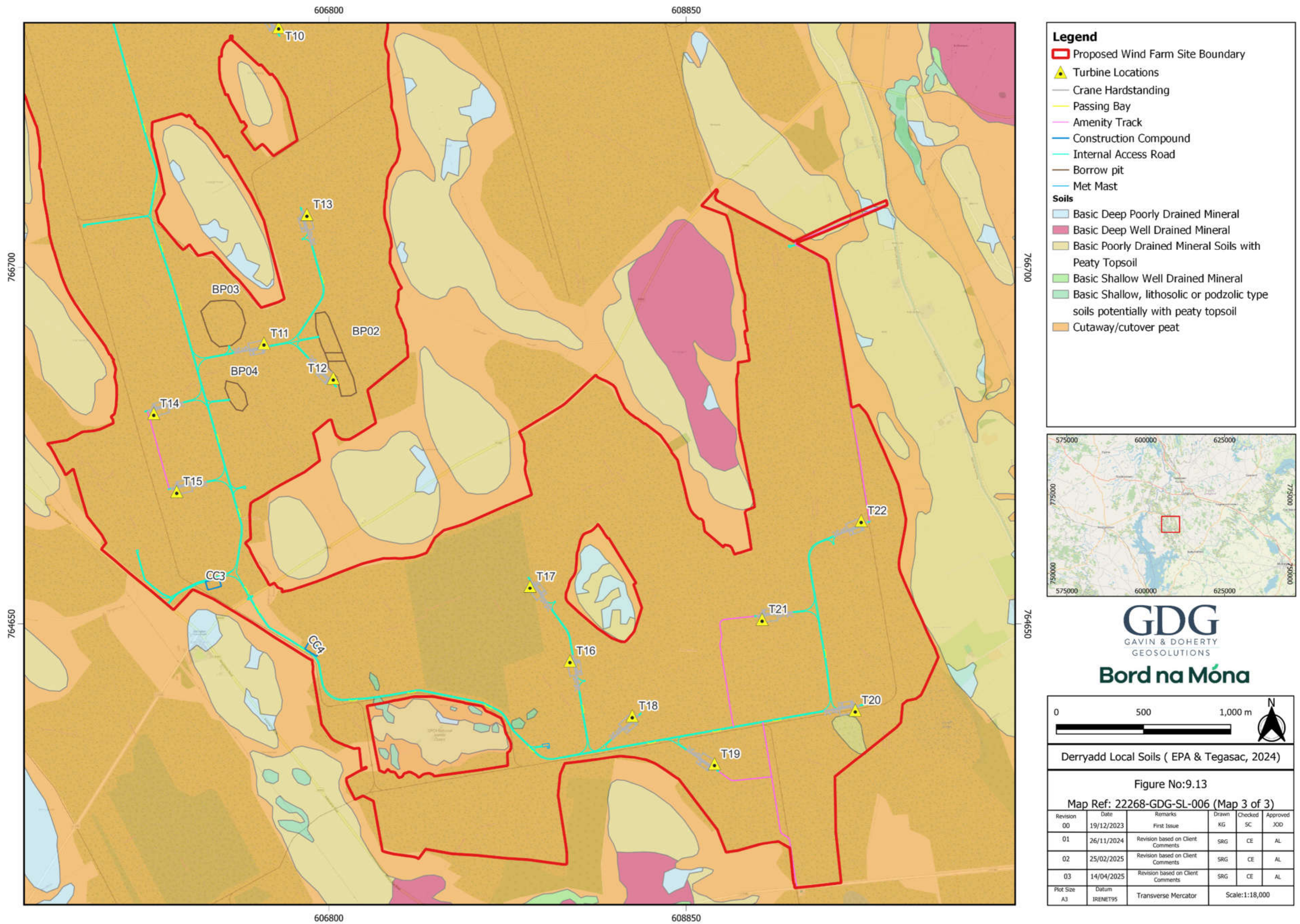


Figure 9-13: Derryadd local soils (EPA/Teagasc National Soils Map, 2024) (Map 3 of 3)

9.3.8 Regional Subsoils

The regional subsoils in this area are shown in Figure 9-14. The dominant subsoil occurring in the region is classified as Cutover raised peat. There are also some bodies of glacial tills present. The 20 subsoil types mapped within the regional scale by the GSI Quaternary Sediments map (2024) are characterised as follows:

- Alluvium (A);
- Alluvium (clayey) (Ac);
- Bedrock Outcrop / Subcrop (Rck);
- Blanket peat (BKtPt);
- Cutover raised peat (Cut);
- Esker comprised of gravels of basic reaction (BasEsk);
- Fen Peat (FenPt);
- Gravels derived from Devonian sandstones (GDSs);
- Gravels derived from limestones (GLs);
- Gravels derived from Lower Palaeozoic Sandstones and Shale (GLPSsS);
- Karstified Bedrock or Subcrop (KaRck);
- Lake Marl;
- Lacustrine sediments (Calcareous marl) (L);
- Made Ground (Fill);
- Till derived from Carboniferous sandstones and cherts (TCSsCh);
- Till derived from Cherts (TCh);
- Till derived from Devonian and Carboniferous sandstones (TDCSs);
- Till derived from Palaeozoic and Carboniferous sandstones and shales (TLPCSsS);
- Till derived from Lower Palaeozoic sandstones and shales (TLSsS); and,
- Till derived from limestones (TLs).

9.3.9 Local Subsoils

The GSI Quaternary Sediments Map (1:50k) at the local scale is shown in Figure 9-15 to Figure 9-17. Peat is encountered across the proposed wind farm site, mapped throughout by the GSI as cut-over raised peat. There are also some bodies of Till derived from limestones (TLs) mapped within the proposed wind farm site, forming small, tear shaped islands within the peat. These pockets of glacial till are mapped underlying the proposed T01, T02, and T03 locations. These are pockets of till located to the south of T04, north of T11, to the west of T16 and T17, and directly south of T20. The bodies of till are related to the drumlins mapped by the GSI and discussed in Section 9.3.10. Glacial till typically comprises a heterogenous mix of sand, gravel, cobbles, and boulders, usually held in an over-consolidated clay matrix. A number of small areas mapped as bedrock at or near the surface can be seen in the far south of the proposed wind farm site (Figure 9-17), indicating the potential presence of bedrock within 1 m of the surface in these locations. The results of the ground investigations carried out as part of the proposed wind farm, and of historic ground investigations carried out in the surrounding areas are discussed in Section 9.3.17, but broadly show agreement with the GSI mapping.

9.3.10 Site Geomorphology

A number of glacial depositions known as drumlins are identified across the site resulting in local variations in topography. Drumlins can be seen in the form of a low oval mound with one steep blunt end, known as the stoss, and another shallow sloping end, known as the lee end. The shape of the drumlins can be seen on the geological plans shown in Figure 9-15 to Figure 9-17 in the form of tear drop shaped geological zones (Basic Poorly Drained Mineral Soil with Peaty Topsoil (BminPDPT) and Till derived from Limestones (TLs). The drumlins generally follow a NNW-SSE alignment.

9.3.11 Mineral / Aggregate Resources

There are no active quarries on the site. The GSI data indicates that one mineral location is present within the proposed wind farm site boundary in Derryaroge (Mineral ID 3976). The mineral is described as a Shelly marl/calcareous mud as found in a trench from the GSI data, it is unclear what the purpose of the trench was. The mineral and aggregate resources located within 6 km of the proposed wind farm site boundary, as mapped by the GSI are presented in Table 9-9 along with their GSI mineral ID, and shown in Figure 9-18.

Table 9-9: Mineral and Aggregate Resources (GSI Mineral Locations, Accessed 2024)

Mineral ID	Type	GSI Description
3106	Clay, brick	Brick clay under bog noted on old 6in map.
3976	Marl	Shelly marl/calcareous mud seen in trench in Doire Dharog.
5184	Limestone (in general)	Disused quarry in dark grey limestone noted on old 6in map.
5191	Jasper	Block of red jasper rock
5192	Limestone	Limestone quarries noted here on old GSI 6in map.
5196	Limestone	First class building stone once quarried here. Noted on old GSI 6in map.
5197	Limestone	Small disused quarry in grey crystalline limestone once used as a first class building stone. Noted on old GSI 6in.
5206	Lead	The Newtown Cashel mineral prospect lies at the west end of the Keel Inlier and comprises fault-controlled zinc, barite and lead mineralisation hosted in dlomitized Courceyan Mixed Micrite Unit.
5206	Zinc	The Newtown Cashel mineral prospect lies at the west end of the Keel Inlier and comprises fault-controlled zinc, barite and lead mineralisation hosted in dolomitized Courceyan Mixed Micrite Unit.

The locations of the four borrow pits for extraction of construction aggregates for construction of the proposed wind farm are within the proposed wind farm site boundary (Figure 9-2-Figure 9-4).

The ground investigations at the borrow pit areas comprise of peat probes, trial pits and borehole locations. The trial pit and borehole logs show peat material overlying predominantly gravelly sandy SILT or silty sandy GRAVEL material, overlying a limestone sandy GRAVEL and/or weathered and competent limestone bedrock. Bedrock at the borrow pit areas are encountered at variable levels across the borrow pits varying between 1.9 and > 8.6mbgl. A preliminary analysis of the Particle size distribution (PSD) testing carried out on samples recovered from the boreholes and trial pits suggests that the gravelly sandy SILT material may not be directly suitable for reuse during the construction of the wind farm. However, it may be suitable for processing and screening for development into a Class 1A or Class 2C material as defined in Table 6/1 of Specification for Road Works (TII, 2013). In the interest of a conservative assessment of material reusability and volume assessments in this report, this material has not been considered suitable. Further ground investigation and analysis of the feasibility of the borrow pits and the material reusability will be required at the detail design stage.

At this stage, it is conservatively assumed that the gravelly sandy SILT material is not suitable for reuse on the site. As a result, gravelly SILT material has been designated as spoil. Estimated volumes of unsuitable spoil are given in Section 9.4.2.4. The identified GRAVEL, weathered bedrock and bedrock material have been considered suitable for reuse with some processing, estimating a conservative 80% productivity of the bedrock following extraction and processing, i.e. loss of 20% of stone volume. Further assessment of this will be required by the Contractor's detailed designer. This further will require rotary core boreholes, and laboratory testing to determine the suitability of the bedrock and gravel for use as aggregate. Potential stone and aggregate volumes are discussed in Section 9.4.2.4, and outlined in Table 9-24. The borrow pits are discussed in terms of potential effects in Section 9.4.

9.3.12 Geological Heritage Sites

The GSI Geological Heritage Database lists sites of geological interest and heritage identified during County Geological Sites (CGS) audits and is kept up to date. The Longford CGS Audit was conducted by the GSI in 2015 (Hennessey et al., 2015) and shows that there are no Irish Geological Heritage sites within the proposed wind farm site boundary. The sites located in the region surrounding the proposed wind farm site are shown in Figure 9-19. The Corlea trackway (LD006) is located adjacent to, but outside, the southern boundary of the proposed wind farm site. The Corlea trackway is an Iron Age trackway constructed from oak planks in 148-147 BC (GSI, 2024). The trackway is preserved by the geological and hydrogeological process of peat growth. For further details on the Archaeological heritage of the proposed development, refer to Chapter 14 (Archaeology, Architectural and Cultural Heritage).

Two additional geological heritage sites are identified by the GSI within 6 km of the proposed development boundary. Newtowncashel (GSI Ref: LD014), located 5 km to the SW of the proposed wind farm boundary, consists of a disused limestone quarry rehabilitated to a community park in 2000, and is now celebrating the quarry's heritage in sculpture and rock carvings. The site is an important County Geological Site as it was the source of stone for buildings in the county including St. Mel's Cathedral in Longford Town.

Mullawornia Quarry (GSI Ref: LD013) is a disused limestone quarry adjacent to the Royal Canal and the Ballymahon-Lanesborough Road. This is an important site for the research conducted on the depth of Waulsortian carbonate mudmounds (Hennessey et al., 2015).

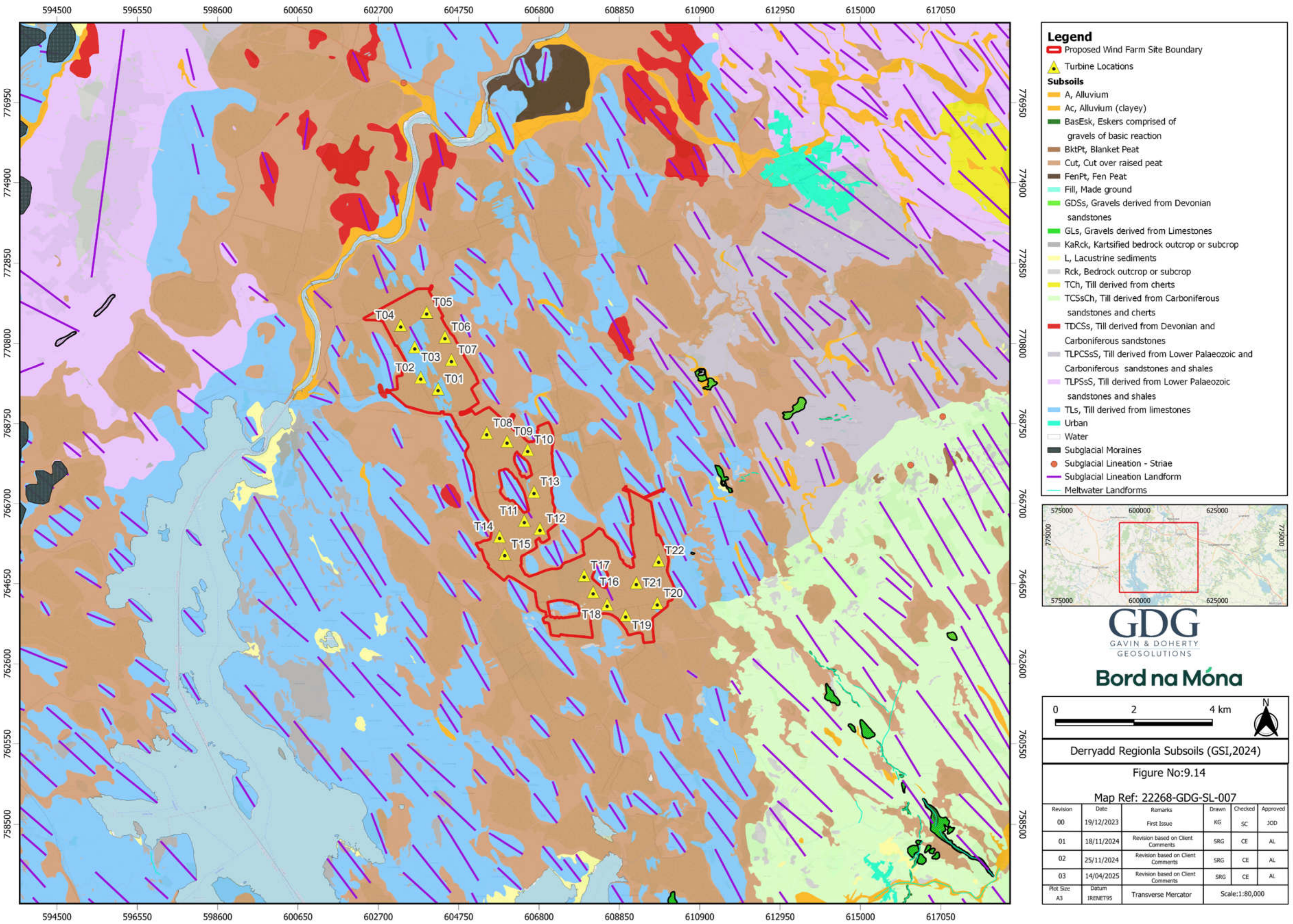


Figure 9-14: Derryadd regional subsoils (GSI Quaternary Sediments, 2024)

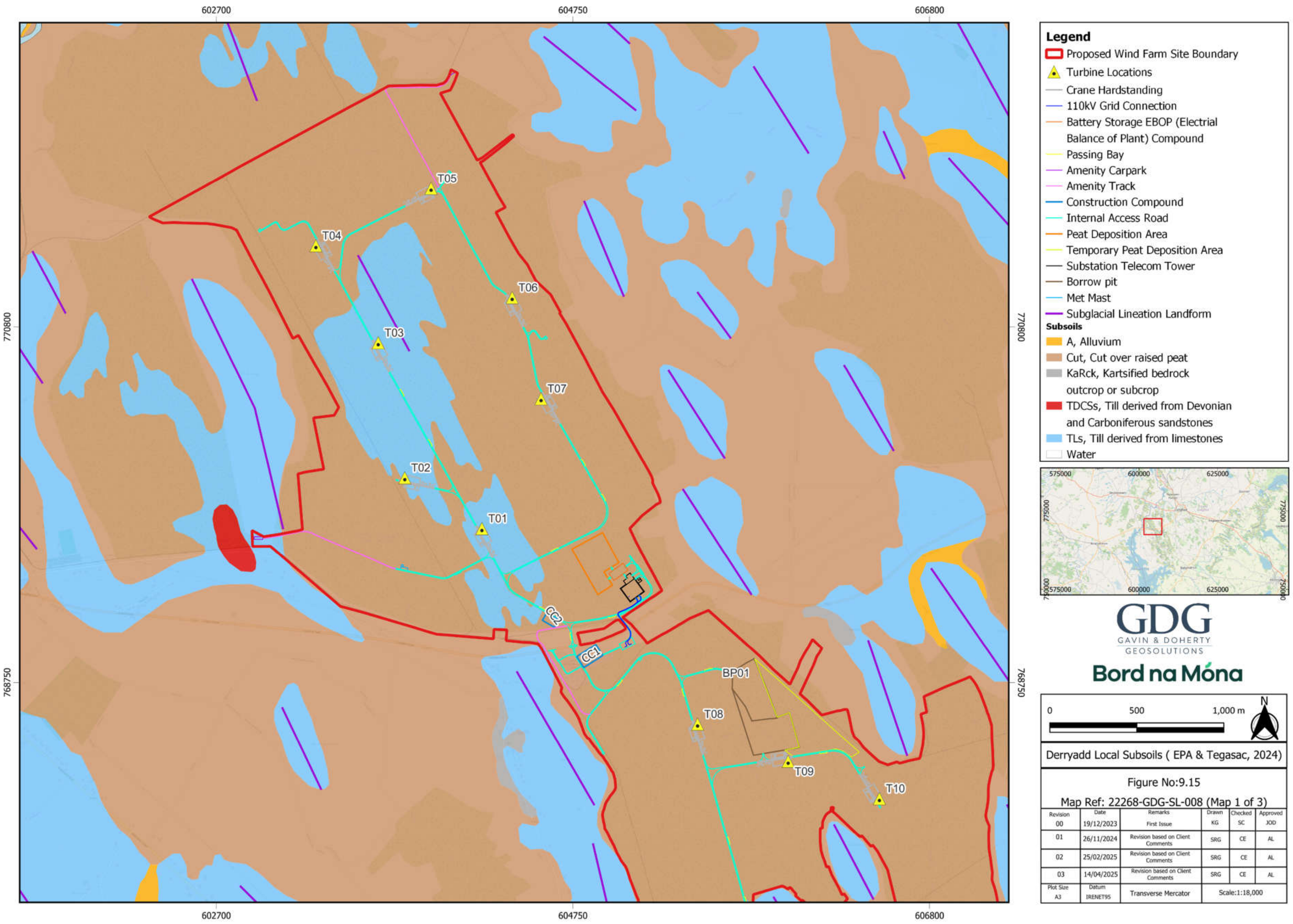


Figure 9-15: Derryadd local subsoils (GSI Quaternary Sediments, 2024) (Map 1 of 3)

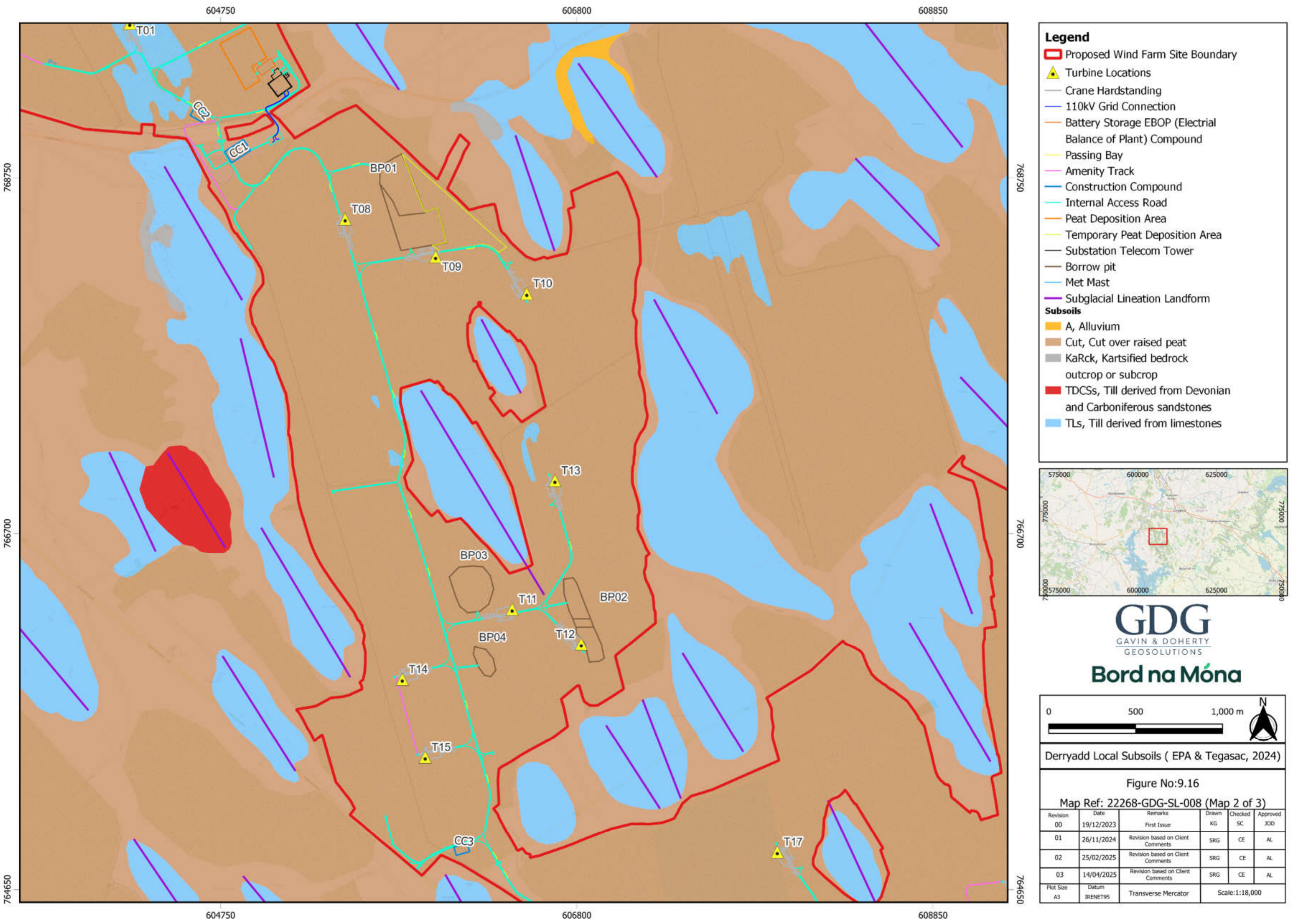


Figure 9-16: Derryadd local subsoils (GSI Quaternary Sediments, 2024) (Map 2 of 3)

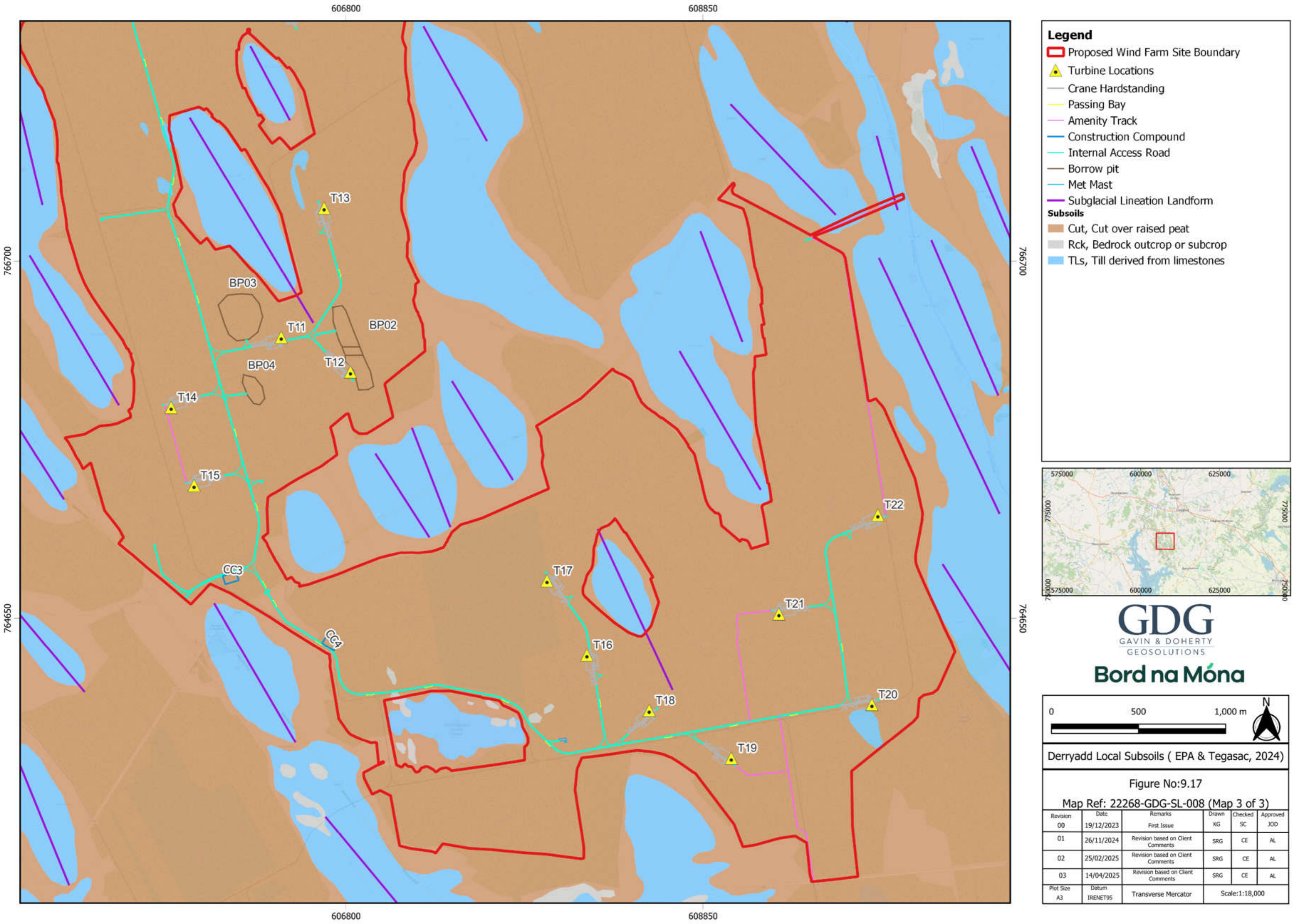


Figure 9-17: Derryadd local subsoils (GSI Quaternary Sediments, 2024) (Map 3 of 3)

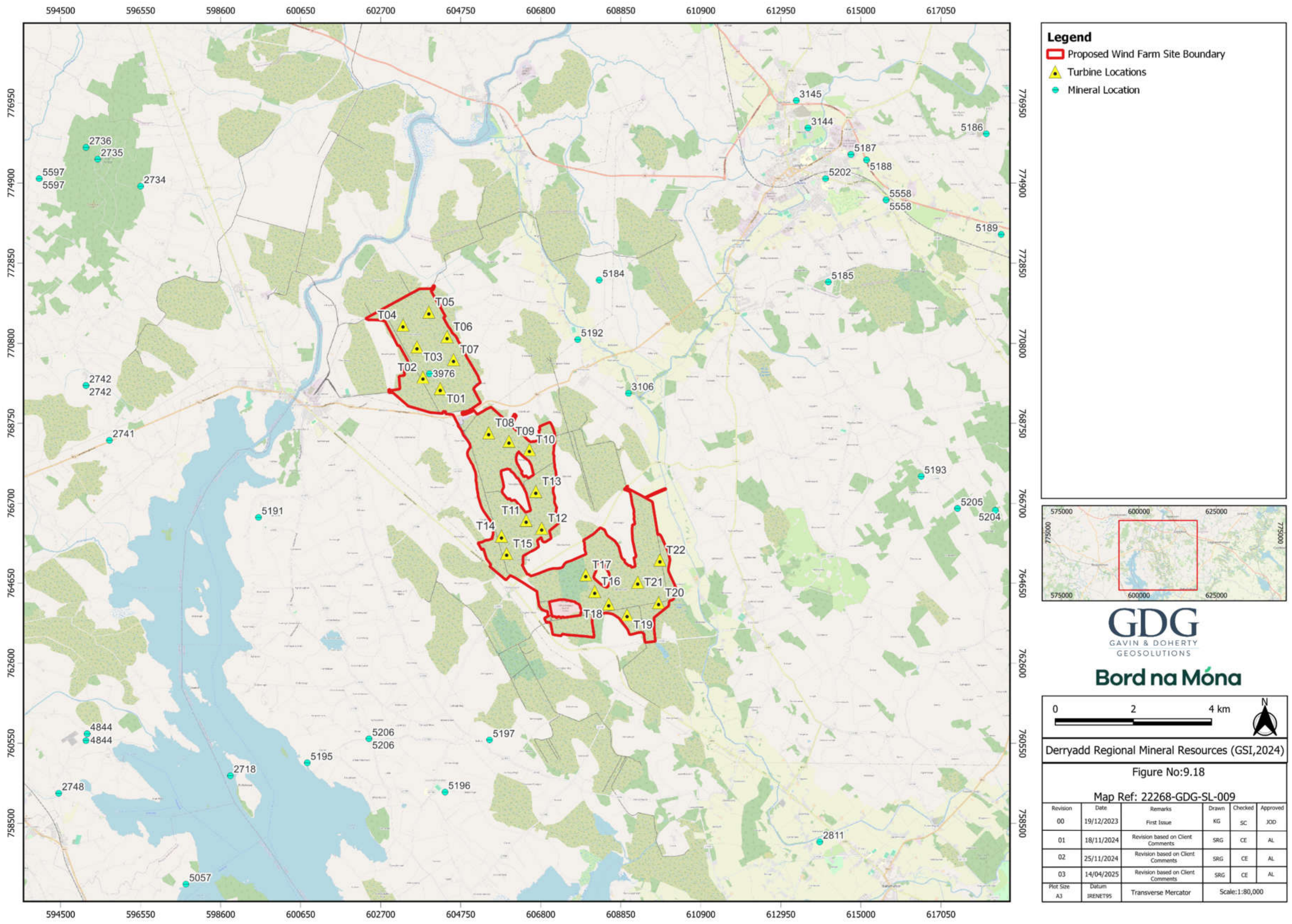


Figure 9-18: Derryadd regional mineral resources (GSI, 2024)

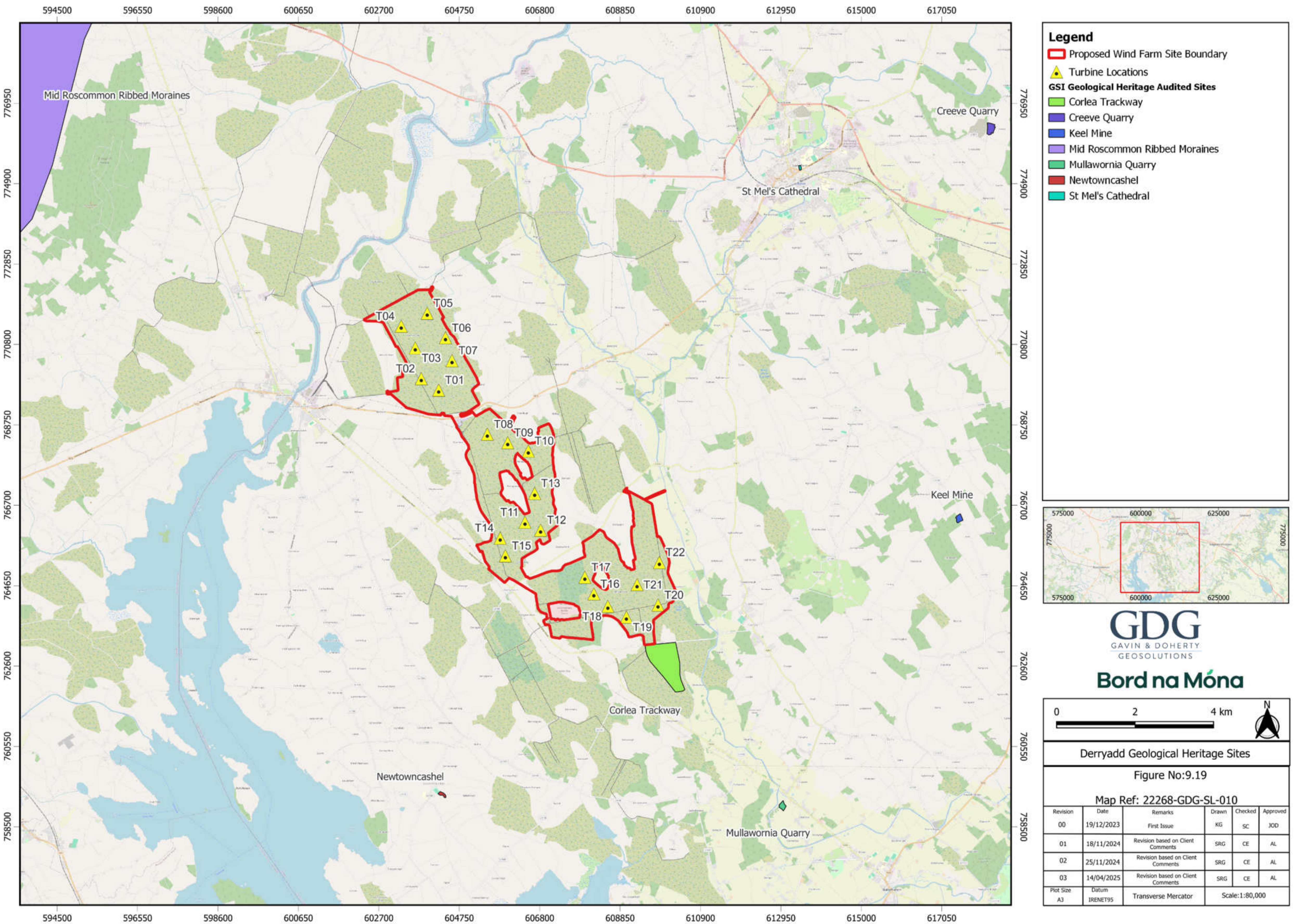


Figure 9-19: Derryadd regional Geological Heritage Sites (GSI, 2024)

9.3.13 Hydrogeology

Hydrogeology has been examined in detail in Chapter 10 (Hydrology and Hydrogeology) of this EIAR, but the key hydrogeological features are summarised in Section 9.3.13.1 to 9.3.13.4.

9.3.13.1 Groundwater Bodies

The EU Water Framework Directive (2000/60/EC) (WFD) establishes a framework for the protection, improvement and management of groundwater. All Groundwater Waterbodies (GWB) are delineated by the GSI and EPA. Groundwater bodies are subdivisions of large aquifers, defined as a distinct volume of groundwater, including recharge and discharge areas with little flow across the boundaries. The proposed wind farm site is underlain by three GWBs: the Funshinagh GWB, the Inny GWB and the Longford Balinalee GWB. The groundwater body descriptions are available from the GSI website, and the 'status' is obtained from the WFD website and the EPA website. The GWBs underlying the proposed wind farm site are classified as being of 'Good' status, as shown on Table 9-10 and in Figure 9-20. The Funshinagh WFD GWB comprises primarily of high transmissivity karstified limestone. The Inny and Longford Balinalee GWB comprises low transmissivity and storativity rocks, described as 'Poorly Productive' bedrock.

Table 9-10: Summary of Groundwater Bodies

EU_CD Code	Name	Description	GWB status (2010-2015)	GWB status (2013-2018)	GWB status (2016-2021)
IE_SH_G_091	Funshinagh	Karstic	Good	Good	Good
IE_SH_G_110	Inny	Poorly Productive Bedrock	Good	Good	Good
IE_SH_G_149	Longford Ballinalee	Poorly Productive Bedrock	Good	Good	Good

9.3.13.2 Bedrock Aquifers

The bedrock aquifer types mapped by the GSI (2024) within the proposed wind farm site boundary and surrounding area are shown in Figure 9-21.

According to GSI's groundwater map viewer, the proposed wind farm site is underlain by two different aquifer bodies. The majority of the proposed wind farm site (Derryaroge and Derryadd Bogs) are underlain by a Regionally Important karstified (Conduit) Aquifer. The southern end of the proposed wind farm site at Turbines T17 to T22 (Lough Bannow Bog) are underlaid by a Locally Important (LI) aquifer, defined as being moderately productive bedrock aquifer in local zones. Regionally important aquifers are generally capable of supplying regionally important abstractions (e.g. large public water supplies), or excellent yields (>400 m^3/d). Bedrock aquifer units generally have a continuous area of >25 km^2 and groundwater predominantly flows through fractures, fissures, joints or conduits. Locally important aquifers are capable of supplying locally important abstractions (e.g. smaller public water supplies, group schemes), or good yields (100-400 m^3/d). In the bedrock aquifers, groundwater predominantly flows through fractures, fissures, joints or conduits.

Bedrock is anticipated to consist of a limited and relatively poorly connected network of fractures, fissures and joints, giving a low fissure permeability which tends to decrease with depth (GSI, 2024).

9.3.13.3 Groundwater Vulnerability

Groundwater vulnerability in Ireland, as defined in the EC Water Framework Directive – Recharge and Groundwater Vulnerability, is a function of the thickness and permeability of the subsoil that overlies bedrock. These factors strongly influence the attenuation processes and the time it takes for contamination to be released into the subsurface. The GSI Groundwater Vulnerability map containing groundwater vulnerability classifications for the proposed wind farm site (GSI, 2024) at the regional view is shown in Figure 9-22.

The majority of the proposed wind farm site exhibits 'Low' degrees of groundwater vulnerability with some localised isolated areas of 'Moderate' groundwater. Vulnerability transitions from 'Moderate' to 'High' and at some locations to 'Extreme' and 'Rock at or near Surface or Karst' at areas to the south of the proposed wind farm site. The areas of 'Extreme' vulnerability and 'Rock at or near Surface or Karst' are southwest of T16 and T17 and correspond to areas mapped as Bedrock Outcrop/Subcrop (Rck) in the GSI Quaternary Sediments map (Section 9.3.8). Areas of 'Moderate' vulnerability mapped just outside of the proposed wind farm site conform to the outlines of possible drumlins and reflect the wider regional trend of localised bulbous shaped areas of elevated ground water vulnerability due to drumlin geomorphologies of higher permeability soils.

Due to the localised variability within the proposed wind farm site, pre-development vulnerability observed at individual wind turbines and other infrastructure such as borrow pits, site compounds and peat storage areas will vary depending on location.

9.3.13.4 Subsoil Permeability

The subsoil permeability affects how easily rainwater can soak down into the ground and fill up the groundwater resource (aquifer). An aquifer is a body of rock and/or sediment that holds groundwater. The GSI Subsoil Permeability Map (2024) for the proposed wind farm site at the regional view is shown in Figure 9-23.

The Subsoil Permeability map shows how permeable the subsoils are in Ireland. The map shows the subsoil permeability category at any point on the land surface as long as the subsoil is greater than 3 metres thick. There are three categories: 'High', 'Moderate' or 'Low'. The majority of the proposed wind farm site is underlain by 'Low' subsoil permeability. Localised areas adjacent to the southern boundary and southeast are currently 'Not Mapped' due to assumed low depth to bedrock and sections of bedrock outcropping.

There are no sand and gravel aquifers within the proposed wind farm site boundary or in the vicinity, although it is possible that localised perched groundwater is present within granular layers and lenses within the glacial till and alluvial soils.

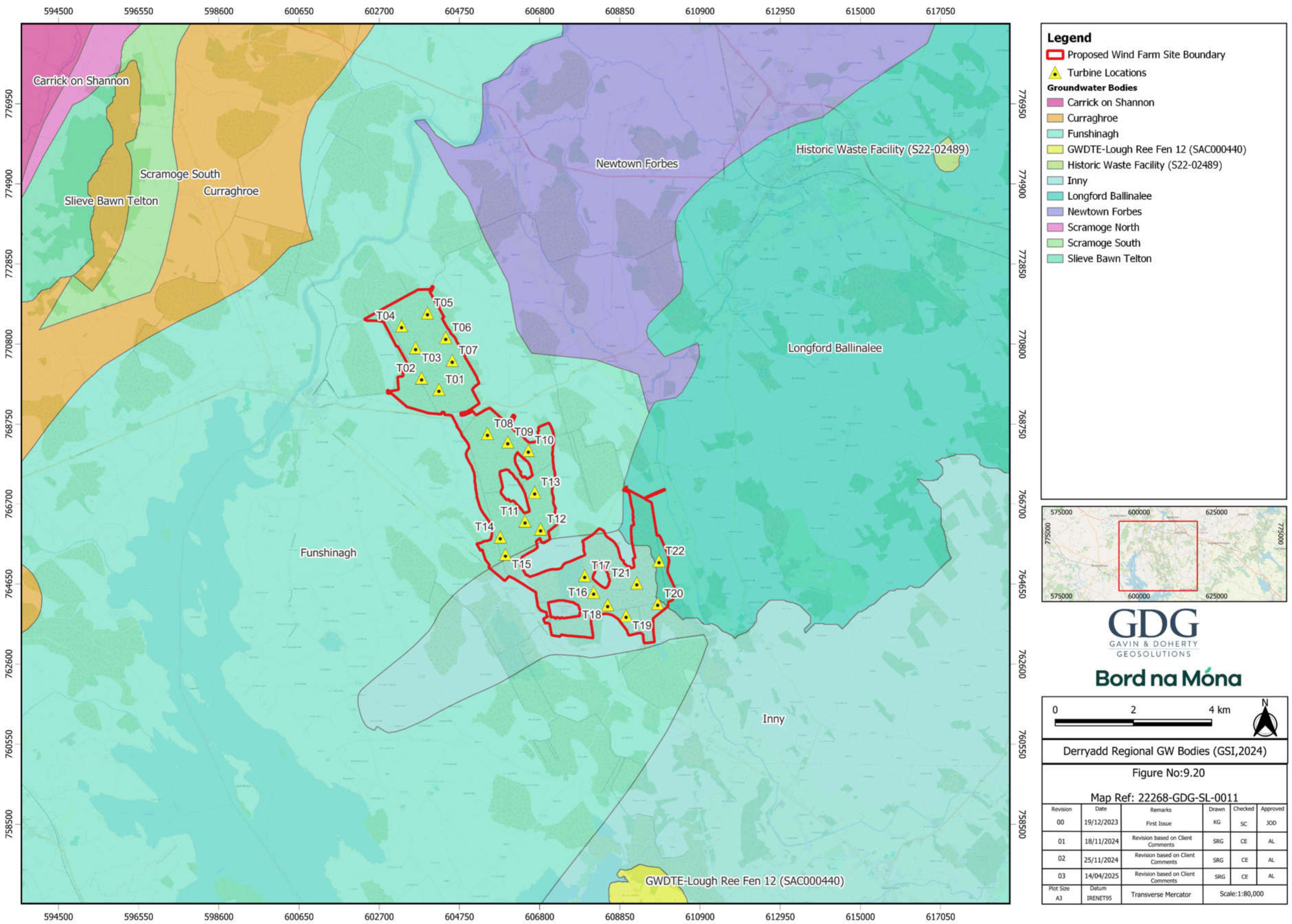


Figure 9-20: Derryadd regional groundwater bodies (GSI & EPA, 2024)

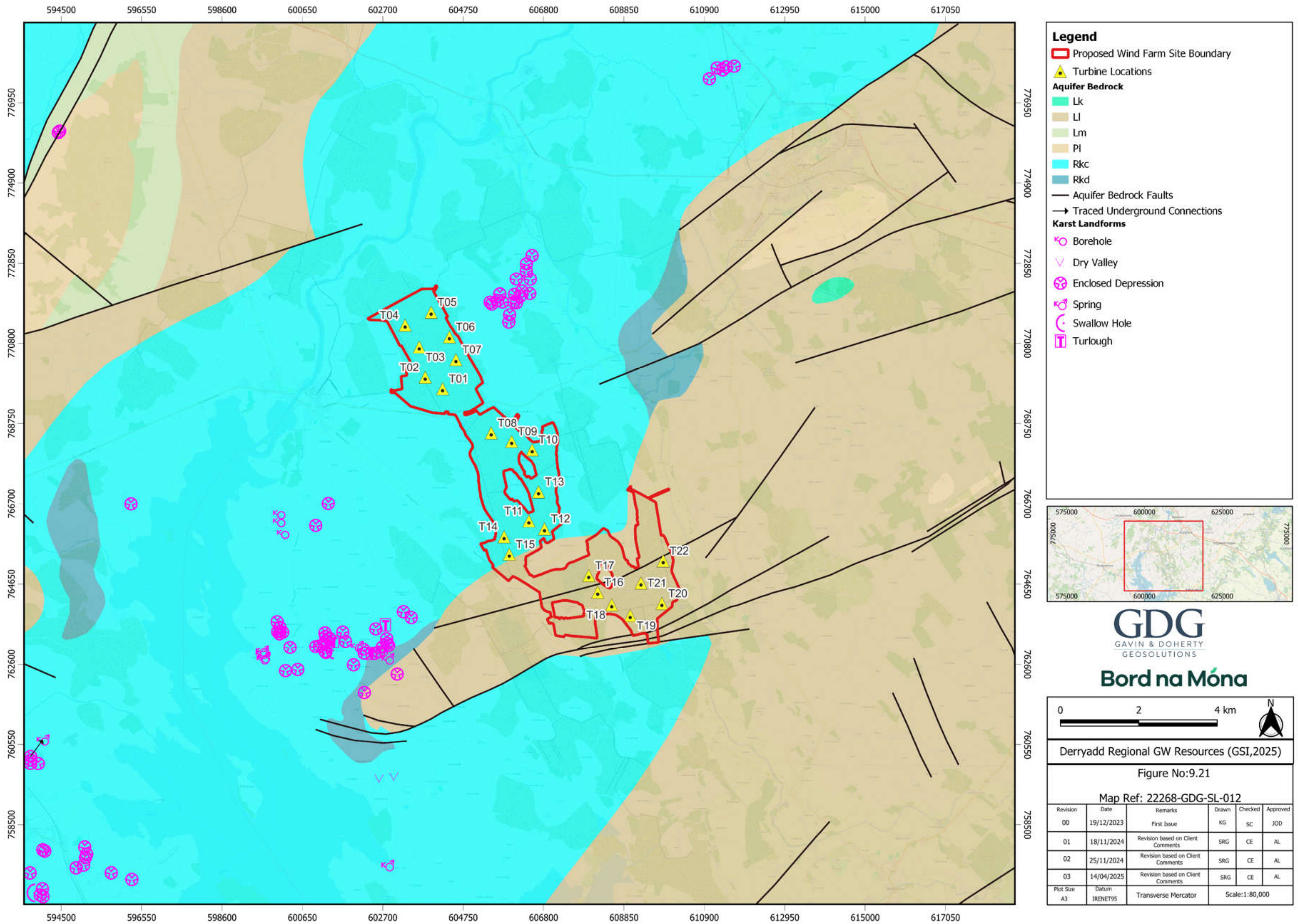


Figure 9-21: Derryadd regional groundwater resources (GSI Bedrock Aquifers, 2024)

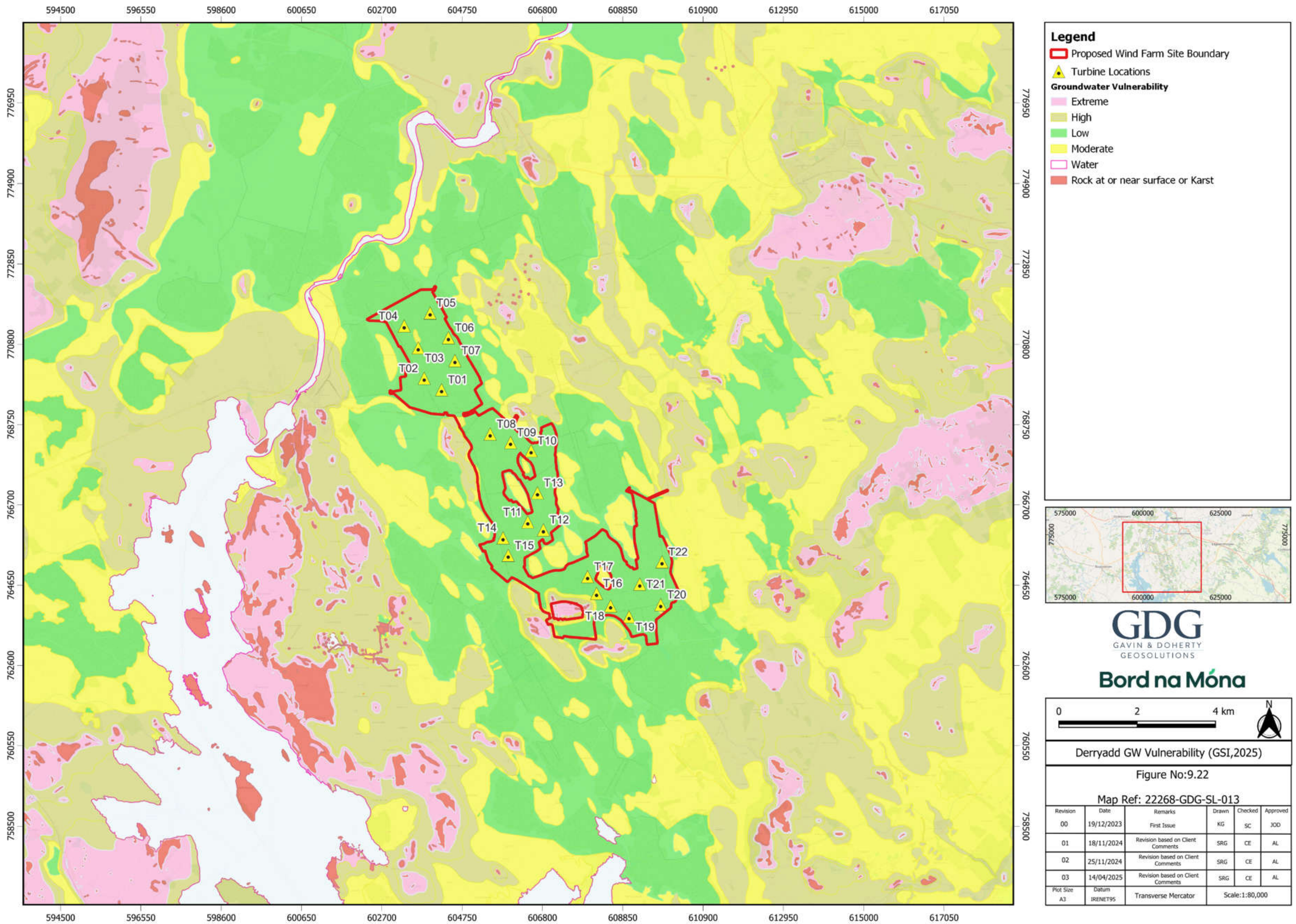


Figure 9-22: Derryadd regional groundwater vulnerability (GSI Groundwater Vulnerability, 2024)

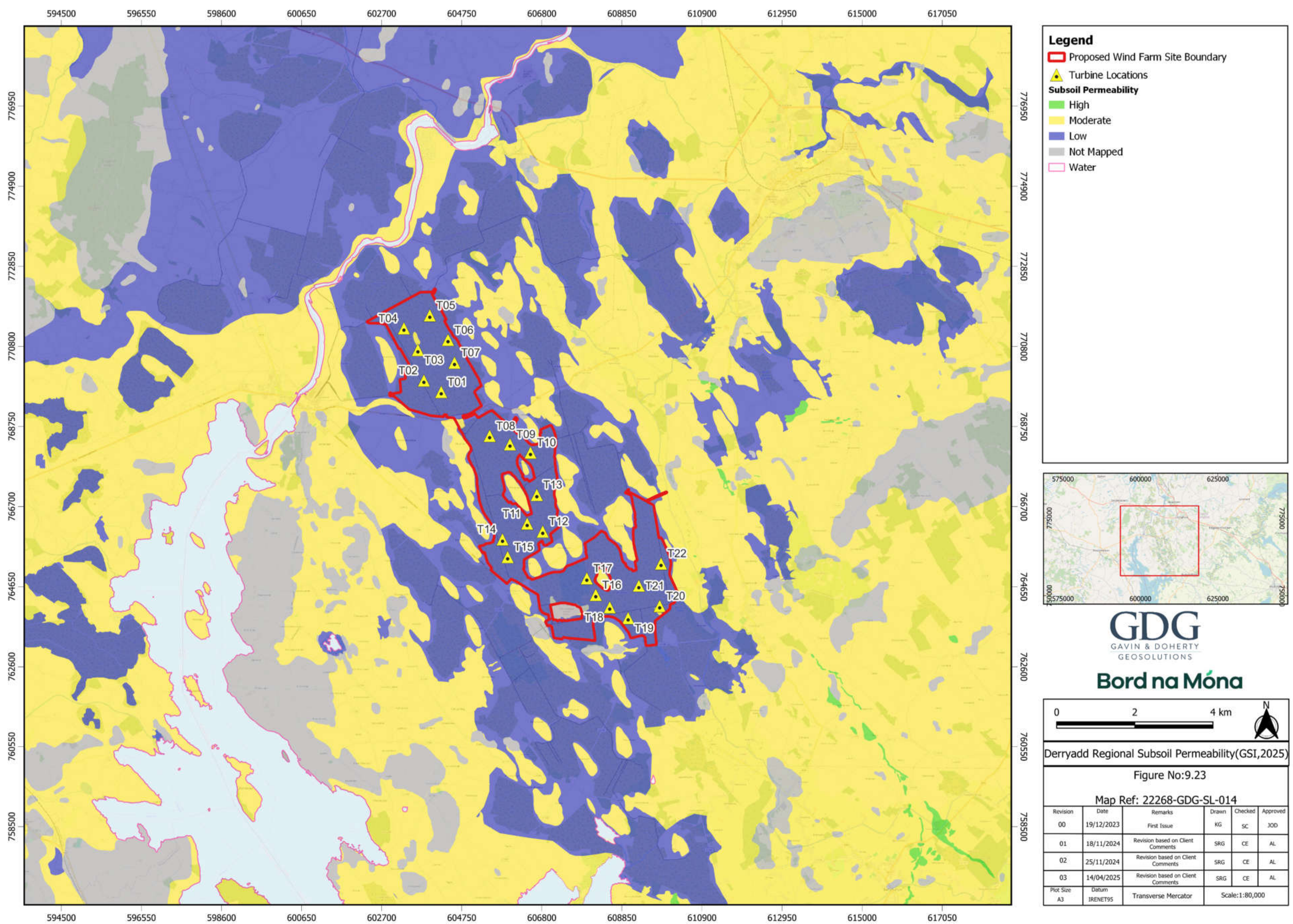


Figure 9-23: Derryadd regional subsoil permeability (GSI Subsoil Permeability, 2024)

9.3.14 Contaminated Land

A review of the EPA website for existing and historic licensed and illegal waste activities, mines and industries was carried out to identify any potential contamination sources present in the area and to identify any potential contaminating activities near the proposed wind farm site. The walkovers did not record any evidence of waste deposition (fly tipping) on site, and the research found no documentary evidence of illegal waste activities within a 1 km radius of the proposed wind farm site during the site walkovers. Two licensed Integrated Pollution Prevention Control (IPC) licenses were issued in proximity to the proposed wind farm site, listed in Table 9-11.

In addition, the history of the site has been reviewed using historical Ordnance Survey Ireland (OSI) maps (6 Inch First Edition 1830s-1880s and 6 Inch Last Edition 1888-1915, 25 Inch) and aerial photography from 1995 to 2018, along with more recent aerial photography available on Google (2024) and Bing (2024). This shows that the history of the site is predominantly rural, with isolated farm properties across the area, which comprised bog and locally farmland. From 1960s peat extraction occurred within the three bogs, which included the construction of a network of railway lines around the perimeter associated with delivering peat to the peat-fired Lough Ree power station located approximately 2 km to the west of the site. Due to the nature of the proposed wind farm site, which is predominantly on the worked peat bog areas, there is a low likelihood of contamination associated with historical uses other than localised low levels of contamination possible associated with peat extraction plant, which would predominantly be focussed around areas of Bord na Móna works buildings.

Site investigation works across the site did not record any areas of made ground with evidence of significant contamination, or other records of contamination observations such as odours or visual evidence of staining or hydrocarbon impacts. Consequently, in the absence of an identified source of contamination, chemical analysis of soils and groundwater were not undertaken. In summary it is considered that there is a low risk of contamination within the site, based on the historical use, which was predominantly for peat extraction, and that the expected ground conditions were corroborated by the intrusive investigation.

9.3.15 Permitted Activities

An IPC Licence (P0504-01) was granted to Bord na Móna Energy Ltd in 2000 for the extraction of peat at the Mountdillon Bog Group. Since 2000, all best practice procedures which were implemented to prevent the occurrence of spills and leakages were upgraded to comply with the IPC licence requirements. Condition 7 referred to Waste Management whereby all hazardous waste materials (oils, oil filters, batteries etc) were required to be disposed of by licenced waste contractors. According to the available AER reports, no significant fuel spills or wastewater discharges have occurred at the proposed wind farm site prior to or since 2000. The area covered by the Mountdillon Bog Group includes the site of proposed wind farm.

No areas of concern were observed during the site walkover.

Table 9-11 lists the licensed integrated Pollution Prevention Control (IPPC) facilities within 6 km of the proposed wind farm site, and these are shown in Figure 9-24.

Table 9-11: Licensed integrated Pollution Prevention Control (IPPC) facilities (EPA, 2024).

License Number	Name	Licences status	Location [Distance from the proposed wind farm site boundary (km)]
P0504-01	Bord na Móna Energy Ltd.	Licensed	Within proposed wind farm site.
P0629-01	Electricity Supply Board (Lanesborough)	Surrendered	Laneborough [approximately 2 km]
P0610-02	Electricity Supply Board	Licensed	Laneborough [approximately 2 km]
P0221-01	Atlantic Mills Ltd.	Licensed	Clondra [approximately 5km]
P0351-01	Gem manufacturing Company Ltd.	Surrendered	Longford [approximately 7km]
P0327-01	Glennon Bros. Timber Ltd.	Licensed	Kilnasvogue [approximately 11km]
P0855-01	Kiernan Structural Steel Ltd.	Licensed	Carriglas [approximately] 14km

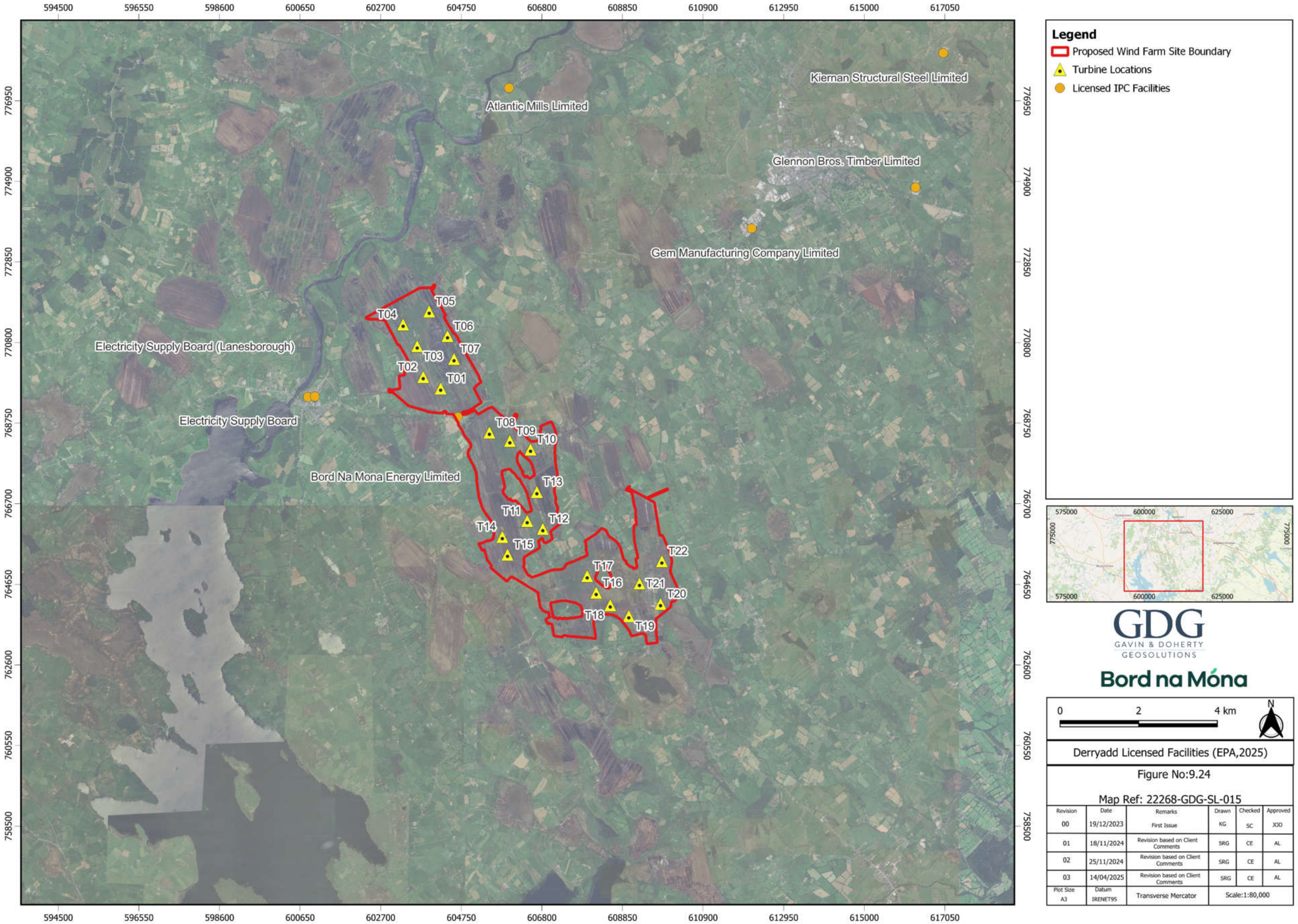
No evidence of historical landfills were identified during the data review.

9.3.16 Landslide Database

A review of the landslide information on the GSI Irish Landslides Database (GSI, 2024) indicates that the nearest recorded landslides occurred approximately 9 km north-east of the proposed wind farm site (ID GSI_LS160043 and 044), as shown in Figure 9-25. Both events are described as peatslides and happened in February 2016. They are characterised by an area of raised peat that has undergone some slippage. In their description of the features, the GSI (2024) note that the peatslide appears to be relatively large and other possible slippages have occurred on the same raised bog previously.

Two additional landslides are also shown approximately 13 km away from the proposed wind farm site, GSI_LS030007 and GSI_LS-0033. These occurred in January 1818 and January 1809 respectively and very little information about these events are given.

Figure 9-25 shows the Regional Landslide Susceptibility while Figure 9-26, Figure 9-27 and Figure 9-28 show the Local Landslide Susceptibility. The proposed wind farm site is designated as 'Low' susceptibility, with a very localised band designated as 'Moderately Low' running along the southeastern proposed wind farm site boundary. The stability of the peat soils on-site is discussed in greater detail in a Peat Stability Risk Assessment (PSRA) report (Appendix 9.3) and summarised in Section 9.3.21.



Revision	Date	Remarks	Drawn	Checked	Approved
00	19/12/2023	First Issue	KG	SC	JOD
01	18/11/2024	Revision based on Client Comments	SRG	CE	AL
02	25/11/2024	Revision based on Client Comments	SRG	CE	AL
03	14/04/2025	Revision based on Client Comments	SRG	CE	AL
Plot Size A3	Datum IRENET95	Transverse Mercator	Scale:1:80,000		

Figure 9-24: Derryadd Licensed Facilities (EPA, 2024)

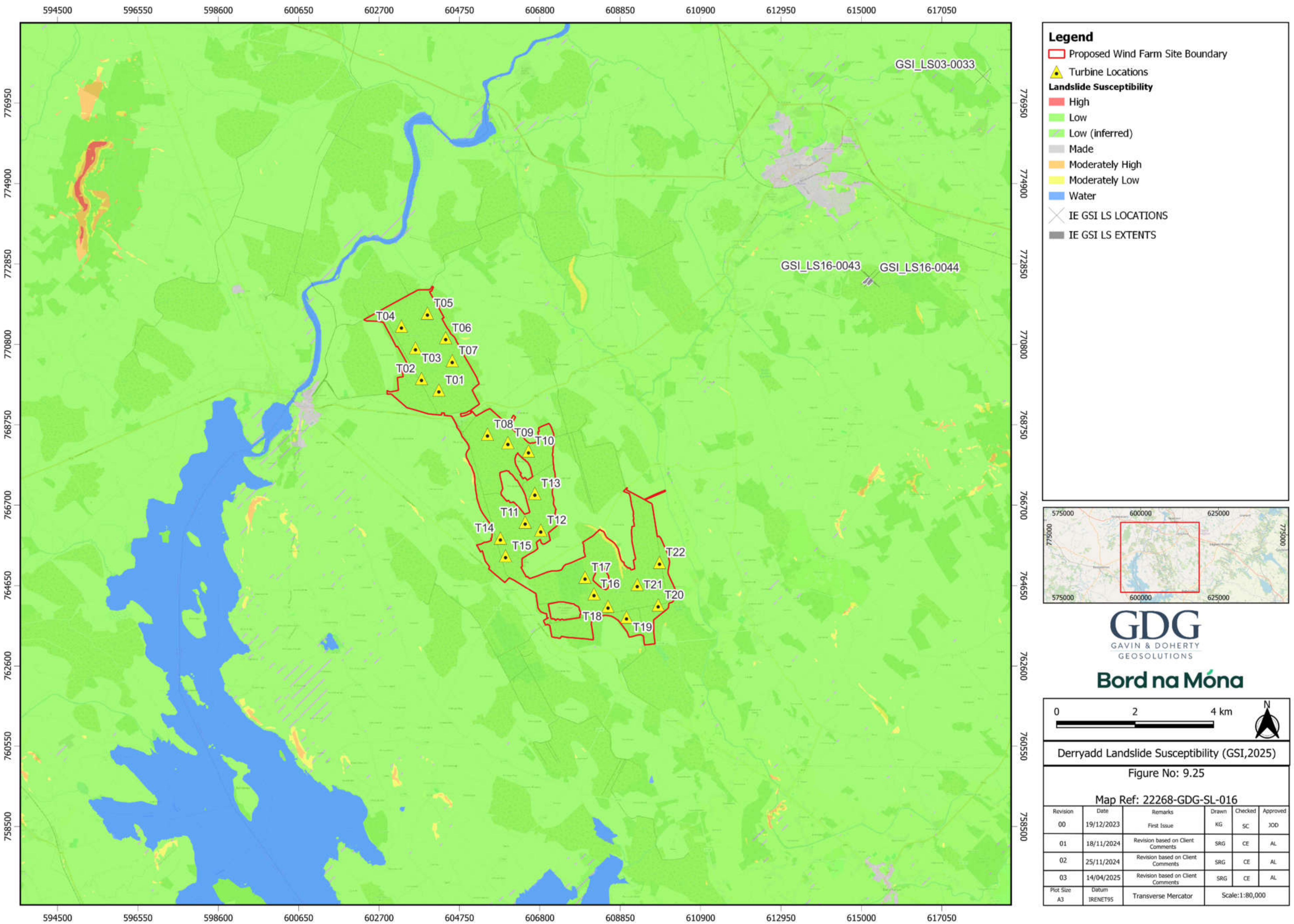


Figure 9-25: Derryadd regional landslide susceptibility (GSI, 2016) and landslide events (GSI, 2024)

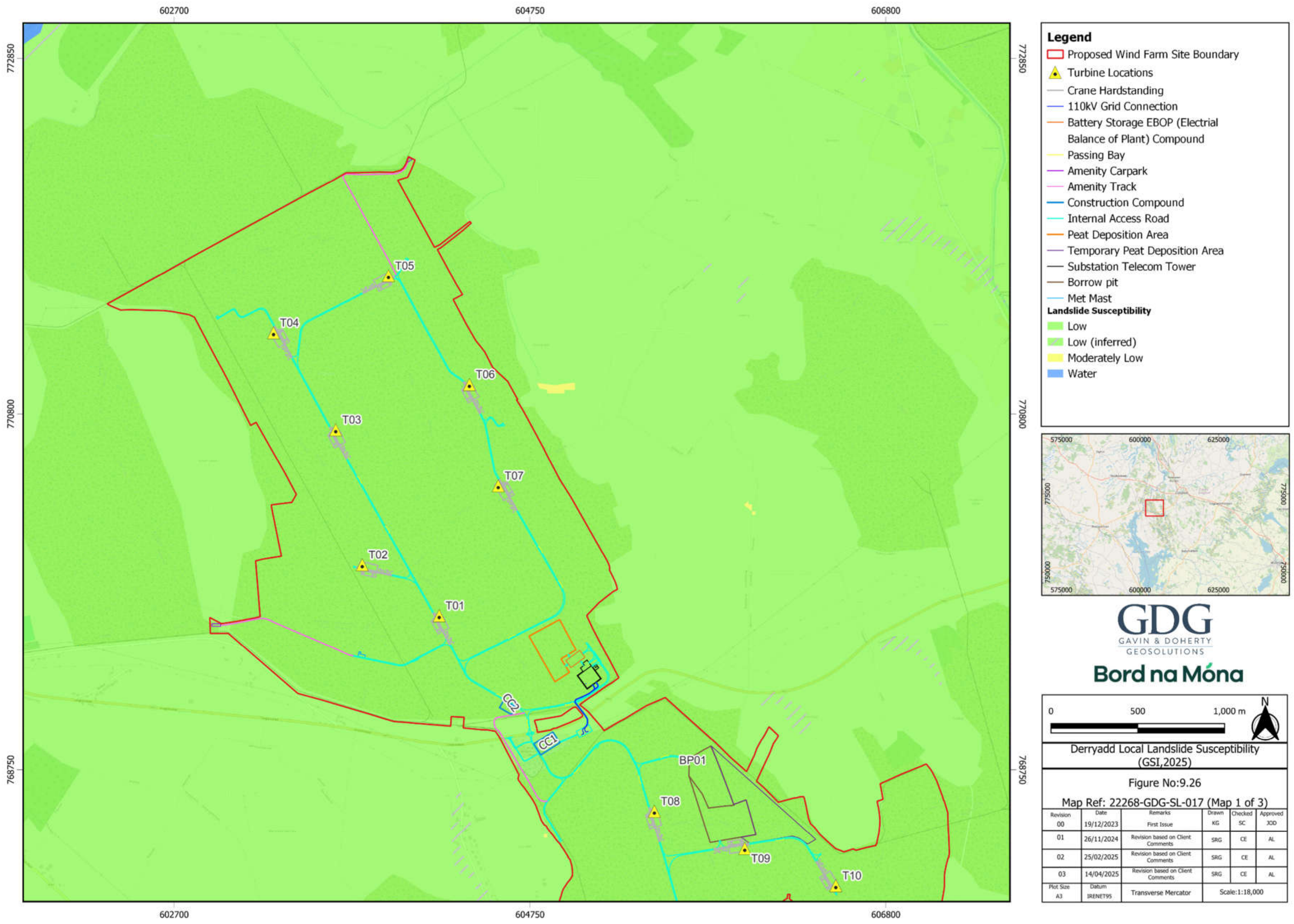


Figure 9-26: Derryadd local landslide susceptibility (GSI, 2016) (Map 1 of 3)

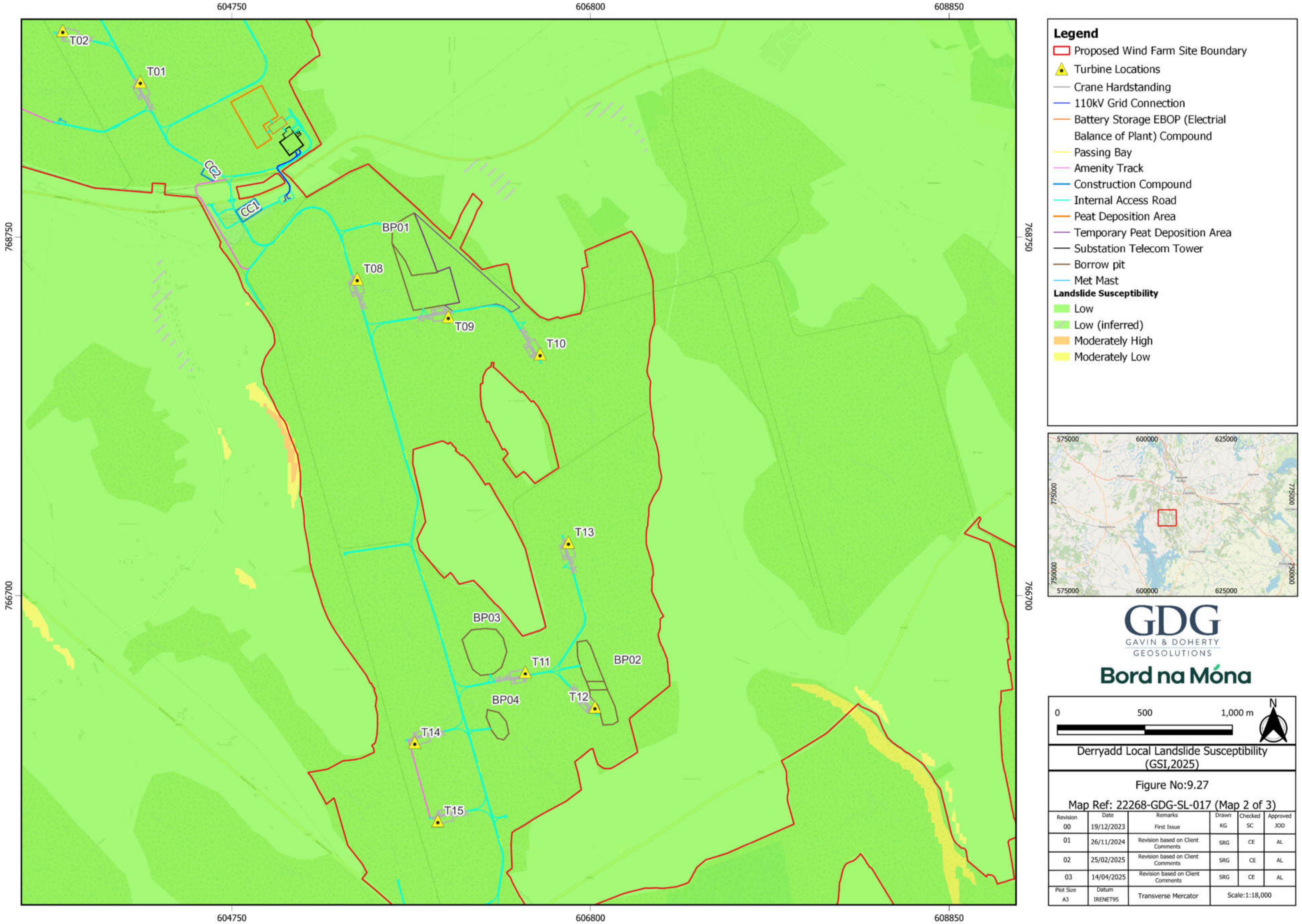


Figure 9-27: Derryadd local landslide susceptibility (GSI, 2016) (Map 2 of 3)

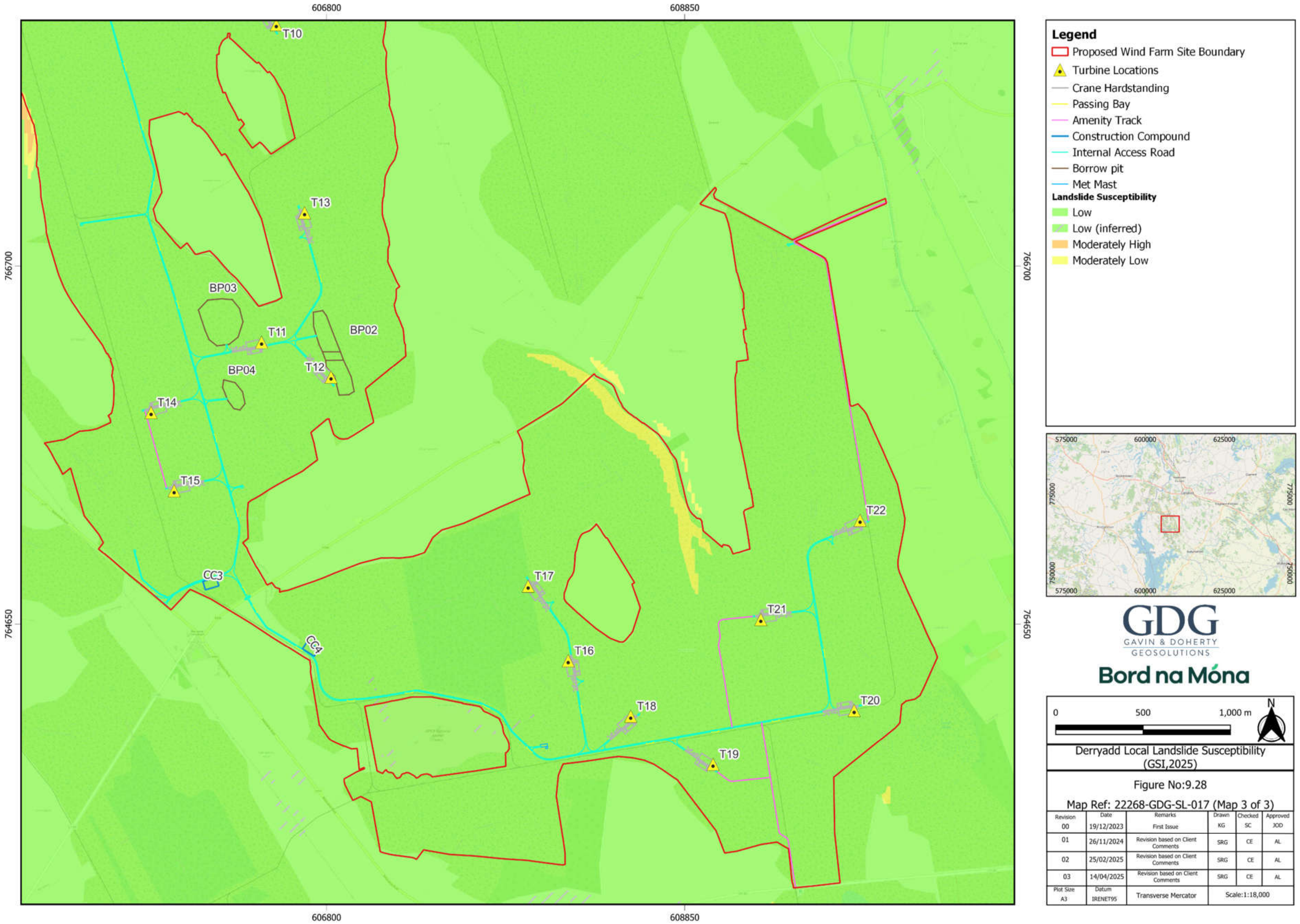


Figure 9-28: Derryadd local landslide susceptibility (GSI, 2016) (Map 3 of 3)

9.3.17 Ground Investigation

9.3.17.1 Ground Investigation specific to the Proposed Wind Farm Site

A number of ground investigations (GI) for the proposed wind farm site were carried out and detailed in Table 9-12 and are presented in Figure 9-29 to Figure 9-31.

It should be noted that a large portion of these GIs were conducted for the previous application (all GI conducted prior to 2021) and before the redesign as part of the proposed wind farm site and can thus not be considered in isolation. The site investigation information across all campaigns can be used to assess the ground conditions at the proposed wind farm site. A specific ground investigation campaign was completed in 2021 and 2023 to target the current proposed wind farm site layout. A summary of the ground profile encountered at each infrastructure location can be found in Table 9-18. Laboratory testing is considered in further detail in Section 9.3.19.

Table 9-12: Ground Investigations Summary

Date	Investigation method	Location	Logged by	Report Available in
October 2016 – January 2017	25 No. Trial Pits	Turbine locations	GDG	Appendix 9.1.1
April 2017	8 No. Trial Pits	Substation	Tobin	Appendix 9.1.2
December 2017	35 No. Trial Pits	Borrow pits	Tobin	Appendix 9.1.3
March 2018	49 No. Trial Pits	Turbine locations and haul roads	Tobin	Appendix 9.1.4
June 2017	5 No. Rotary Core Boreholes	Across Derryadd Bog	IDL	Appendix 9.1.5
April 2017	70 No. Peat Probes	Turbine locations, borrow pits and haul roads	IDL	Appendix 9.1.6
March 2018	131 No. Peat Probes	Turbine locations, borrow pits and haul roads	Tobin	Appendix 9.1.7
December 2017 – April 2018	Laboratory Testing	Turbine locations	Testconsult, NMTL, IDL & GSTL	Appendix 9.1.8
February 2021 - March 2021	336 No. Trial Pits	Turbine and borrow pit locations	IDL	Appendix 9.1.9.1
February 2021 – June 2021	• 94 No. Cable Percussive Boreholes • 90 No. Rotary Core Boreholes • Insitu permeability	Turbine and borrow pit locations	IDL	Appendix 9.1.9.1

Date	Investigation method	Location	Logged by	Report Available in
	• 343 No. Dynamic probes • 4 No. Windowless Samples • Groundwater monitoring (55 no standpipes installed) • Plate bearing tests • Laboratory testing			
July 2021	Geophysical Survey including: • 2D-Resistivity (ERT) • seismic refraction (p-wave) • MASW (s-wave) • Wenner VES measurements	Turbine and borrow pit locations	Minerex Geophysics Ltd.	Appendix 9.1.9.2
December 2022 - February 2023	• 34 No. Trial Pits • 3 No. Rotary Core Boreholes	Turbine and substation locations	IDL	Appendix 9.1.10
November 2023	97 No. Peat Probes	Turbine, access road and all infrastructure and hardstanding areas	GDG	Appendix 9.1.11

In total, the project specific ground investigation works consisted of:

- 298 No. Peat Probes;
- 487 No. Trial Pits;
- 94 No. Cable Percussive Boreholes;
- 98 No. Rotary Core Boreholes;
- 343 No. Dynamic Probes;
- 4 No. Windowless Samples;
- Geophysical Surveying;
- Plate Bearing Tests;
- In-situ Permeability testing;
- Groundwater Monitoring; and
- Laboratory testing.

These investigations confirmed the general geology indicated in the GSI geological mapping. The proposed wind farm site is generally covered in various thicknesses of peat which overlies soft to very soft silty clay or loose sand, and a variation between firm to still gravelly clay and dense sandy gravel gravels with numerous cobbles interpreted as glacial till deposits. The locations of the project specific ground investigations are shown in Figure 9-29, Figure 9-30, and Figure 9-31, and details of each investigation location are presented in Appendix 9.1 (9.1.1 to 9.1.11) (Ground Investigation reports). The interpolated peat map resulting from the peat probing conducted on this site is shown in Figure 9-34, Figure 9-35, and Figure 9-36.

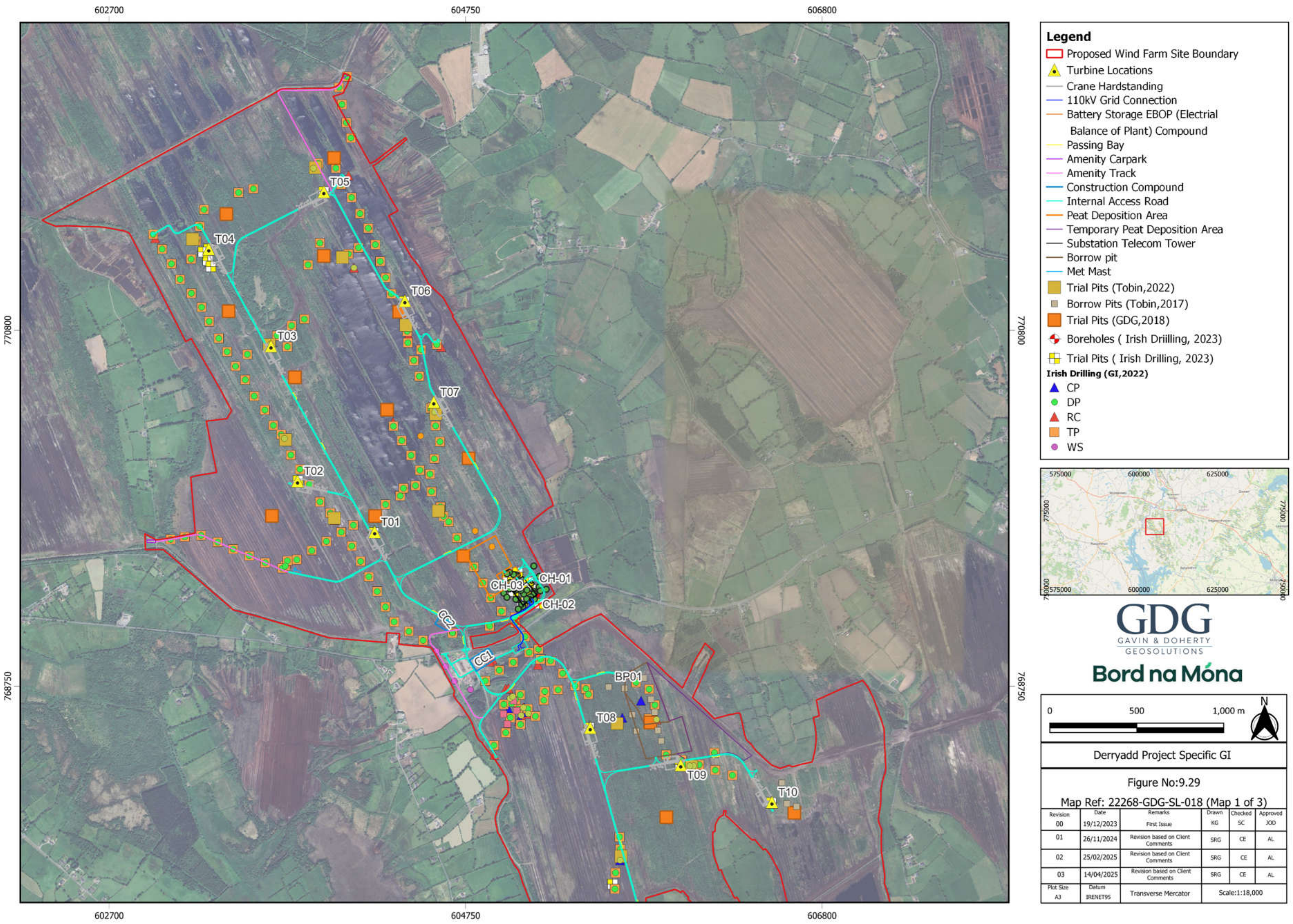


Figure 9-29: Project Specific Ground Investigations (Map 1 of 3)

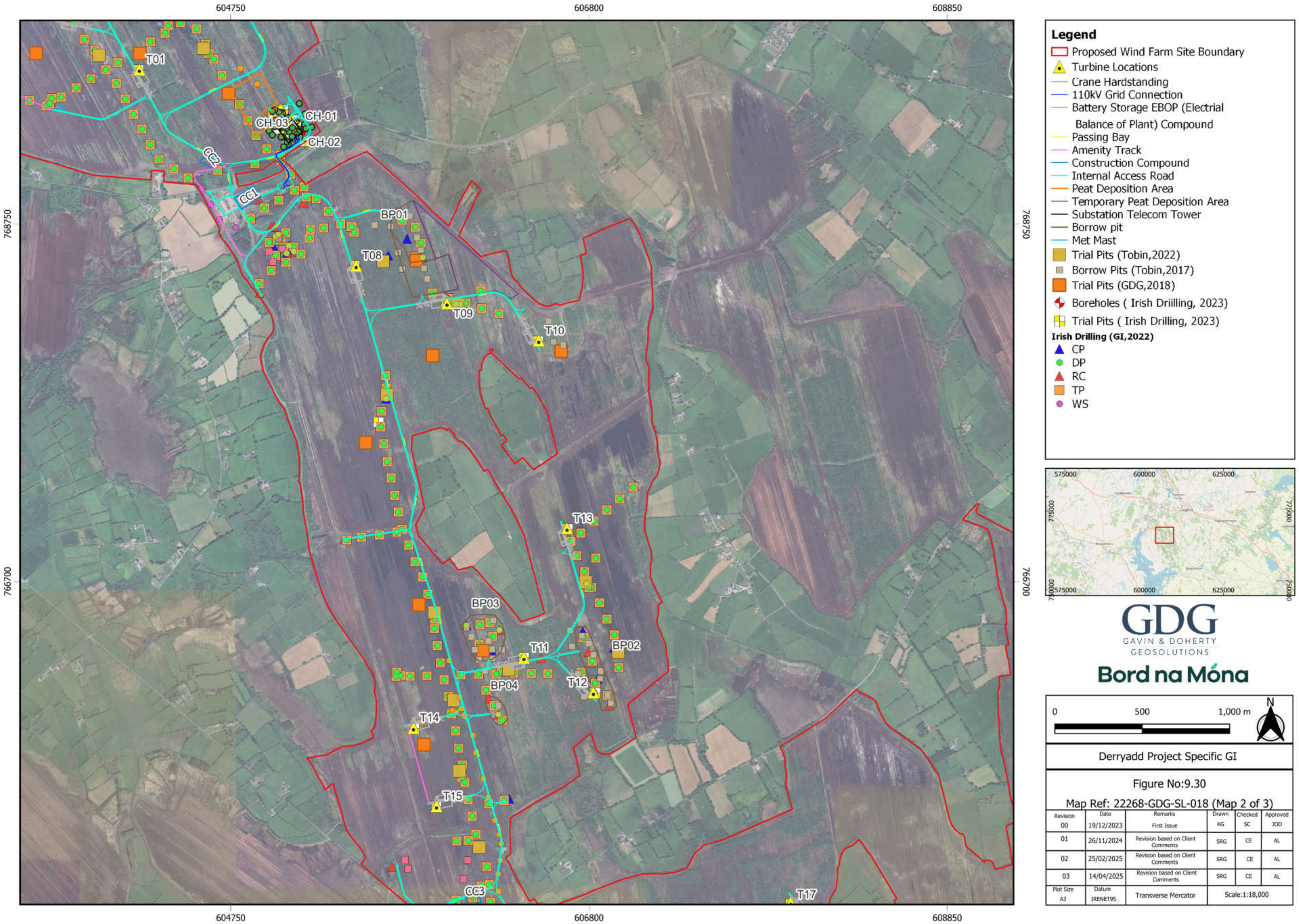


Figure 9-30: Project Specific Ground Investigations (Map 2 of 3)

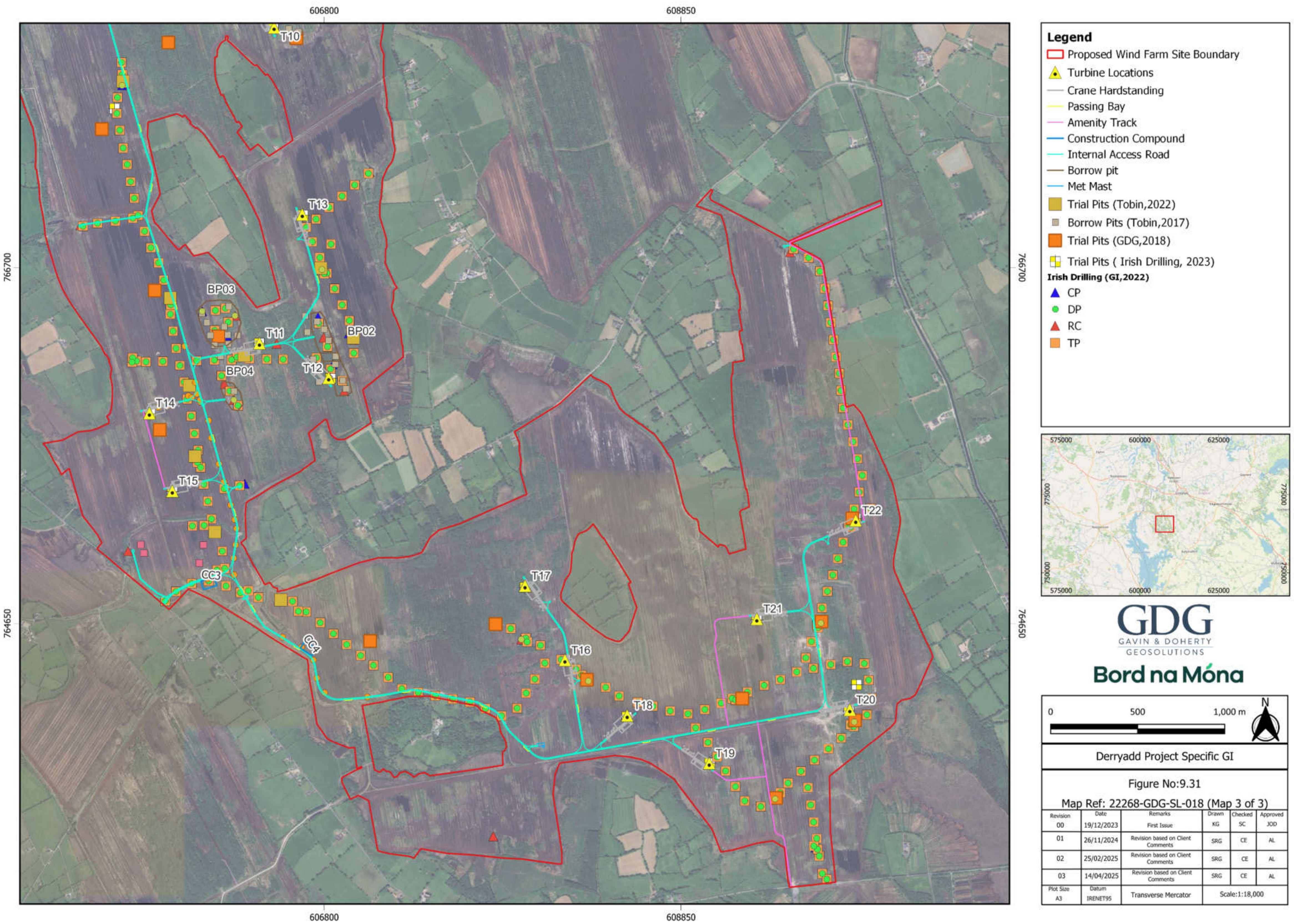


Figure 9-31: Project Specific Ground Investigations (Map 3 of 3)

9.3.17.2 Historical Ground Investigation

The GSI database contains records of historical ground investigations. The locations of these historic ground investigations are within the wind farm boundary (within Lough Bannow Bog) and within 1 km of the proposed wind farm site boundary. Refer to Figure 9.32. These investigations consist of boreholes carried out by Rio Tinto Finance and Exploration Ltd. and Aquitane Mining Ltd. between 1975-1981, located in and around the Lough Bannow bog to investigate potential mineral prospects in the area. A summary of the historical GI along with their GSI reference ID numbers are provided in Table 9-13. Logs for two of these historic boreholes are unavailable from the GSI database, but the available logs that the boreholes were drilled for mining exploration purposes. Limestone, sandstone, dolomite, wackestone, siltstone and claystone were recorded in these boreholes. These lithological descriptions are generally in agreement with those provided by the GSI as shown in Table 9-7 below.

Table 9-13: Historical Ground Investigation Summary

Ground Investigation	Year	Completed GI
Rio Tinto Finance and Exploration Ltd.	1975-1977	15 Rotary core boreholes
Aquitane Mining (Ireland) Ltd.	1981	1 Rotary Core Borehole

The depths to bedrock identified during these ground investigations are summarised in Table 9-14. These GSI database ground investigations carried out in the vicinity of the proposed wind farm site are shown in Figure 9-32. A zone of poor core recovery was identified in Borehole DLF-03, which is described as *possible sinkhole material*. The log indicates the feature is infilled with weathered limestone and clay; however, voiding was not recorded. DLF-03 is mapped within the Basal Clastics unit (GSI, 2024 Figure 9-6), but very close to the border with the Waulsortian Limestone. The presence of weathered limestone in the borehole suggests that this borehole is located within the Waulsortian. Rotary core borehole BHRCMMC (IDL, 2021 – Appendix 9.1.9.1 carried out approximately 350m west of DLF-03, records weathered sandstone and conglomerate, indicating that any potential karstification in DLF-03 is likely limited to the Waulsortian limestone in the immediate vicinity of DLF-03.

Table 9-14: Depths to bedrock from historic ground investigations

Ground Investigation	Year	Borehole ID	GSI Reference	Depth to bedrock (DTB)	Max Borehole Depth (m bgl)
Rio Tinto Fex Ltd.	1975	BPH-1	18117	1.5	32
Rio Tinto Fex Ltd.	1975	BPH-2	18118	1.5	30.5
Rio Tinto Fex Ltd.	1975	BPH-3	18119	12.2	61

Ground Investigation	Year	Borehole ID	GSI Reference	Depth to bedrock (DTB)	Max Borehole Depth (m bgl)
Rio Tinto Fex Ltd.	1976	DDB-2	18124	16.0	76.2
Rio Tinto Fex Ltd.	1976	DDB-3	18125	3.0	182.9
Rio Tinto Fex Ltd.	1976	DDB-4	18126	2.0	152.4
Rio Tinto Fex Ltd.	1976	DLF-02	18158	9.1	12.2
Rio Tinto Fex Ltd.	1976	DLF-03	18159	15.8	21.3
Rio Tinto Fex Ltd.	1976	DLF-04	18160	16.5	18
Rio Tinto Fex Ltd.	1976	DLF-16	17802	3.0	6.1
Rio Tinto Fex Ltd.	1976	DLF-17	17803	10.4	13.7
Rio Tinto Fex Ltd.	1977	DLF-28	17814	12.8	14.9
Rio Tinto Fex Ltd.	1977	DLF-29	17816	10.4	12.5
Rio Tinto Fex Ltd.	1977	LF-20	18151	12.2	104.2
Aquitaine Mining Ltd.	1981	1802DOD-3	16382	11.7	15.4

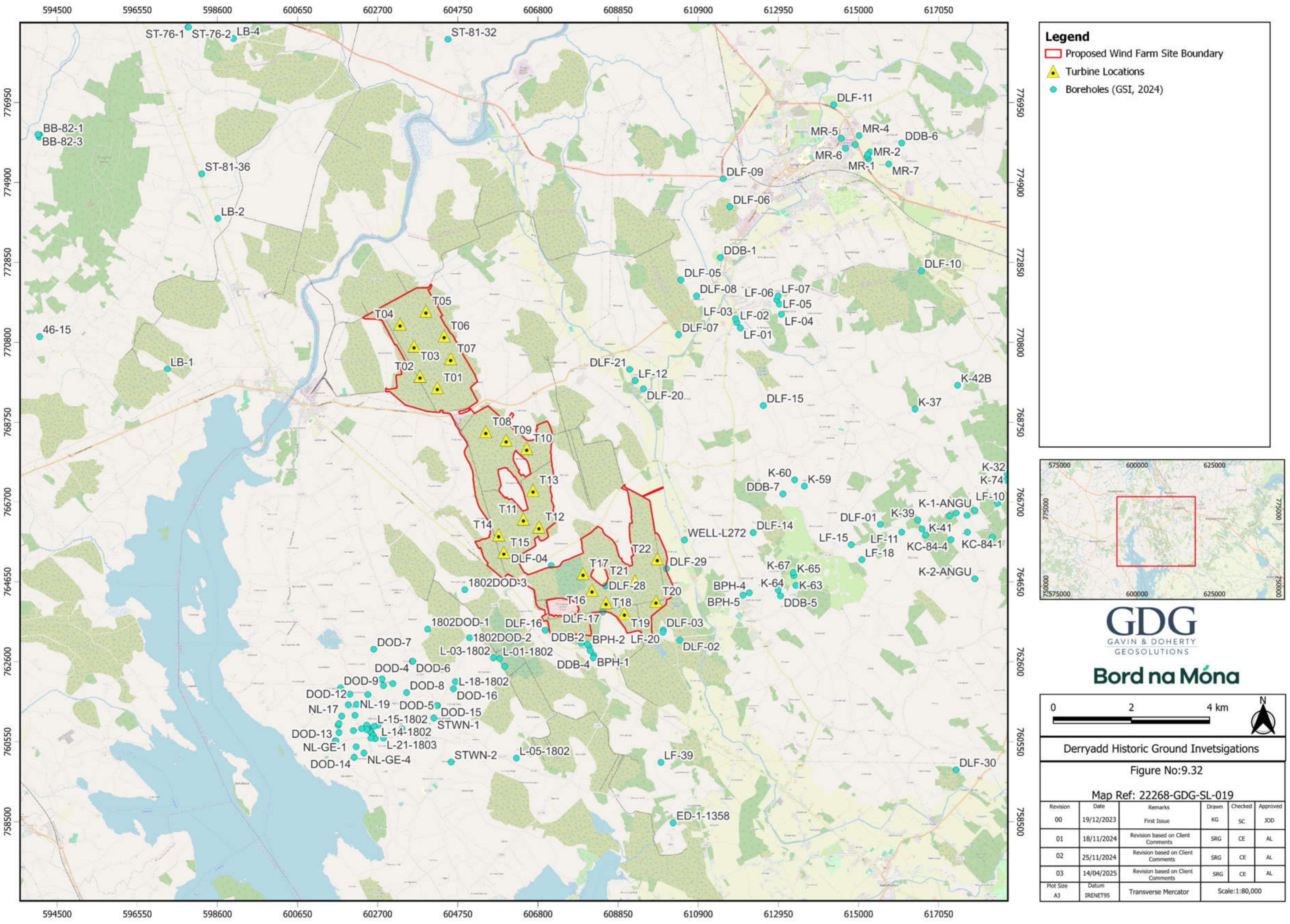


Figure 9-32: Derryadd Historic Ground Investigations

9.3.18 Ground Profile Summary

The proposed wind farm site is relatively flat lying with cutaway/cutover peat overlying a soft to very soft lacustrine marls and medium to high strength glacial till materials. The peat encountered across the site is of variable thicknesses, generally ranging from 0.1 m to 6.2m. There are also pockets of glacial till within the proposed wind farm site boundary. These areas are thought to be drumlin deposits, composed of a granular or cohesive glacial till deposits. These pockets of glacial till are mapped underlying the proposed T01, T02, and T03 locations. These are pockets of till located to the south of T04, north of T11, to the west of T16 and T17, and directly south of T20.

Peat thickness encountered by intrusive investigations at a total of 773 locations across the site, recording peat thicknesses that vary from zero to a maximum thickness of 6.2 m, with an average of 1.38 m recorded. A summary of the peat probes and encountered depths at each of the three bogs is presented in Table 9-15. The frequency of different peat thicknesses is shown in Figure 9-33. In total, 47% of recorded peat thickness were under 1 m, and 77% were under 2 m. Refer to Table 9-16 for the average peat depths at infrastructure locations. Peat depths in excess of 2 m were encountered within the southern part of the site, concentrated around the vicinity of T19, T20 and T22 (Figure 9-34 to Figure 9-36).

Table 9-15: Peat Depth Summary

Bog Name	Number of Peat probes	Maximum Peat Depth (m)	Average Peat Depth (m)	Summary Subsoil Lithology
Derryarogue Bog	263	6.2	1.4	Peat Sandy silty CLAY/SILT Silty SAND/GRAVEL
Derryadd Bog	279	5.8	1.5	Peat Gravelly silty CLAY
Lough Bannow Bog	224	4.1	1.3	Peat Silty gravelly CLAY Sandy silty GRAVEL

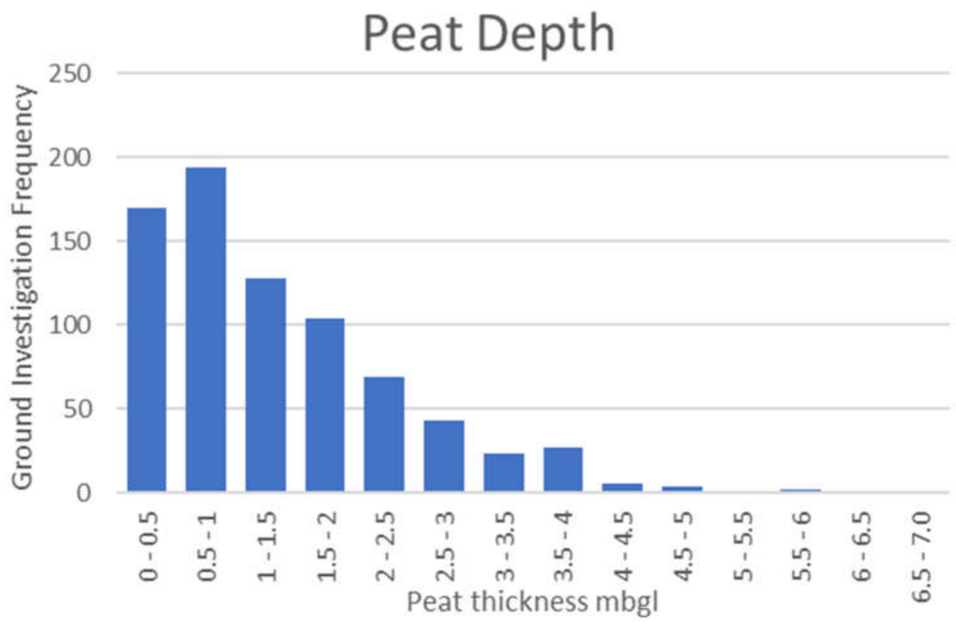


Figure 9-33: Peat depths encountered across the site (all project specific GI, excluding historic GI).

Table 9-16: Average peat depths at infrastructure locations.

Infrastructure Location	Average Peat Depth (m)
Turbine 1	0.26
Turbine 2	0.37
Turbine 3	0.53
Turbine 4	1.25
Turbine 5	2.35
Turbine 6	1.86
Turbine 7	1.57
Turbine 8	0.70
Turbine 9	0.68
Turbine 10	0.29
Turbine 11	0.41
Turbine 12	0.29
Turbine 13	0.84
Turbine 14	0.46

Infrastructure Location	Average Peat Depth (m)
Turbine 15	0.86
Turbine 16	1.79
Turbine 17	0.62
Turbine 18	2.63
Turbine 19	0.89
Turbine 20	1.21
Turbine 21	0.37
Turbine 22	1.79
Battery Storage compound	0.9
Substation	1.7
Construction Compound 1	3.1
Construction Compound 2	3.4
Construction Compound 3	0
Construction Compound 4	1.8
Met Mast 1 (Derryaroge Bog)	1.9
Met Mast 2 (Lough Bannow Bog)	2.9
Borrow Pit 01	0.82
Borrow Pit 02	0.91
Borrow Pit 03	0.6
Borrow Pit 04	0.82
Peat Deposition Area (Derryaroge Bog)	1.6
Peat Deposition Area (Derryadd Bog)	1.5

Isolated areas of glacial till, subcrop and bedrock outcrops were identified across the site. Glacial till and bedrock cuttings are regularly exposed in drainage systems throughout the site. Identified areas of glacial till material subcrop or exposed on cutting was generally described as cohesive with some large cobbles present but some areas of predominantly granular material were also identified.

In general, limestone bedrock was encountered between 2 m and 9 m below ground level. The average elevation at which bedrock was encountered is 39.80 mOD.

Table 9-17 provides a summary of the borehole information used to constrain depth to bedrock, including elevations at which bedrock was encountered at each location.

Table 9-17: Bedrock elevations encountered during site investigations

Borehole ID	Borehole elevation (mOD)	Depth to bedrock (m)	Bedrock elevation (mOD)
RC01 (May 2017)	42.37	8.00	34.37
RC02 (May 2017)	43.16	7.50	35.66
RC03 (May 2017)	42.82	2.70	40.12
RC04 (May 2017)	42.88	3.80	39.08
RC05 (May 2017)	47.19	22.50	24.69
BHRC08A (March/April 2021)	38.22	9.30	28.92
BHRC08B (March/April 2021)	38.23	8.90	29.33
BHRC14A (April 2021)	43.89	4.20	39.69
BHRC19A (April 2021)	49.99	3.70	46.29
BHRC19B (April 2021)	50.57	4.80	45.77
BHRC24A (April / May 2021)	52.70	5.60	47.10
BHRCBPA1 (March 2021)	42.08	3.30	38.78
BHRCBPA2 (March 2021)	42.00	7.10	34.90
BHRCBPA3 (March 2021)	42.66	3.00	39.66
BHRCBPD1 (April 2021)	46.35	2.70	43.65
BHRCBPD2 (April 2021)	46.54	2.00	44.54
BHRCBPB1 (April 2021)	41.09	2.60	38.49
BHRCBPB2 (April 2021)	44.83	3.40	41.43
BHRCBPB3 (April 2021)	43.57	2.40	41.17
BHRCBPC1 (April 2021)	41.88	5.50	36.38
BHRCBPC2 (April 2021)	43.33	7.30	36.03
BHRCBPE1 (April 2021)	47.46	3.00	44.46
RC-01 (December 2022)	41.55	8.20	33.35
RC-02 (December 2022)	42.16	7.10	35.06
RC-03 (December 2022)	43.43	8.60	34.83

CH-01 (February 2023)	41.55	4.30	37.25
CH-02 (February 2023)	42.16	1.20	40.96
CH-03 (February 2023)	43.43	2.20	41.23

A summary of the ground conditions encountered during the 2021-2023 IDL ground investigations carried out as part of this EIAR is given in Table 9-18. This summary has been developed using available trial pit (TP) and borehole (BH) data.

Table 9-18: Ground profile at various locations

Location	Ground Profile Depth (mbgl)	Description	Nearest Representative GI Locations
Turbine 1	0.0 – 0.20 0.20 – 1.20+	PEAT Slightly gravelly silty CLAY Bedrock not encountered	TP-07 (December 2022)
Turbine 2	0.0 – 0.10 0.10 – 1.70+	PEAT Sandy silty gravelly CLAY Bedrock not encountered	TP-06 (December 2022) TP-353 (February 2021)
Turbine 3	0.0 – 0.10 0.10 – 0.40 0.40 – 3.50+	PEAT Slightly gravelly silty SAND Gravelly silty CLAY Bedrock not encountered	TP-03 (December 2022) BHRC-03A (February 2021) BHRC-03B (February 2021)
Turbine 4	0.0 – 1.50 1.50 – 2.30+	PEAT Gravelly sandy SILT Bedrock not encountered	TP – 01 (December 2022) TP-X (December 2022) TP-Y (December 2022) TP-Z (December 2022)
Turbine 5	0.0 – 2.40 2.40 -3.20 3.20 – 3.40 3.40 – 3.70+	PEAT Slightly sandy SILT Silty SAND and GRAVEL Sandy gravelly SILT Bedrock not encountered	TP-02 (February 2023)

Location	Ground Profile Depth (mbgl)	Description	Nearest Representative GI Locations
Turbine 6	0.0 – 0.05 0.05 – 0.70 0.70 – 2.60+	PEAT Silty Clay Clayey very sandy SILT Bedrock not encountered	TP-08 (December 2022)
Turbine 7	0.0 – 2.10 2.10 – 4.00 4.00 – 9.30 9.30 – 15.00+	PEAT SILT Silty sandy Gravel Limestone Bedrock encountered at 9.30 mbgl	BHRC08A (March/April 2021) BHRC08B (March/April 2021) TPT 08 (February 2021)
Turbine 8	0.0 – 0.75 0.75 – 1.30 1.30 – 1.80+	PEAT Silty Clay Gravelly silty Clay Bedrock not encountered	TP-08 (December 2022)
Turbine 9	0.0 – 1.00 1.0 – 2.00+	PEAT Gravelly sandy clayey SILT Bedrock not encountered.	TP-09 (December 2022) TPT 11 (March 2021)
Turbine 10	0.0 – 0.30 0.30 – 1.00 1.00 – 1.80+	PEAT Silty Clay Sandy Gravely silty clay Bedrock not encountered	TP 10 (December 2022)
Turbine 11	0.0 -0.30 0.30 – 5.00 5.00 – 9.80+	PEAT Clay with cobbles Limestone Bedrock encountered at 5.00 mbgl at close by borehole location	TP 12 (December 2022) BHRC14A (April 2021)

Location	Ground Profile Depth (mbgl)	Description	Nearest Representative GI Locations
Turbine 12	0.0 – 0.20 0.20 – 1.30+	PEAT Silty Clay Bedrock not encountered	TP 14 (December 2022)
Turbine 13	0.0 – 1.00 1.00 – 2.20+	PEAT Gravelly silty Clay Bedrock no encountered	TP-11 (Dember 2022) TP240 (March 2021)
Turbine 14	0.00-0.70 0.70 -1.10 1.10 – 1.90+	PEAT Silty Clay Fine to coarse Gravel Bedrock not encountered	TP-13 (December 2022)
Turbine 15	0.0 – 0.80 0.80 -2.50+	PEAT Silty Clay Bedrock not encountered	TP-15 (December 2022)
Turbine 16	0.0 – 1.90 1.90 – 4.80 4.80 – 10.80+	PEAT Silty Clay Limestone Bedrock encountered at borehole locations around 150m from turbine site.	TP (December 2022) TP 131 (March 2021) BH19A (April 2021) BH19B (April 2021)
Turbine 17	0.0 – 0.60 0.60 – 1.10 1.10 – 1.70+	PEAT Slightly gravelly Silty Clay Clayey silty Gravel Bedrock not encountered	TP – 16 (December 2022
Turbine 18	0.0 – 2.00 2.00 – 3.30+	PEAT Silty Clay Bedrock not encountered	TP-18 (December 2022)

Location	Ground Profile Depth (mbgl)	Description	Nearest Representative GI Locations
Turbine 19	0.0 – 0.90 0.90 - 1.80+	Peat Silty very gravelly Clay Bedrock not encountered	TP – 19 (December 2022)
Turbine 20	0.0 – 1.00 1.00 – 1.30 1.30 - 2.00+	PEAT Clayey gravelly sandy SLIT Sandy silty clayey Gravel Bedrock not encountered	TP-23 (December 2022)
Turbine 21	0.0 – 0.30 0.30 – 0.60 0.60 – 1.20+	Peat Gravelly sandy clayey Silt Sandy gravelly silty Clay Bedrock not encountered	TP-20 (December 2022)
Turbine 22	0.0 – 1.60 1.60 – 3.00 3.00 – 5.00 5.00 – 5.60 5.60 - 12.20+	Peat Slightly gravelly sandy Clay Limestone Gravel Weathered limestone Rock Thinly bedded Limestone Rock Bedrock encountered at 5.60 mbgl at close by borehole locations	TP-21A (December 2022) BHRC24A (April/May 2021)
Battery Storage compound	0.0 – 1.90 1.90 – 2.60+	Peat Gravely silty clay/clayey silt Bedrock not encountered	TP-25 (December 2022) TP-26 (December 2022)
Substation	0.0 – 1.20 1.20 – 3.00 3.00 – 3.20+	Peat Silty clay/clayey Silt Clayey Silty Gravel Bedrock not encountered	TP-26 (December 2022) TP-27 (December 2022) TP-28 (December 2022) TP-29 (December 2022)

Location	Ground Profile Depth (mbgl)	Description	Nearest Representative GI Locations
			CH-01 (February 2023) CH-02 (February 2023) CH-03 (February 2023)
Construction Compound 1	0-0.7 0.70-3.80 3.8-5.60 5.60+	MADE GROUND Peat Sandy gravelly Silt Limestone Bedrock	BHRCSSA09 (March 2021) BHRCSSA10 (March 2021)
Construction Compound 2	0-0.4 0.4-3.80 3.8-4.00+	MADE GROUND Peat Sandy clayey gravelly Silt	TPAR17 (February 2021)
Construction Compound 3	0-1.70 1.70-3.80+	Gravelly silty Clay Clayey gravelly Silt	TP104 (March 2021)
Construction Compound 4	0-1.80 1.80-3.50+	Peat Gravelly silty Clay	TP110 (March 2021) TP111 (March 2021)
Met Mast 1 (Derryaroge Bog)	0-1.9 1.90-2.80 2.80-6.00 6.00-6.70 6.70-11.90+	Peat Sandy clayey Gravel Gravelly silty Clay Limestone Gravel Thinly bedded Limestone Rock	BHRCMMA (March 21) TPMMA02 (February 2021)
Met Mast 2 (Lough Bannow Bog)	0-2.90 2.90-3.20 3.20-3.40	Peat Silty gravelly Cobbles Silty gravelly Clay	TP124 (March 2021)
Borrow Pit 01	0.0 – 1.00 1.00 – 2.20 2.20 – 3.20 3.20 – 7.10 7.10 – 8.00+	Peat Silty sandy gravelly Clay Limestone Gravel Weathered Limestone Rock Limestone Bedrock encountered at 7.10 mbgl	BHRCBPA1 (March 2021) BHRCBPA2 (March 2021) BHRCBPA3 (March 2021) TPBPA01 (Marc 2021) TPBPA02 (Marc 2021) TPBPA03 (Marc 2021)

Location	Ground Profile Depth (mbgl)	Description	Nearest Representative GI Locations
			TPBPA04 (Marc 2021)
Borrow Pit 02	0.0 – 0.40 0.40 – 2.00 2.00 – 3.00 3.00 – 9.00+	Peat Silty sandy Clay Limestone Gravel Limestone Bedrock encountered at 3.00 mbgl	BHRCBPD1 (April 2021) BHRCBPD2 (April 2021) BHRCBPE1 (April 2021) BHRCBPE2 (April 2021) TBPBD01 (March 2021) TPBPD02 (March 2021) TPBPE01 (March 2021) TBPBE02 (March 2021)
Borrow Pit 03	0.0 – 0.50 0.50 – 1.20 1.20 – 2.40 2.40 – 8.40 +	Peat Gravelly silty sandy Clay Limestone Gravel Limestone Bedrock encountered at 2.40 mbgl	BHRCBPB1 (April 2021) BHRCBPB2 (April 2021) BHRCBPB3 (April 2021) TPBPB01 (March 2021) TPBPB02 (March 2021) TPBPB03 (March 2021) TPBPB04 (March 2021)
Borrow Pit 04	0.0 – 0.40 0.40 – 2.00 2.00 – 5.50 5.50 – 7.30 7.30 – 8.00+	Peat Silty sandy Clay Sandy Gravelly Silt Limestone Gravel Limestone Bedrock encountered at 7.30 mbgl	BHRCBPC1 (April 2021) BHRCBPC2 (April 2021) TPBPC01 (March 2021) TPBPC02 (March 2021)

Location	Ground Profile Depth (mbgl)	Description	Nearest Representative GI Locations
Peat Deposition Area (Derryaroge Bog)	0-1.6 1.6-2.1 2.1-3.2+	Peat Gravelly silty Clay Gravelly clayey Silt	TP283 (February 2021) TP284 (February 2021) TP285 (February 2021)
Peat Deposition Area (Derryadd Bog)	0-1.5+	Gravelly silty Clay	TP268 (March 2021)

9.3.19 Laboratory Test Results

Laboratory testing was carried out on samples collected from trial pits and boreholes during the several ground investigation campaigns between 2016 and 2021. Laboratory testing was not carried out on samples taken from the 2022 and 2023 (IDL) ground investigations. Testing was carried out on sample locations at turbine and borrow pit locations. These were undertaken by different laboratories at various investigation stages as shown in Table 9-19.

Table 9-19: Laboratory testing undertaken

Date	Laboratory	Description	Tests
December 2016 - January 2017	Testconsult Ltd	Samples from trial pitting (October 2016 – January 2017) at turbine locations;	• 5 no. Atterberg Limits • 7 no. Particle Size Distribution • 3 no. Moisture Content • 1 no. pH
April 2017	IDL	Samples from trial pitting (April 2017) at potential substation locations;	• 4 no. Atterberg Limits • 6 no. Particle Size Distribution • 5 no. MCV
July 2017	IDL	Samples from rotary coring (July 2017) across Derryadd bog;	• 11 no. Point Load Test
January 2018	NMTL	Samples from trial pitting (December 2017) at borrow pit locations; and	• 4 no. Particle Size Distribution • 4 no. MCV
April 2018	GSTL	Samples from trial pitting (March 2018) at turbine locations and some haul roads.	• 20 no. Atterberg Limits • 20 no. Particle Size Distribution • 20 no. Moisture Content
February 2021 - June 2021	IDL	Samples from trial pitting and boreholes.	• 134 no. Atterberg Limits • 103 no. Particle Size Distribution • 394 no. Moisture Content • 5 no. MCV • 11 No. Lab CBR • 3 no. OMC

Date	Laboratory	Description	Tests
			• 2 no. Particle Density • 28 no. pH • 30 no. Sulphate (Total) • 43 no. Organic Content • 13 no. Point Load Test

Tests carried out on disturbed and undisturbed soil samples included the following:

- Water content (417 no.);
- Atterberg limits (163 no.);
- Particle density (2no.);
- Particle size distribution (140 no.);
- Compaction (MCV, 14 no., CBR, 11 no., OMC, 3 no.); and
- Chemical testing (pH, 29 no., Sulphate (Total), 30 no., Organic content, 43 no.)

Tests carried out on rock core samples included:

- Point load testing (24 no.)

The laboratory test results are included in Appendix 9.1.8 and Appendix9.1.9.

9.3.20 Karst Features

Karst features are formed from the dissolution of soluble rocks such as limestone and dolomite and characterised by underground drainage systems with sinkholes and caves. GSI holds a database recording karst features and landforms (GSI, 2024). The dataset indicates that no karst features are present within the proposed wind farm site. However, a number of karst features are located 1.0 km to 4.0 km outside of the proposed wind farm site boundary. Karst features are also discussed in further detail in Chapter 10 (Hydrology and Hydrogeology). Refer to Figure 9-21.

There are two turloughs and a group of enclosed depressions approximately 3 to 4 km to the west of the southern portion of the proposed wind farm site, and another group of enclosed depressions approximately 0.8-2 km to the east of the northern portion of the proposed wind farm site. An enclosed depression is regarded by the GSI as a water entry point into the ground in the form of, for example, a doline or a sinkhole. Figure 9-21 presents the karst features located in the vicinity of the proposed wind farm site. These features are predominantly recorded over the Visean Limestone (undifferentiated) bedrock with one recorded feature located over the Ballysteen formation. Table 9-8 indicates which bedrock formation underlie the various infrastructure. The karst features are also generally recorded in areas of till subsoils without any peat cover. A zone of poor core recovery was identified in historic borehole DLF-03 (Rio Tinto Fex Ltd., 1976), located 750 m south of Turbine 20 (300 m south of the red line boundary) which is described as possible sinkhole material. The log indicates the feature is infilled with weathered limestone and clay; however, voiding was not recorded.

Karst surface features were not observed on site walkovers, although it is noted that karst features would not be easy to identify as the site is predominantly cut bog. Rotary drilling of bedrock within Derryadd Bog identified weathered limestone bedrock in some locations, but this has not been identified beneath any turbine locations. Some joints in the limestone bedrock have been described as open (0.5 to 2.5 mm wide) and moderately wide (10 – 100 mm wide), indicating some minor dissolution at joints. The drilling did not encounter any significant karstic features such as voids (refer to the site investigation contract factual report IDL, 2021 in Appendix 9.1.9.

While karst features have not been encountered within the proposed wind farm site boundary, it is possible that karst features (voids, conduits and highly weathered zones) are located below the proposed wind farm site extents which have not been identified due to the thick cover of peat and subsoils. Potential effects of karst Mitigation measures to manage any residual karst risk are proposed in Section 9.5.

9.3.21 Peat and Subsoil Stability Assessment

A qualitative assessment of the stability of peat and subsoils is presented and discussed in detail in the separate Peat Stability Risk Assessment report (PSRA, Appendix 9.3). A summary of the encountered peat depths is outlined in Section 9.3.18. In addition to peat depths, assessment of peat condition and strength has been carried out over the course of the ground investigation campaigns.

In general, the peat is described as pseudo fibrous or fibrous with a Von Post measurement (from Hobbs, 1986) varying between H3-H5 (very slightly to moderately decomposed peat), some occasional thin thicknesses (<0.5 m) of strongly decomposed amorphous peat with a Von Post reading >H6 (moderately highly decomposed peat or higher) is recorded. There is little evidence of any trend in the Von Post results in plan, or laterally throughout the site. It was common for the Von Post number to increase with depth, although there was considerable local variation and reversals of this trend were also observed.

Over 600 shear vane tests were varied out during the several site investigation campaigns at locations throughout the proposed wind farm site. The tests were carried out at 0.5 m depth intervals through the peat material encountered at the site to best understand any variation within the peat material with depth. A large variation in shear vane results was seen throughout the peat material ranging up to 45 kPa. The weakest peat recorded was a shear strength of 5 kPa was found at scattered locations of the site. These low shear strength results were generally found in the upper part of the ground profile (< 0.5 m). There was no evidence for particularly weak zones being present at depth (>1.5 m) within the peat mass. There appeared to be little trend evident between variation in the shear vane result and the Von Post description.

A deterministic Factor of Safety (FoS) was calculated across the proposed infrastructure locations, and from this, a robust Peat Stability Risk Assessment (PSRA) was performed. The findings of the peat assessment outlined in the PSRA (Appendix 9.3) showed that the site has an acceptable margin of safety and is suitable for the proposed turbine locations.

9.3.22 Summary of Baseline Conditions and Sensitivity Receptors

A review of desk study information on the proposed wind farm site indicates the majority of the proposed wind farm site is covered by glacial till/lacustrine marls, overlain by cutaway/cutover raised peat, and with localised alluvial soils associated with watercourses. Peat is present across large parts of the site at thicknesses typically between 0.1 m and 6.2 m. The peat depths encountered at the footprint of the proposed wind farm generally range between 0.1 and 2 m but occasionally exceeding 2 m and reaching 5 m at some locations. Bedrock comprises of Visean and Argillaceous Limestones, typically encountered between 2.0mbgl and 9.0mbgl.

A number of sensitive receptors in the geological and hydrogeological environment have been identified during assessment of baseline conditions. These receptor sensitivities are presented in Table 9-20.

Table 9-20: Receptor sensitivity

Receptor	Sensitivity	Discussion
Soils (excluding peat)	Low	Peat soils across the site are generally expected to be underlain lacustrine marls and glacial till. Considering their low agricultural value and geological importance, the sensitivity of the marls and glacial till is considered to be low.
Peat (carbon resource)	High	Peat depths present across the proposed wind farm site vary, with peat thickness of up to 6.2 m identified in localised areas. The peat depths within the footprint of the proposed wind farm are generally less than 2 m.
Peat (landslide)	High	The peat stability risk with regards the proposed infrastructure locations ranges between negligible and low. Some localised areas of slightly higher stability risk were identified during the assessment. These are derived from localised peat banks and drains and not considered to be a significant stability risk, and do not interact significantly with proposed infrastructure. Methodologies for the mitigation of these risk areas are outlined in the associated Peat and Spoil Management Plan in Appendix 9.2 and in Section 9.5 of this chapter.
Geology	Low	Visean and Argillaceous Limestones of low geological value, no designated geological sites, economic geological resources or carbonate rock are located within the proposed wind farm site.
Contamination	Low	There are no likely historical sources of significant contamination within the site, other than the possible use of plant and machinery during the industrial extraction of peat. Although no chemical analysis was undertaken during the intrusive investigation, and no significant visual or olfactory evidence of contamination was recorded. Consequently, the sensitivity associated with contamination in relation to soils, geology and hydrogeology is considered to be low.

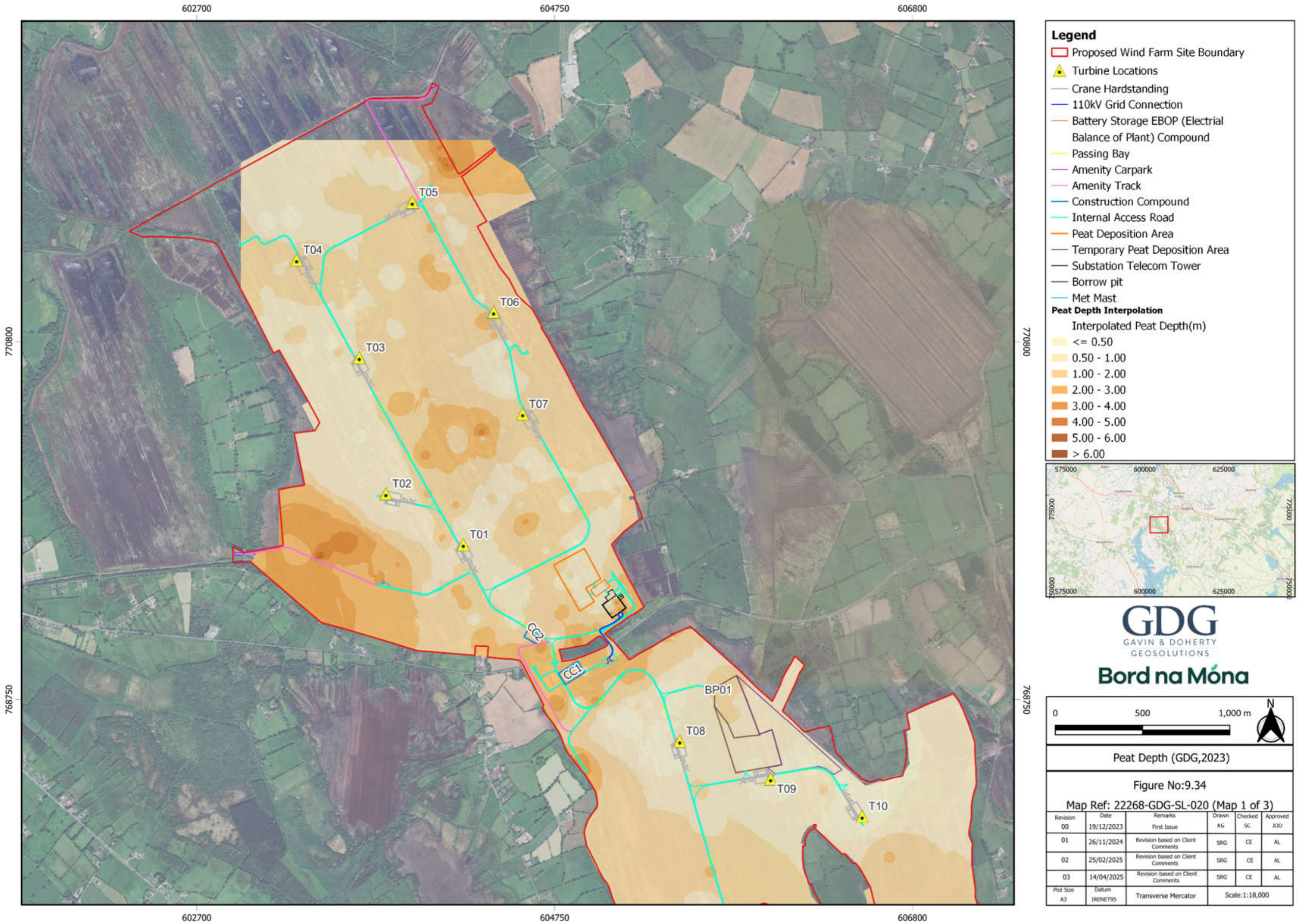


Figure 9-34: Peat Depth interpolation based on final peat probe and GI dataset following GDG, 2023 peat probing (Map 1 of 3)

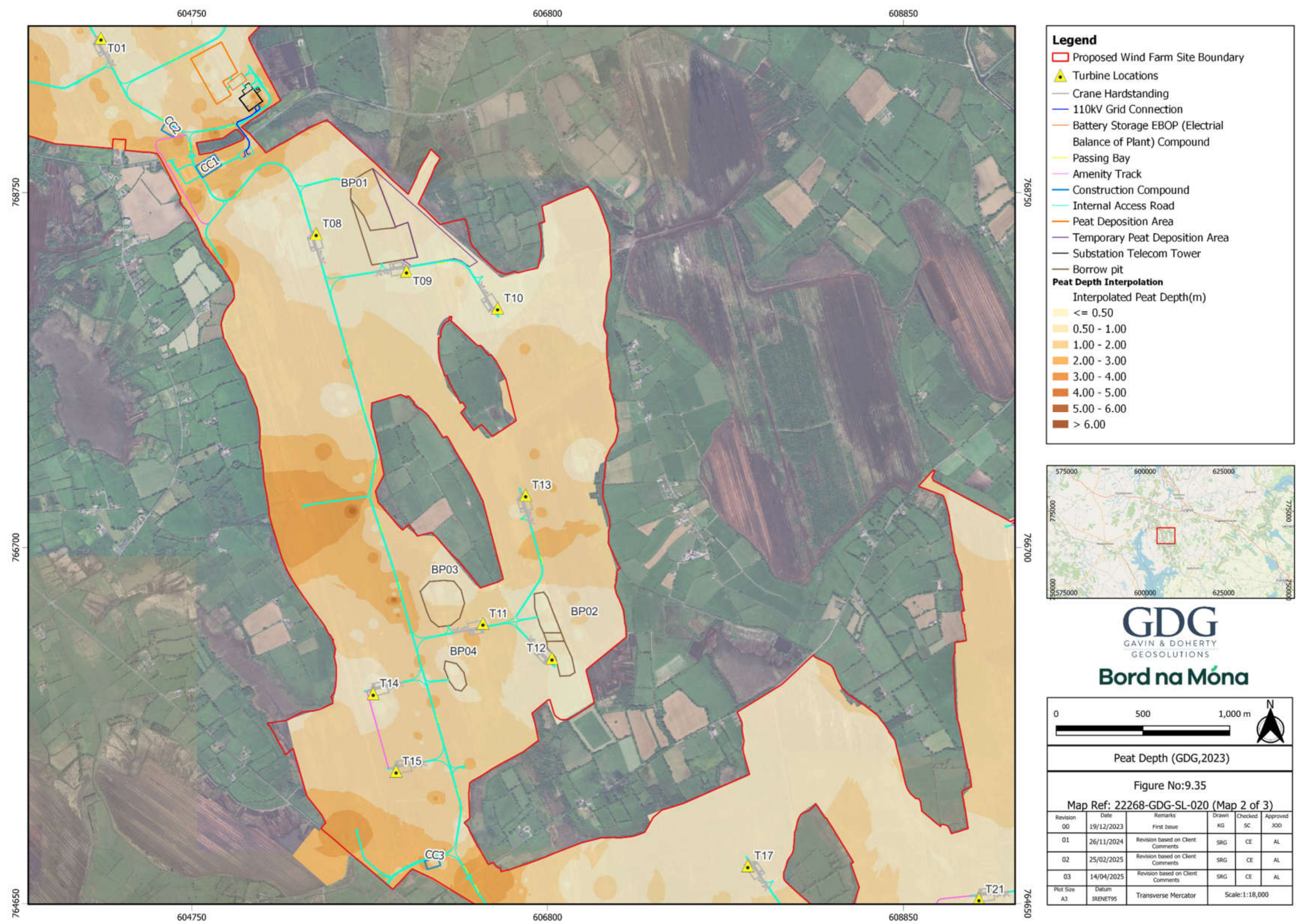


Figure 9-35: Peat Depth interpolation based on final peat probe and GI dataset following GDG, 2023 peat probing (Map 2 of 3)

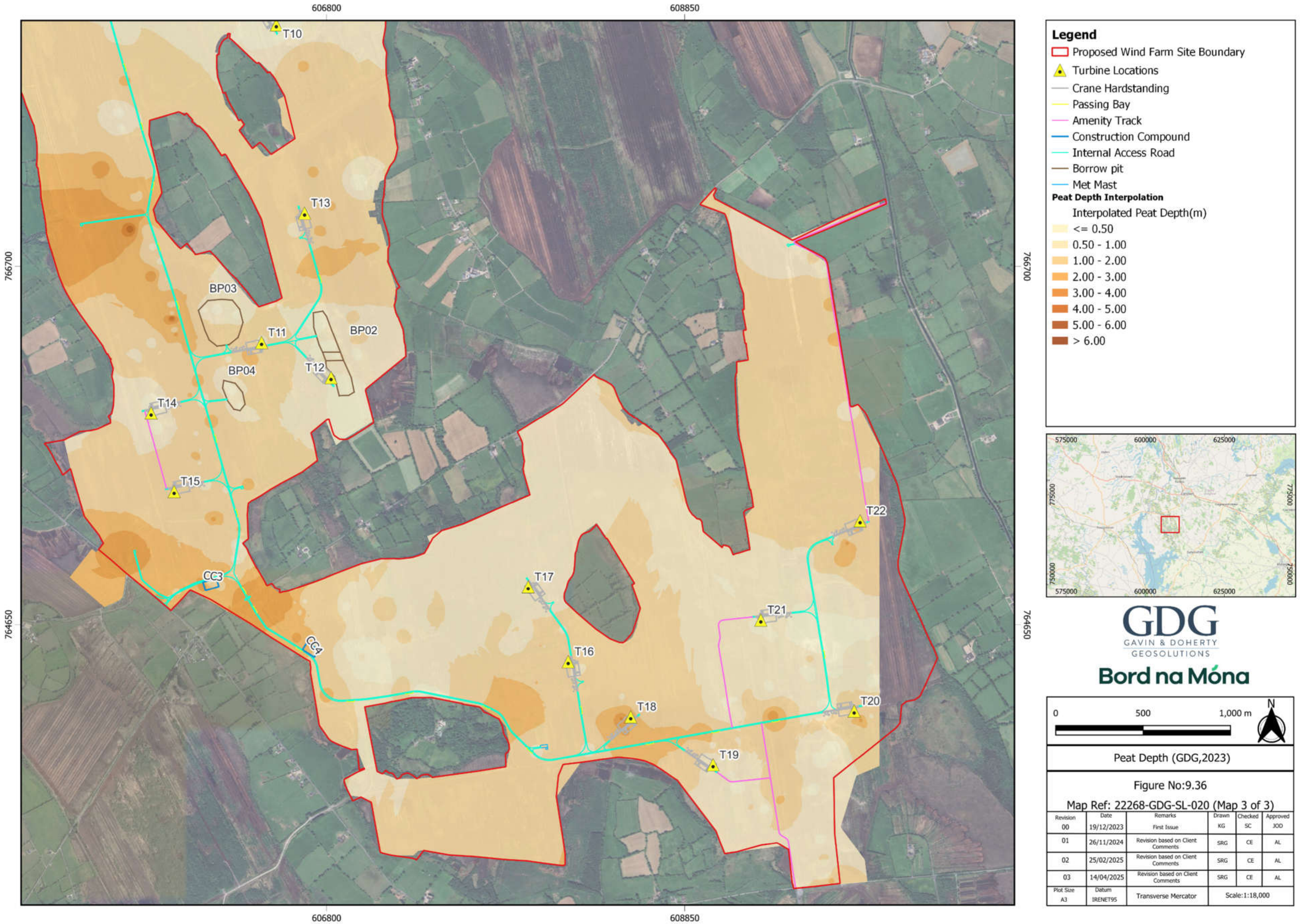


Figure 9-36: Peat Depth interpolation based on final peat probe and GI dataset following GDG, 2023 peat probing (Map 3 of 3)

9.4 Potential Effects

9.4.1 Do-Nothing Effects

The do-nothing scenario relevant to soils and geology is one where no further proposed developments or activities are planned for the site. Bord na Móna has ceased peat extraction and all associated extraction activities at the proposed site since 2019. In the Do-Nothing Scenario, the existing lands will continue to be utilised for its current land use purposes. In this scenario the site would continue to naturally revegetate as is evidenced by those areas which ceased peat production many years prior to 2019. The site would continue to operate in compliance with its IPC licence requirements (ref. no P0504-01). This would involve the continuation of ongoing decommissioning activities associated with the removal of peat extraction machinery, rail infrastructure, structures and materials from the site.

Following the successful decommissioning of the site it is intended that the site would be rehabilitated in line with Condition 10 of the IPC licence. Bord na Móna's Decommissioning and Rehabilitation Plans for the proposed site will continue to be implemented in accordance with the IPC licence requirements, to environmentally stabilise the proposed site through encouragement of re-vegetation of bare peat areas, with targeted active management being used to enhance re-vegetation and the creation of small wetland areas (if required).

If the proposed wind farm did not proceed, the cumulative effect of the Do-Nothing Scenario and the implementation of the Decommissioning and Rehabilitation Plans will therefore have a neutral environmental effect.

9.4.2 Potential Effects – Construction Phase

The proposed development is characterised by the following civil engineering works to provide the necessary infrastructure to complete the proposed wind farm as described in Chapter 3 (Description of the Proposed Development):

- Loss of peat bog;
- Excavation of aggregates via four borrow pits;
- Reinstatement of borrow pits with material as instructed by the engineer on site;
- Construction of internal site access roads to the wind turbines and passing bays;
- Construction of amenity tracks;
- Construction of four temporary compounds including hard stands, construction material storage areas, site welfare facilities and site offices (floated);
- Excavation and construction of hardstanding foundations;
- Excavation and construction of 22 no. turbine foundations;
- Excavation and construction of substation hardstand foundation;
- Excavation and construction of battery storage hardstand foundation;
- Excavation and construction of two. met mast foundations;
- Excavation for cable ducts;
- Stockpiling of excavated soils and peat, including two peat deposition areas;
- Construction of surface water drainage system along the new roads;
- Dewatering of excavations and trenches;
- Discharge of surface water and water from excavations; and
- Site reinstatement and landscaping.
- Temporary works along the turbine delivery route.

The direct and indirect effects of the construction activities, and their expected duration are discussed further in the following sections. The effect on use of land and on natural resources required to carry out the works which relate to soils and geology is also discussed.

9.4.2.1 Land Use

The site of the proposed wind farm is predominantly covered in bogland that was previously drained for peat extraction. The main impact of the wind farm with regard to land and natural resources is the removal of vegetation, peat and topsoil. It is anticipated that the removed vegetation will be utilised in the peat deposition areas. Bord na Móna has considerable experience in the moving and storage of peat, both during peat extraction operations and during the rehabilitation phase associated with its cutaway/cutover bogs. Management of excavated material is discussed in section 9.4.2.3. The total land take for the proposed wind farm is summarised in Table 9-21.

Table 9-21: Summary of land take and associated effects

Construction Element	Land Take (m^2)	Effect	Duration
Turbine Foundation (22 No.)	11,682	Slight Negative	Permanent
Crane Hardstanding (22 No.)	58,520	Slight Negative	Permanent
New Access Roads including site entrance works	211,284	Slight Negative	Permanent
Compounds (Floated) 4 No.	22,400	Imperceptible Negative	Temporary
Substation	15,250	Slight Negative	Permanent
Battery Storage	5,000	Slight Negative	Permanent
Met Mast 1	700	Not Significant Negative	Permanent
Met Mast 2	700	Not Significant Negative	Permanent
Cable and Grid Route Connection	14,000	Not Significant Negative	Permanent
Amenity Tracks and Carparks	27,395	Not Significant Negative	Permanent

4 Security Cabin Compounds	800	Imperceptible Negative	Permanent
Borrow pits (4 No.)	222,000	Slight Negative	Permanent
Total	**589,731**	**Slight Negative**	**Permanent**

According to Table 9-18, 3% (58.97 hectares) of the total area will be used for infrastructure within the proposed wind farm site (1,900 hectares). Due to the land take for the proposed wind farm and change in land use at the proposed wind farm site, it is considered that there will be a slight, negative and permanent effect due to peat and soil stripping and borrow pit reinstatement/landscaping works.

9.4.2.2 Carbon Loss

As outlined in Section 9.4.2.3, excavation of peat across the site is anticipated. The excavation of in-situ peat will lead to carbon release, and to the loss of potential carbon storage, due to depletion of the peat bog carbon sink. The effect of this is anticipated to be certain, permanent, slight and negative. This has been further assessed in Chapter 18 (Climate).

9.4.2.3 Management Of Excavated Materials

A summary of the construction activities expected to generate excavated material, and the estimated volumes is given in Table 9-22. Peat should be stockpiled no higher than 1.0 m and follow the recommendations set out in the NRA Guidelines for the Management of Waste from National Road Construction Projects (NRA, 2017) and Guidance on Developments on Peatland (Scottish Government, 2014).

Table 9-22: Summary of Preliminary Peat and Spoil Excavation Volumes

Construction Element	Peat Volume (m^3)	Peat Volume (m^3) Factored for Bulking (20% total)	Spoil Volume (m^3)	Spoil Volume (m^3) Factored for Bulking (20% total)
Turbine Foundation (22 No.)	14,446	17,335	96,931	116,317
Crane Hardstanding (22 No.)	44,123	52,948	22,078	26,494
Founded Roads	3,200	3,840	0	0
Floated Roads	0	0	0	0
Compounds (Floated) 4 No.	0	0	0	0
Substation	41,321	49,585	4,575	5,490
Battery Storage	3,535	4,242	1,515	1,818

Construction Element	Peat Volume (m^3)	Peat Volume (m^3) Factored for Bulking (20% total)	Spoil Volume (m^3)	Spoil Volume (m^3) Factored for Bulking (20% total)
Met Mast 1	1,190	1,428	210	252
Met Mast 2	1,750	2,100	210	252
Ducting Cable Route	10,080	12,096	0	0
Borrow pits (4 No.)	130,105	156,126	349,320	419,184
Security Hut 1	0	0	60	72
Security Hut 2	200	240	60	72
Security Hut 3	0	0	0	0
Security Hut 4	0	0	0	0
Derryaroge West Amenity Car Park	0	0	0	0
Total	**249,950**	**299,940**	**474,959**	**569,951**

Effects associated with the management of excavated materials include:

- Risk of collapse/landslide if peat is not stored correctly / in appropriate areas;
- Risk of increased sediment in runoff if appropriate peat storage design and drainage measures are not implemented;
- Risk of increased sediment in runoff from the storage of other materials (soils and gravel) if appropriate storage design and drainage measures are not implemented; and
- Degradation of the peat if not stored appropriately, through drying out for example, as part of storage.

As the works are located within cutaway / cutover bog, it is intended that peat and excess soils (spoil) will be side cast, bermed and profiled i.e. placed adjacent to works locations, and used for landscaping around turbine bases. Considering the topography, it should be appropriate to do this across most of the site. The height of berms and thickness of peat that is side-cast will not be greater than 1 m in height in general, although location specific designs and assessments during the design and construction phase may allow berms of non-peat spoil to reach 2 m. This action is expected to have a slight, negative, direct, permanent effect. In addition to side-casting, it is proposed that 46,286 m^3 of excavated peat will be placed in the Peat Deposition Area, and that any remaining peat volume will be used to reinstate the borrow pit locations. To enable sufficient capacity for peat placement to be open at each phase of the proposed wind farm, a peat deposition area is proposed adjacent to Borrow Pit 1. A full analysis of the peat reinstatement and sequencing is outlined in the Peat and Spoil Management Plan (Appendix 9.2).

For works along the grid connection, the excavated material will be side-cast to be reused as backfilling material where appropriate. This material will not be stored within 50 m of any watercourse. It will be cast on the upgradient side of the trench, so if any runoff did occur it would run into the downgradient trench. Excess material will be used on the site of the proposed wind farm for landscaping and reinstatement. If contaminants are encountered the material will be removed from site using an appropriate permitted contractor and disposed at an appropriately licenced facility. The management of excavated materials during construction phase is expected to have a not significant, short-term negative effect.

Minimal excavations will be required for the Turbine Delivery Route (TDR). At road/junction accommodation works along the TDR, the topsoil will be side-cast and smoothed off with the back of an excavator bucket, battered to minimise the potential for runoff. This soil will be used for reinstatement after the turbine delivery is complete. These work areas are compact, and the expected excavation depths are minimal. Where suitable conditions are not present to allow side-casting, the soils will be disposed of at a suitable licensed facility. Side-casting of excavated materials expected to have a not significant, short-term negative effect.

9.4.2.4 Excavation of Borrow Pits, Processing of Materials and Reinstatement

There are four borrow pit locations which will be excavated to provide fill material for roads, amenity tracks, hardstanding, upfill to foundations and construction compounds. Excavation and processing of materials in the borrow pit for use in construction will likely generate dust, and wastewater with high quantities of suspended solids, potentially increasing run-off to surface waters (discussed further in Chapter 10 (Hydrology and Hydrogeology), Chapter 11 (Air Quality) and Chapter 12 (Noise and Vibration).

Dewatering of excavations, rock breaking, crushing and screening will be required for the development of the borrow pits. Excavation of peat and excess soil unsuitable for use as aggregate (referred to as spoil) will be required to enable extraction of suitable rock and aggregate material.

It is envisaged that the borrow pits will be excavated down to average depth of 5.5 m below ground level (bgl).

Estimated volumes of usable stone materials available on site within the borrow pits are summarised in Table 9-23.

Table 9-23: Borrow pit summary

Borrow Pit	Estimated Surface Area (m^2)	Estimated Peat Excavation Volume (m^3)	Estimated Spoil Excavation Volume (m^3)	Estimated Sand and Gravel Excavation Volume (m^3)	Estimated stone volume – 5.5 m excavation (m^3)
Borrow pit 1	112,514	88,772	202,381	-	288,213
Borrow pit 2	50,881	25,182	61,039	40,213	134,611

Borrow pit 3	46,009	11,412	54,819	85,385	73,258
Borrow pit 4	13,745	4,739	31,081	23,810	2,888
Total	**223,149**	**130,105**	**349,320**	**149,409**	**498,970**

Using the average borrow pit depth of 5.5 m bgl, the available volume of useable material is 648,379 m^3, including sand and gravel, and stone. A percentage of this material may not be suitable, i.e. it may not be economical to extract or may be suitable for fill but not for the upper layers of the haul roads or hardstanding areas. This assumption will need to be confirmed by additional laboratory testing during the detailed design phase. The volume will also be subject to a degree of bulking (an increase in volume that may occur when a block of rock or soil is excavated and transported).

Where excavations extend into competent rock, they are likely to require rock break and potential ripping to extract the stronger rock. However, rock breaking will be required for the majority of the time in all borrow pits. The depth of competent rock varies across each borrow pit. The effects of this method of extraction are addressed in Chapter 12 (Noise and Vibration).

Potential Effects arising from the excavation of each of the proposed borrow pits are outlined below:

9.4.2.4.1 Borrow Pit 1 Potential Effects

- Exposure of soils leading to increased erosion and sediment run-off;
- Loss of soil, peat or solid geological resource, it is estimated that the excavation of 88,772 m^3 of peat, and 202,381 m^3 of spoil will be required at Borrow Pit 1;
- Exposure of bedrock leading to increased groundwater vulnerability;
- Potential localised alteration of the groundwater regime;
- Peat compaction and loss of carbon resource; and
- Stripping of vegetation.

9.4.2.4.2 Borrow Pit 2 Potential Effects

- Exposure of soils leading to increased erosion and sediment run-off;
- Loss of soil, peat or solid geological resource, it is estimated that the excavation of 25,182 m^3 of peat, 61,039 m^3 of spoil and 40,213 m^3 of sand and gravel will be required at Borrow Pit 2;
- Exposure of bedrock leading to increased groundwater vulnerability;
- Potential localised alteration of the groundwater regime;
- Peat compaction and loss of carbon resource; and
- Stripping of vegetation.

9.4.2.4.3 Borrow Pit 3 Potential Effects

- Exposure of soils leading to increased erosion and sediment run-off;
- Loss of soil, peat or solid geological resource, it is estimated that the excavation of 11,412 m^3 of peat,54,819 m^3 and 85,385 m^3 of sand and gravel of spoil will be required at Borrow Pit 3;
- Exposure of bedrock leading to increased groundwater vulnerability;
- Potential localised alteration of the groundwater regime;
- Peat compaction and loss of carbon resource; and
- Stripping of vegetation.

9.4.2.4.4 Borrow Pit 4 Potential Effects

- Exposure of soils leading to increased erosion and sediment run-off;
- Loss of soil, peat or solid geological resource, it is estimated that the excavation of 4,739 m^3 of peat, 31,081 m^3 of spoil and 23,810 m^3 of sand and gravel will be required at Borrow Pit 4;
- Exposure of bedrock leading to increased groundwater vulnerability;
- Potential localised alteration of the groundwater regime;
- Peat compaction and loss of carbon resource; and
- Stripping of vegetation.

The borrow pits will be reinstated using two material sources: (a) overburden from the opening of the borrow pits, and: (b) mineral soils and peat excavated elsewhere on the site that cannot be reused in construction.

Given the volumes of material available from these borrow pits and should they prove suitable it is likely that the borrow pits will significantly contribute to the material requirements for the proposed wind farm and therefore, reduce the volume of imported material required from local quarries. The use of on-site borrow pits will reduce the environmental effect of other aspects of the proposed wind farm by reducing the need to transport material to site. On-site processing of extracted rock materials can produce dust during construction. This is outlined in Chapter 11 (Air Quality). Similarly, water may be generated from any groundwater pumping at borrow pits (refer to Chapter 10 (Hydrology and Hydrogeology). The deep temporary excavations into bedrock will create a temporary exposure of bedrock which may provide a source knowledge of the soils and geology in the area.

Peat and spoil generated during excavation at each borrow pit will be placed temporarily in the peat deposition area in Derryadd Bog. Once borrow pit excavation is complete at each borrow pit, the peat temporarily placed in the temporary peat deposition area will be backfilled to reinstate the borrow pits, as outlined in the Peat and Spoil Management Plan (Appendix 9.2). It is proposed that any excavated peat which is not placed in the permanent peat deposition area will be used for borrow pit reinstatement.

Overall, the excavation of on-site borrow pits will have a moderate, negative, direct, permanent effect.

9.4.2.5 Construction of internal site access roads to the wind turbines and passing bays

Internal site access roads are required to accommodate the construction works and provide access to turbine locations for the whole life cycle of the proposed development. The roads will be constructed using unbound crushed aggregates and incorporate over the edge drainage to capture runoff during wet weather and allow it to flow into the existing site drainage system. Drainage is discussed in further detail in Chapter 10 (Hydrology and Hydrogeology). The roads will be constructed as founded or floating roads. Founded roads are excavated down to and constructed up from a competent geological stratum where applicable, whereas floated roads are built directly on top of the peat and soft soils. The founded roads shall be constructed to average heights of 0.2 m above existing ground level, and the floated roads to average heights of 0.8 m above existing ground level. The vast majority of access roads/tracks (>98%) will be of floated construction, with the remainder of the access roads/tracks to be of founded construction. This will minimise the amount of excavation required for the access roads.

Ground investigation in the form of peat probes, trial pits and dynamic probes (as outlined in Table 9-12) has been carried out along the proposed access roads to inform the depth of excavation and upfill required for the access roads. Preliminary volume calculations provide an approximate estimation of fill required for construction and are presented in Section 9.4.2.11. Material will be obtained from on-site borrow pits and imported from locally approved quarries as required. The potential effect of extracting on-site material is discussed in Sections 9.4.2.1 and 9.4.2.12. The potential effect of extracting additional volumes of material from external quarries include extra pressure on transport routes and more fuel consumption. This is discussed in Chapter 15 (Traffic and Transport). The maximum excavation depth for founded access road construction is estimated to be 1 m.

Direct effects generated from the construction of internal site access roads, as well as the excavation associated with obtaining suitable construction material, include:

- Exposure of soils leading to increased erosion and sediment run-off;
- Loss of soil, peat or solid geological resource – excavation of an estimated 3,200 m^3 of peat and 3840 m^3 of spoil will be required to construct the founded access roads, and no excavation will be required to construct the floated access roads;
- Exposure of bedrock leading to increased groundwater vulnerability;
- Peat compaction by machinery during construction and loss of carbon storage resource; and,
- Potential human health risks to construction workers could also occur associated with any such spillages and leakage.

Overall, the construction of the temporary and permanent roads presents a slight, permanent, negative effect.

9.4.2.6 Construction Of Amenity Access Tracks

For the most part the amenity access tracks will be situated on the construction traffic haul routes within the site. There are, however, some locations where the roads will be used for amenity purposes only, i.e. there is no vehicular traffic envisaged on these. These tracks will be constructed in the same manner to the haul road access tracks and will therefore generate similar, but smaller scale, effect (see Section 9.4.2.5).

Preliminary volume calculations provide an approximate estimation of fill required for construction and are presented in Section 9.4.2.13. The construction of the amenity tracks will have a not significant, permanent, negative effect.

9.4.2.7 Construction Of Temporary Compounds Including Hardstanding, Construction Material Storage Areas, site Welfare Facilities and Site Offices

At the commencement of the construction phase four temporary compounds will be constructed to provide office space, welfare facilities and hardstands for storing materials and hazardous materials. The temporary site accommodation is likely to consist of temporary porta-cabins constructed on a granular platform floated on the peat. The hardstanding's shall be constructed to average heights of 0.5 or 1.0 m above existing ground level. The plan areas of the compounds are given in Table 9-21.

Direct effects generated by the construction of such infrastructure include:

- Exposure of soils leading to increased erosion and sediment run-off;
- Loss of soil, peat or solid geological resource;

- Exposure of bedrock and increased groundwater vulnerability; and,
- Peat compaction and loss of carbon resource.

Preliminary volume calculations provide an approximate estimation of fill required for construction and are presented in Section 9.4.2.13. This material volume will be obtained from onsite borrow pits and/or imported from locally approved quarries. As discussed in Section 9.4.2.4, there are potential effects to extraction of materials on site and also from local quarries.

The construction of the temporary compounds presents a not significant, temporary, negative effect.

9.4.2.8 Hydrocarbon Release

Wherever there are vehicles and plant in use, there is the potential for a direct 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 an unlikely, moderate, long-term negative effect on the soil and geological environment. Good site practice will mitigate any effect in the short-term and long-term (refer to Section 9.5).

9.4.2.9 Excavation For Turbine Foundations

Construction of the turbine bases will require excavation of the surrounding soil or peat from the foundation and crane hardstanding area to founding level with access being provided from adjacent roads at or near the surrounding ground level. The soil or peat will be replaced with granular fill where required.

Each wind turbine will require piled foundations or a gravity foundation of reinforced concrete (RC) foundation comprising a base slab bearing onto rock or other competent substrata with a central upstand to support the tower. The foundations for each turbine will be designed by the appointed Civil Designer. Piled foundation bases are generally 24-26 m in diameter and gravity foundation bases are typically 24-26 m in diameter with detailed foundation design being dictated by the local ground conditions.

Three main foundation solutions have been identified:

- Gravity Foundations;
- Concrete driven piles; and
- Bored piles.

The material encountered in the trial pits excavated at each turbine location was generally soft to very soft and not capable of supporting the applied loads from a wind turbine (Table 9-18). Deeper excavations to more competent material will be required to construct the turbine foundations. It should be noted that, although it is anticipated that most foundations will be required to be piled, it is likely that some turbines could utilise gravity foundations. Additional GI is required prior to detailed design in order to confirm the foundation types. Where foundations are not piled, additional fill material will be needed to upfill the excavation to the levels required for the wind turbine foundations. A maximum excavation of 4.5 m bgl is anticipated at each turbine foundation. Gravity, bored pile and driven pile details are shown on Planning Drawings 11399-2042 to 2044.

For the piled turbine foundations, the piling type and configuration, as shown on Planning Drawing 11399-2044, could be up to 50 - 70 no. 300 mm x 300 mm square concrete driven piles or up to 16 no. 1200 – 1600 diameter bore piles. While final piling depths will depend on localised ground conditions as discussed, the drawings detail a piling depth of 15 m – 18 m for indicative purposes. For gravity type turbine foundations, unsuitable material will be excavated and replaced by granular fill (6N) and excavated material will be placed in the peat deposition areas or utilised near the proposed turbines.

Each turbine foundation will be investigated before and during construction to identify any potential karst features. If significant karst features are uncovered, the potential risk posed by the features to the bearing capacity of the foundations will be addressed through the design and construction phases of the proposed wind farm. As discussed in Section 9.3.18, there are no recorded karst features recorded on the GSI database (GSI, 2024). Some minor dissolution was noted along joints following rotary drilling. If a void, conduit or highly weathered zone is identified below a foundation which the initial design cannot accommodate, the solution is likely to consist of filling the feature with grout /concrete. The potential for this having a negative environmental effect on the soil and geology of the site is considered to be low. Where karst features may be present, the resultant effect on soils and geology is considered to be not significant, permanent and negative.

Potential effects for the excavation of turbine foundations include:

- Temporary exposure of soils leading to increased erosion and sediment run-off;
- Loss of soil, peat or solid geological resource;
- Temporary exposure of bedrock and an increased groundwater vulnerability;
- Peat excavation and subsequent compaction and loss of carbon storage resource;
- Potential localised alteration of the groundwater regime during construction of the turbine base structures and windfarm infrastructure;
- Potential spillages of concrete causing pollution of groundwater;
- Contact with hidden karst features below foundations, requiring mitigation to avoid potential stability issues; and
- Generation of dust.

Excavation for the turbine foundations (gravity and piled/bored) is considered to have a not significant, permanent, negative effect on the environment. Preliminary volume calculations providing an approximate estimation of fill required for construction are presented in Section 9.4.2.11.

9.4.2.10 Excavation For Hardstanding Foundations

The environmental effects of the construction of the hardstanding foundations are similar to that of the founded access roads as discussed in Section 9.5.2.3. Ground investigation in the form of peat probing and trial pitting has been carried out along the proposed hardstanding locations to inform the depth of excavation and upfill required (See Table 9-18). Preliminary volume calculations provide an approximate estimation of fill required for construction and are presented in Section 9.4.2.3. The estimated maximum hardstand excavation depth is 2.3m bgl at T18.

Similar to above, some of the material may be required from local quarries. The potential effects are considered to be not significant, permanent and negative.

9.4.2.11 Excavation For Substation Foundations

The construction of the substation will require removal of peat/topsoil and subsoil to a competent founding layer, to be specified at detailed design, but assumed to be at least 2.5m bgl based on peat depths, and upfilling with concrete or structural fill to the required finished floor level. Ground investigations at the substation location have been undertaken for the purposes of this EIAR and have been used to inform the depth of excavation and upfill required (see Table 9-18).

Preliminary volume calculations provide an approximate estimation of fill required for construction and are presented in Section 9.4.2.3.

The construction of the substation is anticipated to have negative effects due to the requirement to excavate peat and soil, and to use stone excavated from the borrow pits and/or local quarries. These effects are considered to be not significant, permanent and negative.

9.4.2.12 Excavation For Met Masts

The construction of two met masts will require removal of peat/topsoil and subsoil to a competent founding layer and upfilling with concrete or structural fill to the required foundation formation level. A crane hardstanding will also be required to install the met mast. This will be similar but smaller than those constructed at the turbines. Ground investigations at potential locations have only been undertaken for the purposes of the EIAR and have been used to inform the depth of excavation and upfill required (Table 9-18). The top of concrete (ToC) level at the Derrarogue Met Mast is proposed at 41.0mOD, and the Lough Bannow Met Mast ToC level is 50.50mOD. The maximum estimated excavation depth at the Derryaroge Met Mast is 1.70m bgl, and 2.50m bgl at the Lough Bannow Met Mast.

Preliminary volume calculations provide a rough estimation of fill required for the foundations and crane pad for the proposed met masts, assuming spread foundations are used where they are founded on competent material. Preliminary volume calculations are presented in Section 9.4.2.3. These effects are considered to be not significant, permanent and negative.

9.4.2.13 Summary Of Stone Volumes

A summary of the granular fill estimated to be required for the construction of the proposed infrastructure, broken down into import requirements and fill which can be obtained from on-site sources, is given in Table 9-24.

Table 9-24: Stone volume summary

Area		Required stone material (m^3)	Borrow pit stone required (m^3)	Import stone requirement (m^3)	Stone from Turbine excavation (m^3)
Internal Haul Roads	Enabling works	5,774	-	5,774	-
Passing Bays	Enabling works	275	-	275	-

Substation	Enabling works	45,750	-	45,750	-
Battery Storage/ EBOP compound	Enabling works	15,000	-	15,000	-
Construction Compounds 1, 2, 3 & 4.	Enabling works	22,400	22,400	-	-
Internal Access Roads	Permanent works	116,856	102,249	14,607	-
Amenity Track	Permanent works	13,480	11,234	2,247	-
Passing Bays	Permanent works	11,068	11,068	-	-
Security Hut	Permanent works	480	480	-	-
Amenity Carpark	Permanent works	850	850	-	-
Pump Station Access roads & Hardstand Area	Permanent works	8,350	7,819	531	-
Met Mast Plinth & Hardstand	Permanent works	2,940	2,770	170	-
Foundation	Permanent works	42,845	-	5,841	37,004
Crane Hardstand	Permanent works	158,004	158,004	-	-
Grid Connection & 110kV access road	Permanent works	1,295	1,295	-	-
Total		**445,367**	**318,169**	**90,195**	**37,004**

Presently the estimated volumes of compacted material required for construction is 445,367 m^3.

As not all stone material can be sourced from the on-site borrow pits, importing of stone from licensed external quarries will be required. Stone material estimated to be required for import from local quarries include stone fill directly below the turbine foundation, the surface capping layer on the running surface of the proposed access roads and hardstand, and all elements of the enabling works package including the substation and battery storage hardstand. An estimation of 90,195 m^3 imported stone volume will be required, of which 66,799 m^3 is required for the construction of enabling works and 23,396 m^3 is required for the construction of permanent works. The effects of stone excavation from the borrow pits is assessed in Section 9.4.2.4. The effect of importation of stone is considered to be certain, not significant, temporary and negative.

9.4.2.14 Turbine Delivery Route

In some cases, temporary accommodation works are required along the turbine delivery route such as hedge or tree cutting, temporary relocation of powerlines/poles, lampposts, signage and local road widening. Any upgrades to the identified haul route options (See Chapter 15 Traffic and Transport) will be carried out in advance of turbine deliveries and following consultation and agreement with Longford County Council. The potential impact on soils and geology is negative, certain, direct, not significant and short term.

9.4.2.15 Peat Stability

Negative effects on slope stability during wind farm development may cause landslides. Peat stability is discussed further in Section 9.3.22 and in the Peat Stability Risk Assessment (PSRA) in Appendix 9.3. However, some of the risk factors which may trigger slope failure (and associated impacts on surface water, infrastructure and human receptors) during the construction phase include the following:

- Cutting of peat at the toe of slopes creating an unloading of peat mass;
- Loading of peat mass via heavy machinery and structures;
- Changes to vegetation and tree cover which reduces the tensile strength of the slope;
- Mechanical vibrations or vibration from rock breaking causing an increase in shear stresses in peat;
- Changes in pore water pressures along slip surfaces due to an artificial drainage regime; and,
- Inappropriate storage of excavated peat and soil.

The effects of potential peat failure at the proposed wind farm site would include:

- Death or serious injury to site personnel;
- Contamination of watercourses by peat material;
- Damage to site machinery;
- Damage or loss of infrastructure (access roads/tracks, hardstands);
- Disruption of site drainage; and
- Loss of the peat carbon storage resource.

The peat stability risk for the proposed infrastructure is considered to be negligible to low. However, the results of the factor of safety deterministic calculation and the site walkover allowed for the identification of some areas of potential local instability where the proposed wind farm footprint is on or adjacent to existing peat banks/drainage ditches from historical peat extraction or drainage excavations. These narrow linear areas are not considered to be a landslide or bog burst risk and may only cause a local failure or small volume by failure of the existing cutting face. The Contractor shall follow the construction methods and mitigations outlined in Section 9.5, and in the associated Peat and Spoil Management Plan (Appendix 9.2) relating to these existing banks and ditches to ensure the safe and stable construction and operation of the proposed structures.

The PSRA report summarises that there is a risk of instability related to the requirement for deep excavations on the proposed wind farm site and that mitigation measures that will be put in place during the construction of the proposed wind farm to reduce the likelihood of an excavation collapsing.

A risk rating score has been calculated for each infrastructure locations. This risk rating is generated by combining identified hazard and consequence factors using the following equation:

Risk = (Hazard) x (Adverse Consequences)

The hazard is calculated from a variety of weighted factors, including the quantitative Factor of Safety and thirteen secondary qualitative factors related to geomorphic observations, topography, hydrology, vegetation, peat workings, existing loads and slide history. These secondary factors are difficult to quantify in a stability calculation but may contribute to peat instability. The adverse consequences assessment considers nine possible adverse consequences. A full summary of the considered factors and weighting is given in the PSRA report (Appendix 9.3). A summary for the risk rating calculated at each infrastructure location can be seen in Figure 9-37 and Figure 9-38.

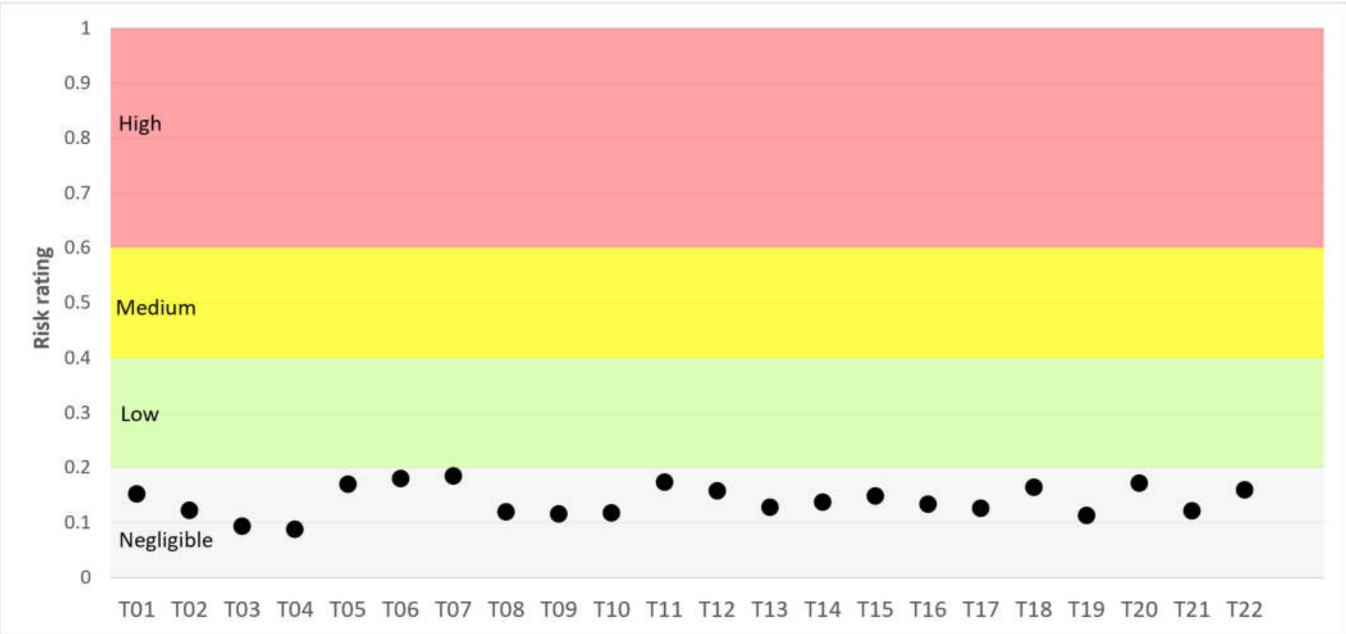


Figure 9-37: Risk ratings at the proposed turbine locations

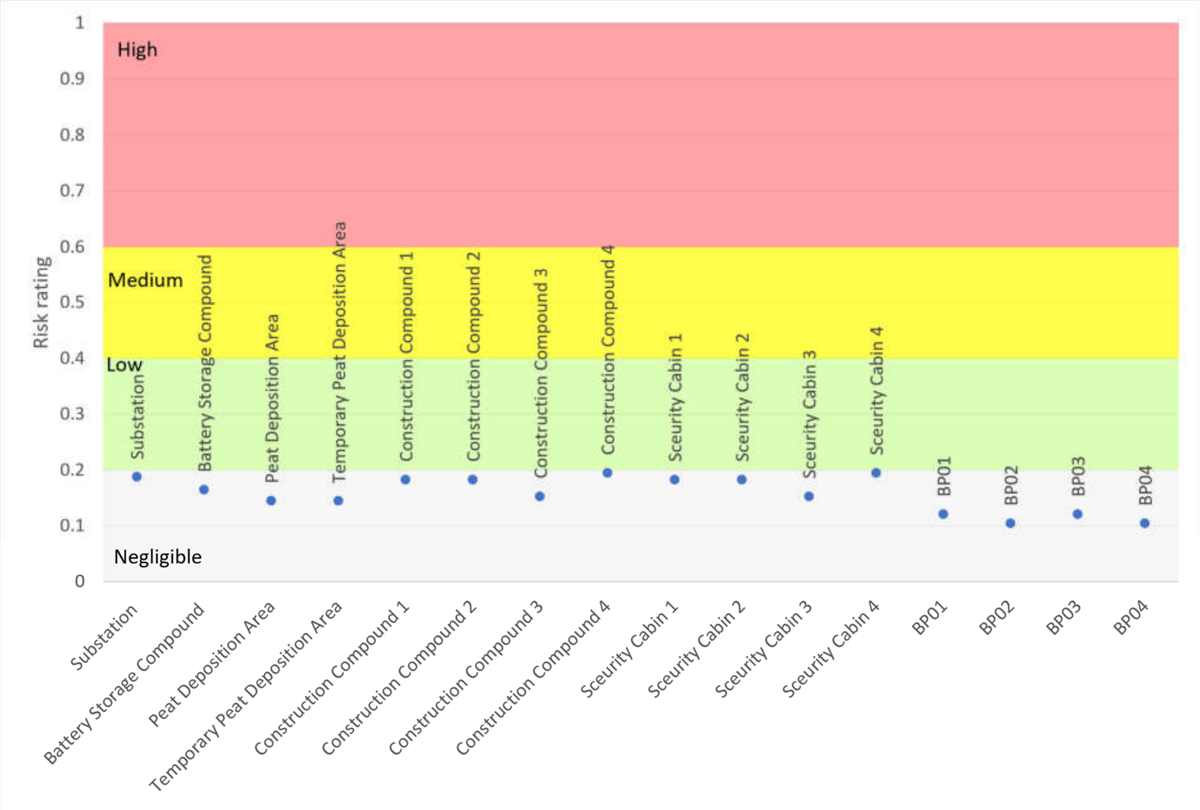


Figure 9-38: Risk ratings at the proposed substation, battery storage compound, peat deposition, construction compound and borrow pits.

A peat and spoil management plan (PSMP) has been prepared for the proposed wind farm which is included in Appendix 9.2. The PSMP indicates that the peat and spoil excavated on site can be safely managed and reinstated in the proposed peat deposition areas, and for reinstating the borrow pits.

Recommendations and mitigation measures made in this EIAR chapter and in the PSMP will be applied during the design and construction phase of the proposed development. Best practice guidance regarding the management of peat stability must be inherent in the construction phase of the proposed wind farm.

The findings of the PSRA showed that the proposed wind farm has an acceptable margin of safety and is suitable for the wind farm site and grid connection. Overall, the peat characteristics on the wind farm site and grid connection cable route are similar to that encountered on many developed wind farm sites. Prior to the implementation of mitigation measures detailed in section 9.5.2.1 the potential peat stability effect is considered to be unlikely, significant, long-term and negative.

Mitigation measures to further reduce the potential peat stability risk at the proposed development are outlined in the Peat and Spoil Management Plan (Appendix 9.2) and in section 9.5.3.1.

9.4.2.16 Karst Risk

Overall, the karst risk at the proposed wind farm site is considered to be negligible to not significant, with no major karst features identified within the proposed wind farm site boundary, and only minimal signs of dissolution identified from the extensive ground investigations. Mitigation measures to manage any residual karst risk are proposed in Section 9.5.3.3.

9.4.2.17 Natural Resources

Natural resources (material assets) on site include potential extraction of shelly marl/calcareous mud soil, sand/gravel aggregate and rock.

Bord na Móna has permanently ceased peat extraction at Derryadd since 2019. There is no plan to resume peat extraction at the site in the future so the effect on the proposed wind farm occupation of the peat land area in terms of a loss of peat harvest resource are assessed to be imperceptible.

In terms of potential extraction of the shelly marl/calcareous soil resource, the construction phase will have a permanent imperceptible negative. Construction is likely to reveal the extent and quality of this resource and other similar subsoils resources on site.

During the construction phase, there will be a depletion of sand/gravel aggregate and rock natural resources due to extraction of material from borrow pits, and excavation at turbine foundations. This material is for reuse on site to build infrastructure items such as access roads, turbine foundations, hardstanding foundations and the substation. The depletion of natural resources is considered to be a moderate, negative and permanent effect. The use of piled foundations if required, will have a permanent imperceptible negative effect on the bedrock, as piles may need to be drilled into the bedrock. There are benefits in sourcing material required for construction on site, as opposed to external quarries. These are discussed further in Section 9.5.2.10. A positive effect of construction is that the extraction of material is likely to reveal the extent and quality of the bedrock resources on site. This is of benefit in terms of geological wealth of knowledge.

There is a potential for sterilisation of the borrow pit resources once extraction has ceased and the excavations have been reinstated with the overburden, surplus subsoils and peat from construction. This could have a moderate, permanent negative effect. The negative effect associated with the extraction of material from a borrow pit; (dust, noise, traffic) will no longer exist once extraction of the borrow pit is complete and hence, the effect of reinstatement will be imperceptible.

9.4.2.18 Human Health

The primary risk to human health is dust from material extraction and transport of soils and excavated rock which is discussed in Chapter 11 (Air Quality). There is potential for a negative effect to human health from peat instability in excavations, the risk of which is discussed in the Peat Stability Risk Assessment (PSRA) report (Appendix 9.3) and summarised in Section 9.3.21. The risk is restricted to within and in the immediate vicinity of the excavations only considering the general site topography. Other negative effects include the typical risks to construction personnel associated with earthworks and large excavations such as falling from heights, engulfment, drowning, etc. Each of these effects is considered unlikely, significant, negative and temporary.

One potential risk to receptors (i.e., construction workers) is direct contact, ingestion or inhalation with any soils which may potentially contain hydrocarbon concentrations from site activities (potential minor leaks and spills of fuels, oils, and paint).

Taking account of the baseline environmental setting and the proposed mitigation measures during the Construction Phase, no human health risks associated with exposure to contaminants (via. direct contact, ingestion, or inhalation) resulting from the proposed development are anticipated.

Potential human health effects will only be present during construction. The effects of the proposed development on human health are discussed in Chapter 6 (Population and Human Health).

9.4.2.19 Accidents / Disasters

Peat/soil instability is the main source of hazard related to potential major accidents and/or natural disasters on the proposed development and is discussed in detail in the Peat Stability Risk Assessment (PSRA) report (Appendix 9.3) and summarised Section 9.3.21. The stability analyses indicate that the peat stability risk is negligible to low. The effect of peat instability is considered to be unlikely, significant, long-term and negative. The effects of accidental fuel and oil spills arising are discussed in Section 9.4.2.7. Soil erosion due to flooding may be considered another accident or disaster; a site-specific flood assessment is discussed further in the Chapter 10 (Hydrology and Hydrogeology). Additionally, an assessment of the vulnerability of the proposed development to major accidents and/or natural disasters is carried out in Chapter 19 (Major Accidents and Natural Disasters).

9.4.3 Potential Effects - Operation

During the lifetime of the proposed development, maintenance will be carried out as required. These works have the potential to result in the mobilisation of suspended solids from shallow excavations and fuel and lubricating oils from machinery and equipment. This may potentially result in unlikely, negative, slight and short-term effects on receiving soils and/or bedrock. Some construction vehicles or plant may be necessary for the maintenance of turbines which could result in minor accidental leaks or spills of fuel/oil. The transformer in the substation and transformers in each turbine are oil cooled. There is potential for spills/leaks of oils from this equipment resulting in contamination of soils and groundwater. The potential effects of this would be unlikely, negative, moderate, and long-term. The mitigation measures outlined in Section 9.5.4 will be implemented to address any potential impacts.

Additional unbound crushed aggregate material may be required during the operation phase where roads have settled on the peat, to resurface unbound roads and for the maintenance of the amenity tracks surface. This will be sourced from approved local resources. It is expected that only small quantities of unbound crushed aggregates may be needed. The resurfacing of internal site access roads and amenity access tracks will therefore pose an imperceptible negative short-term effect.

9.4.4 Potential Effects - Decommissioning

In general, the potential effects associated with decommissioning will be similar to those associated with construction phase but of reduced magnitude because extensive excavation, and wet concrete handling will not be required. Turbine foundations would remain in place underground and would be covered with earth and allowed to revegetate or reseed as appropriate. The majority of the site roadways will be in use for additional purposes to the operation of the wind farm (such as amenity and recreational use) by the time the decommissioning of the proposed wind farm is to be considered, and therefore it will be more appropriate to leave the site roads in situ for future use or development. The substation will be retained by EirGrid. The potential environmental effect of peat and spoil deposition and stockpiling and contamination by fuel leaks will remain during decommissioning. The effect of temporary excavations during decommissioning has the potential to be slight, short term and negative. The effect of the turbine bases remaining in place will be not significant, permanent and negative. The effect of the roads remaining in place for amenity use will be not significant, permanent and positive. The effects of the substation remaining in operation will be certain, long-term, not-significant and negative.

9.4.5 Summary Of Potential Effects

A summary of the potential effects discussed in the previous subsections is provided in Table 9-25.

Table 9-25: Summary of pre-mitigation effects on the receiving soil, land and geology environment during the construction, operation and decommissioning phases

Receptor	Potential Effects	Importance (sensitivity)	Duration and Frequency of Effects	Significance of Effects
Construction Phase				
Soils (excluding peat)	• Potential loss of / negative effects on the superficial geological resource (soils) due to temporary excavations for windfarm infrastructure.	Negligible	Permanent and likely	Slight Negative
Peat (carbon resource)	• Potential loss of/negative effects on the peat soils due to temporary excavations for windfarm infrastructure. • Potential loss of / negative effects on the peat soils due to deep excavations at turbine foundation locations. • Peat compaction associated with construction traffic may reduce soil permeability and increase surface runoff. • Potential increased erosion of superficial soils due to loss of surface vegetation.	High	Permanent and certain	Slight Negative
Peat (landslide)	• Potential landslide of peat caused by risk factors such as cutting, loading, vibration, alterations to surface water drainage, vegetation removal, or inappropriate storage of peat, leading to effects on surface water, infrastructure and people.	High	Long term and unlikely	Significant Negative
Geology (resource)	• Potential loss of / negative effects on the solid geological resource beneath temporary excavations for windfarm infrastructure.	Low	Permanent and likely	Not Significant Negative
Karst	• Potential risk of encountering hidden karst features during construction of turbines and infrastructure	Medium	Permanent and unlikely	Slight Negative
Groundwater bodies	• Potential localised increase in alkalinity from spillages of concrete or unset cement causing pollution of groundwater. • Potential accidental release, leakage or spillage of hydrocarbons, fuel or oils from storage tanks/construction plant during construction causing contamination of groundwater. • Potential localised alteration of the groundwater regime during construction of the turbine base structures and windfarm infrastructure. • Potential exposure of bedrock, particularly potentially karst bedrock and increase in groundwater vulnerability.	Medium	Short term and unlikely	Moderate Negative
Contamination	• Mobilisation of contamination in soils as a result of additional sediment loading or leaching.	Low	Long term and unlikely	Moderate Negative
Turbine Delivery Route	• Hedge or tree cutting, temporary relocation of powerlines/poles, lampposts, signage and local road widening	Low	Short term and certain	Not Significant Negative
Operational Phase				
Soils (excluding peat)	• Potential loss of / negative effects on the superficial geological resource (soils) due to permanent excavations for windfarm infrastructure.	Negligible	Permanent and likely	Slight Negative
Peat (carbon resource)	• Potential loss of / negative effects on the peat soils due to permanent excavations for windfarm infrastructure.	High	Permanent and likely	Slight Negative
Peat (landslide)	• Ongoing potential landslide of peat caused by risk factors during the construction phase such as cutting, loading, vibration, alterations to surface water drainage, vegetation removal, leading to effects on surface water, infrastructure and people.	High	Short term and unlikely	Significant Negative
Geology (resource)	• Potential loss of / negative effects on the solid geological resource beneath permanent excavations for windfarm infrastructure.	Low	Permanent and likely	Not Significant Negative

Receptor	Potential Effects	Importance (sensitivity)	Duration and Frequency of Effects	Significance of Effects
Groundwater bodies	• Potential accidental release, leakage or spillage of hydrocarbons, fuel or oils from storage tanks/plant during operation causing contamination of groundwater. • Potential localised alteration of the groundwater regime due to turbine base structures and windfarm infrastructure. • Potential contamination of groundwater by leachable contamination from imported fill materials. • Reduction in infiltration caused by increased hardstanding cover or compaction of soils, resulting in impacts on groundwater.	Medium	Short term and unlikely	Moderate Negative
Contamination	• Mobilisation of contamination in soils as a result of additional sediment loading or leaching.	Low	Short term and unlikely	Slight Negative
Decommissioning Phase				
Soils (excluding peat)	• Potential increased erosion of superficial soils during the decommissioning process due to temporary exposure of ground during removal of infrastructure and prior to restoration.	Negligible	Permanent and unlikely	Imperceptible
Peat (carbon resource)	• Potential loss of / negative effects on the peat soils during any excavations necessary for decommissioning.	High	Permanent and likely	Not Significant Negative
Peat (landslide)	• Potential landslide of peat caused by risk factors such as cutting, loading, vibration, alterations to surface water drainage, vegetation removal, or inappropriate storage of peat, leading to effects on surface water, infrastructure and people.	High	Short term and unlikely	Significant Negative
Geology	• None	Low	Temporary and unlikely	Imperceptible
Groundwater bodies	• Potential accidental release, leakage or spillage of hydrocarbons, fuel or oils from storage tanks/construction plant during decommissioning causing contamination of groundwater. • Potential localised alteration of the groundwater regime due to removal of turbine base structures and windfarm infrastructure. • Changes to infiltration caused by reduced hardstanding cover or compaction of soils, resulting in impacts on groundwater.	Medium	Long term and unlikely	Moderate Negative
Contamination	• Mobilisation of contamination in soils as a result of additional sediment loading or leaching.	Low	Short term and unlikely	Not Significant Negative

9.5 MITIGATION MEASURES

Mitigation measures for the construction, operation and decommissioning phases of the proposed development site to avoid or reduce the potential effect of the proposed development are presented in the following subsections.

9.5.1 Mitigation of Avoidance

The opportunity to mitigate any effect is greatest at the design period. In this respect Bord na Móna carried out a detailed site selection process. This process identified deep peat as a specific constraint. The detailed site selection process is described in Chapter 4 (Consideration of Reasonable Alternatives). Furthermore, within the chosen site, those areas of deep peat were identified and the internal road design sought to avoid those areas where possible. Finally, although it is expected that floated roads will constitute the majority of the site, founded roads will also be considered where suitable. However, there are some risks that cannot be mitigated through design and need to be managed during construction. Mitigation through design is especially applicable in the risk to human health during a project and shall be exercised to minimise the negative risks present.

9.5.2 Mitigation Measures – Design

- Placement of turbines and associated infrastructure in areas with shallower peat where constraints allow;
- Use of floating roads, where appropriate, to reduce peat excavation volumes;
- The peat and subsoil which will be removed during the construction phase will be localised to the wind farm infrastructure turbine location, substation, temporary compounds and access roads;
- The proposed wind farm has been designed to avoid sensitive habitats within the red line boundary;
- A minimal volume of peat and subsoil will be removed to allow for infrastructural work to take place in comparison to the total volume present on the site due to optimisation of the layout by mitigation by design; and,
- In general, excavated peat will be moved short distances from the point of excavation and used locally for landscaping.

9.5.3 Mitigation Measures - Construction Phase

The construction of the proposed development has the potential (with no mitigation) to cause not significant to significant short-term to long-term effects to the soil and geology of the proposed wind farm site as outlined in Section 9.4. Implementing mitigation measures detailed below will reduce the significance of the effects. Many of the mitigation measures have been based on CIRIA (Construction Industry Research and Information Association, UK) technical guidance on water pollution control and on current accepted best practice, (CIRIA report ref. C532, 2001). The general constructions mitigation include:

- Good site practice will be applied to ensure no fuels, oils, wastes or any other substances are stored in a manner on site in which they may spill and enter the ground;
- Dedicated, bunded storage areas will be used for all fuels or hazardous substances; and

- All works will be managed and carried out in accordance with the Construction and Environmental Management Plan (CEMP) (Appendix 3-2), which will be updated by the civil engineering contractor and agreed prior to any site works commencing.

9.5.3.1 Peat Stability

Risks are outlined in the Peat Stability Risk Assessment (PSRA) and Construction Environmental Management Plan (CEMP) and any identified risks will be minimised by applying the principles of avoidance, prevention and protection. Slope stability will be addressed in greater detail with site specific measures identified during the detailed design phase. A detailed method statement will be prepared prior to any element of work being carried out and the methods are outlined in the CEMP.

A bespoke Peat Stability Risk Assessment (PSRA) has been carried out for the proposed development and is included in Appendix 9.3. This document has used the site investigation information, topographic mapping information and site walkover observations to assess the stability of the peat across the site and identify any hazardous conditions. The findings of this report including any proposed mitigation measures and/or works exclusion areas are outlined in the PSRA report in Appendix 9.3.

As outlined in Section 9.4.2.15, the peat stability risk assessment has yielded a negligible risk rating for each infrastructure location. The Scottish Government Best Practice Guidelines (2017) states the following for areas with negligible risk level: "Project should proceed with monitoring and mitigation of peat landslide hazards at these locations as appropriate."

All earthworks shall be designed by a competent geotechnical designer which shall be informed where necessary by a post consent detailed ground investigation campaign which will need to include intrusive methods such as trial pitting and borehole locations with a specified suite of in-situ and geotechnical laboratory testing to further assessment the engineering characteristics of the infrastructure locations.

Possible mitigation measures in relation to peat instability are considered below. Additional mitigation measures relating the handling and deposition of peat are outlined in the Peat and Spoil Management Plan (GDG, 2025) in Appendix 9.2.

Mitigation by Avoidance

Site infrastructure has been sited to avoid areas of medium or high risk where possible, and all main infrastructure locations are assessed as being of negligible risk.

Engineering Mitigation Measures

Many of the site specific (e.g. peat depth, slope angle) and site independent variables (e.g. weather) that contribute to the incidence of natural peat landslides are beyond engineering control without significant damage to the peat itself. However, a number of engineering measures exist to minimise the risks associated with potential triggers (such as short term peaks in hydrogeological activity).

Construction management

Inappropriate storage of excavated peat and overburden, as well as uncontrolled loading of peat material is considered one of the main causes of peat instability and landslide event triggers during the wind farm construction process. The management and control of these activities is key to de-risking peat stability at the proposed wind farm site. It is required that the construction method statements for the project also take into account, but not be limited, to the guidance documents listed in Section 9.2.1 and the recommendations and requirements outlined throughout this document.

The general requirements for the management of peat and the mitigation of peat instability at the site are as follows:

- Appointment of experienced and competent contractors and designers;
- The construction works on site will be supervised by experienced and qualified personnel;
- 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;
- Prevent placement of loads/overburden on marginal ground;
- Manage and maintain a robust drainage system. This will be the responsibility of the appointed contractor and their designer;
- Storage of peat material including temporary and side casting be carried out in the permitted areas only.
- Acrotelm (upper) peat material may be used as landscaping material where topography allows and the detail designer has assessed the stability risk;
- Uncontrolled placement of peat or loading of peat material must be avoided;
- Water flows within drainage systems will be controlled. Velocities of slows must be controlled using check damns within drainage systems and the uncontrolled release of water onto slopes can create a landslide risk and must be avoided,
- All construction requiring cut and fill earthworks required a robust monitoring and inspection programme. The details of this inspection programme will depend on the purpose and methodologies of the works and the ground conditions;
- A method statement and risk assessment (RAMS) which considers the potential causes and mitigations of peat instabilities and landslide is required and must be regularly communicated to all site staff. An observational approach by all site staff to the ground conditions and the risks should be promoted and any changes in the ground or site conditions should be reported and the risk dynamically assessed. The RAMS will be reviewed for compliance with the PSRA, prior to acceptance by the developer.

<u>Drainage Measures</u>

The drainage measures outlined in Chapter 10 (Hydrology and hydrogeology) of the EIAR. Surface water drainage plans will be implemented to account for modified flows created by construction, which in turn may affect peat stability, pollution and wildlife interests. Drainage measures need to be carefully planned to minimise any negative impacts.

Runoff will be maintained at the existing runoff rates. Controlled discharge will be maintained at existing pumping rates. The layout of the proposed wind farm site has been designed to collect surface water runoff from hard standing areas within the development and discharge to associated surface water attenuation lagoons adjacent to the proposed infrastructure. It will then make its way into the existing field drains and existing settlement ponds infrastructure before being discharged through existing discharge points by pump or gravity flow. From here the water will outfall at the appropriate existing run off rates. Where temporary excavations for turbines and borrow pits, water will be stored within the existing topographical depressions.

Monitoring

The installation of movement monitoring posts is recommended for areas where works are taking place on or adjacent to identified peat depths greater than 2m.

Movement monitoring posts shall be installed upslope and downslope of the works areas and shall be as outlined:

- Posts shall be 1m to 1.5m in length, installed at 5m intervals with no less than seven posts in each line of sight (~30m).
- A string line shall in attached to the first and last post with all intermediate posts in contact with one side of the string line,
- A numbering system shall be designs for the monitoring posts and a record shall be kept of this numbering system.

Movement monitoring posts shall be observed at least once a day with more frequent inspections which adjacent works are ongoing. Should movements be recorded the frequency of these inspections will be increased. Record shall be kept of all monitor post inspections with reference to date, time and any relative movement between posts, if any. Any movement identified in the posts shall be recorded with reference to the post numbering system.

The contactor shall also develop a routine inspection of all areas surrounding work in peat, not just exclusively on the monitoring posts. These inspections shall include an assessment of ground stability and drainage conditions. These inspections should identify any cracking or deformation on the peat surface, excessive settlement on structures, drain blockages or springs etc.

Engineering Mitigation Measures to Control Landslide Impacts

Although the stability of the peat and overburden is considered to be safe for the construction activities proposed, and should the peat and spoil be managed in line with the details of this document, the risk of a peat failure or landslide is negligible. However, it is important to consider the actions which shall be carried out if signs of instability are identified during the outlined monitoring or should a failure occur at the site.

The full methodologies for these activities will be outlined in the construction Contractors RAMS and include the methodologies for immediate and long-term response.

Movement or Instability Observed in Monitoring Areas

Where excessive movement has been observed in the installed monitoring, the following measures will be taken;

- All construction activities will be suspended in the area,
- The Contractors Geotechnical Engineer shall carry out an assessment of the peat instability including drainage. The Contractors Geotechnical Engineer shall compile a report outlining the surveys undertaken, the potential cause of the instability, assessment of any increased risk caused by the instability, and the further measures required to manage this risk,

- An increased monitoring regime shall be specified including increase in number of monitoring post lines, decrease on monitoring post spacing and an increase in the frequency of monitoring post observations,
- Should no further movement be detected, construction activities will be recommenced while maintaining the increased monitoring regime,
- Should further excessive movement be detected, the Contractors design and project geotechnical engineer will need to be informed and the design of further reinstatement works will be required such as excavation of the disturbed material, installation of a granular berms or similar.

Emergency Response to a Landslide Event

If the scenario of a landslide, bog burst or peat slide occurring at the site the following steps shall be carried out by the contractor:

- All member of the project will be alerted immediately or as it is safe to do so;
- All site works will be ceased, and all available resources will be used for the management and mitigation of the risks posed by the event;
- The key initial activity will be to prevent displaced materials from reaching any watercourses or sensitive environments. Given the terrain of the Proposed Development Site, the key risk is the development of a propagation landslide or slip within topographic valleys and watercourses. Where possible, check barrage structures or catch ditches on land or within these topographic valley and watercourses shall be constructed to aid prevent further run out of the disturbed peat or spoil material.

Check Barrages

Check barrages are permeable granular structures constructed within the path of a landslide to prevent the further downhill or downstream movement of the disturbed material. Typically, these will be constructed of locally generated stone material, often of large sizing. The large material sizing will allow water to pass through the check barrage material, avoiding a build-up in hydrostatic pressure while containing the debris within the slide. Check barrage will typically be a dam structure between 1 and 1.5m high, with slopes between 1(V):1.5(H) or 2(H), and constructed across the full section of topographic valley and/or water course.

The check barrage is an emergency preventative measure only to restrict or reduce the movement of displaced material downslope and away from a watercourse. Further assessment and reinstatement works will likely be required should a landslide occur, and engagement and reporting of the incident will be required by all parties involved in the project. Should the check barrage no longer be required it may be removed and the area reinstated.

The use of check barrages is only proposed for use in the unlikely event of a large landslide event. The proposed locations are only indicative, targeting potential topographic channels but will vary depending on the location and nature of the slide event. The Contractors will need to include an assessment of potential check barrage locations and method for their construction within the emergency procedures in their associated Method Statement documentation.

Catch Ditches

Similarly, ditches may also slow or halt runout, although it is preferable that they are cut in non-peat material. Simple earthwork ditches can form a useful low-cost defence. Paired ditches and barrages have been observed (Tobin, 2003) to slow peat landslide runout at failure sites.

Peat and Spoil Management Plan

A Peat and Spoil Management Plan (PSMP) has been developed and is included in Appendix 9.2. The PSMP outlines the guidelines and methodologies for the careful management, handling and storage of peat on the site. These mitigation measures include:

- A competent Project Geotechnical Engineer shall be appointed for the construction phase to oversee peat excavation and management;
- Peat related works will be subject to additional detailed designed and checked by the relevant professionals, for example by a qualified geotechnical engineer, hydrologist, and/or drainage engineer;
- Placement of peat and spoil material, including temporary and side casting, will be carried out in the permitted peat deposition areas only;
- Excavated peat and spoil will be immediately moved short distances to the designated peat deposition area or borrow pit areas with the exception of the storage required for the opening of the initial borrow pit. Acrotelm (upper) peat material will be used as landscaping material where the topography allows, and the detail designer has assessed the stability risk;
- Peat and spoil will only be placed in the proposed deposition area or re-used for landscaping purposes. Peat deposition areas are outlined in the PSMP in Appendix 9.2 and have been located only in areas where the peat instability risk allows;
- The velocity of water flows within drainage systems will be controlled using check dams, and the uncontrolled release of water onto slopes can create a landslide risk and must be avoided;
- All construction requiring cut and fill earthworks requires a robust monitoring and inspection programme. The details of this inspection programme will depend on the purpose and methodologies of the works and the ground conditions;
- A method statement and risk assessment (RAMS), which considers the potential causes and mitigations of peat instabilities and landslides, is required and must be regularly communicated to all site staff. An observational approach by all site staff to the ground conditions and the risks will be promoted, and any changes in the ground or site conditions will be reported and the risk dynamically assessed;
- Regular briefing of all site staff (e.g. toolbox talks) to provide feedback on construction and ground performance and to promote reporting any observed change in ground conditions.
- Frequent monitoring of slopes associated with the proposed wind farm shall be undertaken during the construction phase, and where required, additional monitoring undertaken following heavy and/or prolonged rainfall events;
- Installing movement monitoring posts is recommended for areas where works occur on or adjacent to identified peat depths greater than 2m and existing slope angles exceeding 5°. At those locations, monitoring posts are recommended to be installed upslope and downslope of the works areas;
- Movement monitoring posts shall be observed at least once daily during the construction phase, with more frequent inspections where adjacent works are ongoing. Should movements be recorded, the frequency of these inspections will be increased. A record of all monitor post inspections will be kept with reference to date, time and relative movement between posts, if any. Any movement identified in the posts shall be recorded with reference to the post numbering system. The monitoring regime will be further developed and assessed during the detailed design phase; and,

- The Contractor shall also develop a routine inspection of all areas surrounding work in peat, not just exclusively on the monitoring posts. These inspections shall include an assessment of ground stability and drainage conditions. These inspections will identify any cracking or deformation on the peat surface, an excessive settlement on structures, drain blockages or springs etc.

9.5.3.2 Borrow Pits

The Peat and Spoil Management Plan (GDG, 2024) attached as Appendix 9.2 sets out the guidelines for the construction and reinstatement of the on-site borrow pits. Upon the removal of the required volumes of granular material (for the construction of the infrastructure elements at the wind farm) from the borrow pits it is proposed to reinstate the pits using excavated peat and spoil. The borrow pits are designed and will be constructed in a way which will allow the excavated peat and spoil to be placed safely, with areas within the borrow pits designated for the storage of excavated peat. Other mitigation measures included in the design of the borrow pits are as follows:

- Borrow pits will be developed with stable ground inclinations;
- Exposed slopes will be left with irregular faces to promote re-vegetation; and,
- Infilling of peat should commence at the back of the borrow pit and progress towards the pit entrance.

9.5.3.3 Karst Risk

If karstic void features are identified within the footprint of infrastructure, the following mitigation measures will be implemented:

Access Road/Track Cuttings

- Slope Buttressing
- Choking and infilling of fissures and small sinkholes
- High strength geotextiles for larger sinkholes
- Bolting and meshing

Access Road/Track Embankments

- Choking and infilling of fissures and small sinkholes
- High strength geotextiles for larger sinkholes

Turbine/Substation Foundations

- Piling through the void / karstified zone
- Foundations to span voids

9.5.3.4 Excavation Of Soil, Subsoils and Bedrock

The disturbance of soil, subsoil and bedrock is an unavoidable effect of the proposed wind farm, but every effort will be made to ensure that the amount of earth materials excavated is kept to a minimum to limit the effect on the geological aspects of the site. The management of geological materials is an important component of controlling dust, and sediment and erosion control. The following mitigation measures will be implemented:

- Excavated peat will only be moved short distances from the point of extraction and will be used locally for landscaping;
- Landscaping areas will be sealed and levelled using the back of an excavator bucket to prevent erosion. Where possible, the upper vegetative layer will be stored with the vegetation part of the sod facing the right way up to encourage growth of plants

and vegetation at the surface of the landscaped peat. These measures will prevent the erosion of peat in the short and long term;

- Construction of settlement ponds will be volume neutral, and all excess material will be used locally to form pond bunds and surrounding landscaping; and.
- Peat, overburden, and rock will be reused where possible on site to reinstate borrow pits and other excavations where appropriate.

A Peat and Spoil Management Plan has been prepared for the proposed development which is included in Appendix 9.2.

9.5.3.5 Vehicular Movements

Vehicular movements will be restricted to the footprint of the proposed development boundary, particularly with respect to the newly constructed access roads. Vehicular movements will not be permitted outside of the proposed wind farm site boundary and will not move onto areas that are not permitted for the development. The soft ground nature of the site will inhibit vehicles deviating from access roads and tracks due to the low bearing capacity of the peat.

Vehicular traffic on site is reduced through the use of extracting material from borrow pits on site as opposed to sourcing from external quarries.

9.5.3.6 Waste Management

Details on the management of any site generated construction waste and the storage and disposal of the waste are outlined in the CEMP. A specific Peat and Spoil Management Plan (Appendix 9.2) is in place for the site for the management of peat and spoil generated during excavations. Prior to construction commencement, the appointed Contractor will prepare a detailed C&D Resource and Waste Management Plan (RWMP) in accordance with the relevant following guidance 'Best Practice Guidelines for the preparation of resource & waste management plans for construction & demolition projects' (EPA, 2021). The Construction RWMP will provide a mechanism for monitoring and auditing waste management performance and compliance for the duration of the proposed development. The document will also provide a detailed overview of key waste management considerations for the proposed development and will be fully implemented onsite for the duration of the construction phase of the proposed development.

Waste streams (including material-related streams such as metals, paper and cardboard, plastics, wood, rubber, textiles, bio-waste and product-related streams such as packaging, electronic waste, batteries, accumulators and construction waste) will be managed, collected, segregated and stored in separate areas at the temporary compound and removed off site by a licensed waste management contractor at regular intervals during the works in line with condition 7 of the IPC Licence (P0504-01).

A wastewater holding tank (twin-hulled) will be used for the temporary welfare facilities and managed by a licensed contractor. Any introduced seminatural (road building materials) or artificial (PVC piping, cement materials, electrical wiring) materials will be taken off site at the end of the construction phase. Any accidental spillage of solid state introduced materials will be removed from the site by the appropriate means. In the unlikely event that soil material is unsuitable for use/ excess soil is generated, all waste soils (including made ground) will be appropriately sampled and tested prior to offsite removal and classified in accordance with the EPA Guidance Document *'Waste Classification, List of Waste & Determining if Waste is Hazardous or Non-Hazardous'* (2015). It will be the Contractors responsibility to ensure that all waste soils are classified correctly and managed, transported and disposed of offsite in accordance with the requirements of the Waste Management Act 1996, as amended, the Waste Framework Directive 2008/98/EC of the European Parliament and Council on waste and any relevant subsequent waste management legislation.

Excavated bedrock that will not be required will be stockpiled within the red line boundary and removed for offsite disposal to a suitably licenced / permitted waste facility and will be appropriately sampled and tested prior to offsite removal. This material will be classified in accordance with the EPA Guidance Document *'Waste Classification, List of Waste & Determining if Waste is Hazardous or Non-Hazardous'* (2015). It will be the Contractors responsibility to ensure that all waste soils are classified correctly and managed, transported and disposed of offsite in accordance with the requirements of the Waste Management Act 1996, as amended, the Waste Framework Directive 2008/98/EC of the European Parliament and Council on waste and any relevant subsequent waste management legislation.

It will be the Contractors responsibility to ensure that a project specific Detailed Resource and Waste Management Plan (developed in accordance with relevant 2021 EPA Guidance) is fully implemented onsite for the duration of the project.

9.5.3.7 General Site Management

The CEMP will also include the checking of assets (plant, vehicles, fuel bowsers) on a regular basis during the construction phase of the proposed development. 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. The use of ready-mixed concrete deliveries will eliminate any potential environmental risks of on-site batching. When concrete is delivered to site, only the chute of the delivery truck will require cleaning, using the smallest volume of water necessary, before leaving the site. Concrete trucks will be washed out fully at the batching plant, where facilities are already in place.

Management of Fuel and Oil

A fuel management plan has been prepared (and included in the CEMP) which incorporates the following elements:

- Mobile bowsers, tanks and drums will be stored in secure, impermeable storage area, away from drains and open watercourses;
- Fuel containers will be stored within a secondary containment system e.g. bund for static tanks or a drip tray for mobile stores;
- Fuels, lubricants and hydraulic fluids for equipment used within the proposed development, as well as any solvents, oils, and paints will be carefully handled to avoid spillage, properly secured against unauthorised access or vandalism, and provided with spill containment according to best codes of practice. All materials will be sufficiently bunded;
- Ancillary equipment such as hoses, pipes will be contained within the bund;
- Taps, nozzles or valves will be fitted with a lock system;

- Fuel and oil stores including tanks and drums will be regularly inspected for leaks and signs of damage;
- The contractor will have a dedicated area within the compound for refuelling plant or any other equipment that is bunded and has the necessary spill kit equipment and adsorbents available as and when required in line with any statutory IEPA & H&S legislations. Refuelling of machinery will be carried out using a mobile double skinned fuel bowser to allow for ease of work. The fuel bowser will be re-filled off site or at the contractors site compound and will be towed around the site by a 4x4 jeep to where machinery is located. Mobile measures such as drip trays and fuel absorbent mats will be used during all refuelling operations;
- All machinery will be serviced before being mobilised to the proposed development;
- Only designated trained operators will be authorised to refuel plant on site;
- Procedures and contingency plans will to be set up to deal with an 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 will be trained in its use;
- Strict supervision of contractors will be adhered to in order to ensure that all plant and equipment utilised in the proposed development are in good working condition. Any equipment not meeting the required standard will not be permitted for use within the proposed development. This will minimise the risk of soils and bedrock becoming contaminated through the proposed development activities;
- The highest standards of site management will be maintained, and utmost care and vigilance followed to prevent accidental contamination or unnecessary disturbance to the Site and surrounding environment during construction. A named person will be given the task of overseeing the pollution prevention measures agreed for the Site to ensure that they are operating safely and effectively; and,
- In the highly unlikely event that ground contamination is encountered beneath the site during the construction works, all works will cease. Advice will be sought from an experienced contaminated land specialist and a phased environmental risk assessment (specifically to assess any associated potential environmental and/ or human health risks) will be undertaken in accordance with relevant EPA guidance 'Guidance On The Management Of Contaminated Land And Groundwater At EPA Licensed Sites' (EPA, 2013) and UK Environment Agency Guidance 'Land contamination risk management (LCRM)' (UK EA, 2021).

Drainage and the Management of Sediment and Geological material

The permanent road works will require a drainage network to be in place for the construction and operation phases of the proposed wind farm site. Fundamental to any construction phase is the need to keep 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 a Sediment and Erosion Control Plan, with associated settlement ponds and silt traps. The Sediment and Erosion Plan is part of the CEMP for the site. The good management of material on site will reduce any indirect risk to water. Drainage measures are considered in further detail in Chapter 10 (Hydrology and Hydrogeology).

The handling, storage and re-use of excavated materials are of importance during the construction phase of the proposed wind farm. Excavated topsoil will not be stored in excessive mounds on the site. Seeding of the work affected areas with indigenous species will occur, only where natural revegetation or the reuse of the upper vegetated layer is unsuccessful. The re-vegetation of these areas promotes stability, reduces desiccation, run-off erosion and susceptibility to freeze/thaw action.

9.5.3.8 Hydrocarbon Release

Wherever there are vehicles and plant in use, there is the potential for a hydro-carbon release in the form of a spill that has the potential to directly pollute soil, and indirectly pollute water. This is due to the fact that soil may act as a pathway for the contamination. Any spill of fuel or oil would potentially present a moderate, long-term negative effect on the soil and geological environment.

Good site practice as outlined in 9.5.3.7 above will mitigate any effect. Good site management by means of regular checks on plant, and diligent housekeeping of machinery reduce the potential of hydrocarbon release on site. It is important for personnel on site to have the correct training and expertise in the event that a hydrocarbon leak occurs.

9.5.3.9 Excavation for Turbine Foundations

Three main foundation solutions have been identified:

- Gravity Foundations;
- Concrete driven piles; and
- Bored piles.

Mitigation measures to be adopted during excavation for the turbine foundations include:

- A temporary works design for foundation excavations will be carried out by a competent designer;
- The materials encountered in the trial pits across the GI phases are likely to be unstable during the excavation for the turbine bases. Where battering back of excavations to a safe angle (as determined by a detailed slope stability assessment by the competent designer) is not feasible, a physical barrier will be applied where required between the excavations and the potentially unstable material in the form of a granular berm or sheet piles.
- The long-term stability of the area around the wind turbine foundations will be achieved by filling the area back up to existing ground level following installation of the foundation;
- The design will be carried out by a suitably qualified and experienced geotechnical engineer and the management of the ground stability will be ongoing throughout the construction phase;
- Each turbine foundation will be investigated before and during construction to identify any potential karst features;
- Excavation works will be monitored by a suitably qualified and experienced geotechnical engineer or engineering geologist;
- The earthworks will not be scheduled to be carried out during severe weather conditions; and
- Any piling works will not produce significant volumes of spoil as the proposed piling system will be driven or bored piles.

9.5.3.10 Excavation for Hardstanding Foundations

The mitigation strategies for the hardstanding foundations follow similar procedures as the excavations for turbine and substation foundations, see Section 9.5.2.8. All works will be monitored by suitably qualified and experienced geotechnical engineer or engineering geologist.

9.5.3.11 Excavation for Substation Foundations

The mitigation strategies for the substation foundations follow similar procedures as the excavations for turbine and hardstanding foundations, see Section 9.5.2.8. All works will be monitored by suitably qualified and experienced geotechnical engineer or engineering geologist.

9.5.3.12 Turbine Delivery Route

Any temporary accommodation works required along the turbine delivery route such as hedge or tree cutting, temporary relocation of powerlines/poles, lampposts, signage and local road widening (See Chapter 15 Traffic and Transport) will be carried out in advance of turbine deliveries and following consultation and agreement with Longford County Council. All temporary accommodation works will be designed by and monitored by suitably qualified and experienced geotechnical engineer or engineering geologist.

9.5.3.13 Natural Resources

Bord na Móna has permanently ceased peat extraction at Derryadd since 2019. The potential for long term sterilisation of the borrow pit resource will be mitigated by diligent borrow pit design and appropriate material management. This would include detailed assessment of the material resource and borrow extent to ensure efficient exploitation of any borrow pits.

9.5.3.14 Human Health

Potential human health effects will only be present temporarily during the construction phase. These effects will be mitigated through good site management including dust control, applications of safe systems of work and mitigation through design with particular care taken of the design of temporary works in peat.

Further mitigation of the effects on human health are discussed in Chapter 6 (Population and Human Health).

9.5.4 Mitigation Measures - Operation

The following mitigation measures will be implemented during the operation phase:

- All wastes from the control building and ancillary facilities will be removed by the appropriate contractor;
- An appropriate contractor will be appointed to carry out maintenance works (to access roads, substation and turbines) who will put in control measures to mitigate the risk of hydrocarbon or oil spills during the operational phase of the windfarm;
- 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 effects are limited by the size of the fuel tank of vehicles used on the site;
- Spill kits will be available in all site vehicles to deal with an accidental spillage and breakdowns;
- An emergency plan for the operational phase to deal with accidental spillages and breakdowns will be contained in the finalised Environmental Management Plan; and,

- The substation transformer will be within a concrete bunded capable of holding 110% of the stored oil volume. Turbine transformers are located within the turbines, so any leaks would be contained within the turbine.

9.5.5 Mitigation Measures – Decommissioning

Following the end of the wind farm lifespan, the wind turbines may be replaced with a new set of machines, subject to planning permission being obtained, or the site may be decommissioned fully, with the exception of the electricity substation and amenity access track and car parks.

Upon decommissioning of the proposed wind farm, the wind turbines would be disassembled in reverse order to how they were erected. All above ground turbine components would be separated and removed off-site for recycling. Turbine foundations would remain in place underground and would be covered with earth and allowed to revegetate or reseed as appropriate. Leaving the turbine foundations in-situ is considered a more environmentally prudent option, as to remove that volume of reinforced concrete from the ground could result in potentially significant environment nuisances such as noise, dust and/or vibration. The majority of the site roadways will be in use for additional purposes to the operation of the wind farm (such as amenity and recreational use) by the time the decommissioning of the project is to be considered, and therefore it will be more appropriate to leave the site roads in-situ for future use.

The on-site substation will not be removed at the end of the useful life of the wind farm project as it will form part of the national electricity network and will be managed by EirGrid/ESB. Therefore, the substation will be retained as a permanent structure and will not be decommissioned.

The activities required to facilitate wind turbine decommissioning and removal from site will be similar to those outlined for the construction phase, albeit to a lesser extent and duration than during the construction phase.

Mitigation measures to be adhered to during decommissioning phase are as follows:

- Internal access roads will remain in situ which is also recommended by the Irish Wind Energy Association suggest there may be benefits to leaving them in place (IWEA, 2017). Furthermore, in the context that almost all of the internal roads will have a dual function of providing access to the turbines and amenity tracks it is intended that all of the roadways will be retained.
- Concrete bases will be left in the ground, covered with topsoil and allowed to naturally re-seed in line with IWEA best practises (IWEA, 2017).
- 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.
- A fuel management plan to avoid contamination by fuel leakage during decommissioning works will be implemented as per the construction phase mitigation measures.

As noted in the Scottish Natural Heritage report (SNH) Research and Guidance on Restoration and Decommissioning of Onshore Wind Farms (SNH, 2013) reinstatement proposals for a wind farm are made approximately 30 years in advance, so within the lifespan of the wind farm, technological advances and preferred approaches to reinstatement are likely to change.

According to the SNH guidance, it is therefore *'best practice not to limit options too far in advance of actual decommissioning but to maintain informed flexibility until close to the end-of-life of the wind farm'.*

9.5.6 Monitoring

As stipulated in the Peat and Spoil Management Plan (Appendix 9.2), a monitoring regime for potential peat instability is recommended.

Installing movement monitoring posts is recommended for areas where works occur on or adjacent to identified peat depths greater than 2 m and existing slope angles exceeding 5°. At those locations, monitoring posts are recommended to be installed upslope and downslope of the works areas.

Movement monitoring posts shall be observed at least once daily during construction, with more frequent inspections where adjacent works are ongoing. Should movements be recorded, the frequency of these inspections is to be increased. A record of all monitor post inspections will be kept with reference to date, time and relative movement between posts, if any. Any movement identified in the posts shall be recorded with reference to the post numbering system. The monitoring regime will be further developed and assessed during the detailed design phase.

The Contractor shall also develop a routine inspection of all areas surrounding work in peat, not just exclusively on the monitoring posts. These inspections shall include an assessment of ground stability and drainage conditions. These inspections will identify any cracking or deformation on the peat surface, an excessive settlement on structures, drain blockages or springs etc.

Monitoring requirements that are stipulated under the IPC licence (P0504-01) for the peatlands will continue to be fulfilled for the lifetime of the licence. The monitoring will be completed at the locations and for the parameters already specified in the IPC Licence (P0504-01). These monitoring proposals are further detailed in Chapter 10 (Hydrology and Hydrogeology) and included in the CEMP (Appendix 3-2).

9.6 RESIDUAL EFFECTS

According to the EPA (2022) guidelines, the residual effects of a proposed development are the final predicted or intended effects which occur after the proposed mitigation measures have been implemented. These are the remaining environmental 'costs' of a project that could not be reasonably avoided.

The potential residual effects of the construction, operation and decommissioning phases of the proposed development on the receiving geological environment following implementation of the mitigation measures outlined in Section 9.5 are assessed below, and summarised in Table 9-26.

9.6.1 Residual Effects – Construction

9.6.1.1 Slope Stability and Karst Features

The trial pits and peat stability assessment showed that there are potential peat stability issues that will need to be managed during the construction of the proposed wind farm. Following the mitigation procedures outlined in Section 9.5.3.1, the residual effect in relation to peat stability will be unlikely, not significant, short-term, and negative, and will be localised to excavations carried out during in construction phase. Following the implementation of mitigation measures outlined in 9.5.3.2, the risk to infrastructure posed by karst will be mitigated in such a manner that the residual effects will be unlikely, not significant, short term and negative.

9.6.1.2 Excavation Of Soil, Subsoils and Bedrock

The excavation and replacement of natural peat, subsoils and rock, with gravels and concrete for the construction of the infrastructure will result in a change in ground conditions within the proposed wind farm site. Following the implementation of the mitigation measures outlined in section 9.5.2.3 the residual effect is likely, not significant, permanent and negative.

9.6.1.3 Vehicular Movements

Following implementation of the mitigation measures outlined in Section 9.5.3.5, the residual effects from vehicular movements will be unlikely, not significant, temporary, and negative.

9.6.1.4 Waste Management

Following implementation of the mitigation measures outlined in Section 9.5.3.6, the residual effects from waste management will be unlikely, imperceptible, temporary, and negative.

9.6.1.5 General Site Management

Following implementation of the mitigation measures outlined in Section 9.5.3.7, the residual effects from the management of fuel and oil, drainage and sediment will be unlikely, not significant, temporary, and negative.

9.6.1.6 Hydrocarbon Release

Mitigation of this effect as outlined in Section 9.5.3.8 reduces this likelihood and severity of any hydrocarbon spills, thus the residual effect is unlikely, not significant, long-term and negative.

9.6.1.7 Excavation for Turbine Foundations

Following the implementation of the mitigation measures outlined in Section 9.5.3.9, the residual effect will be likely, not significant, permanent and negative.

9.6.1.8 Excavation for Hardstanding Foundations

Following the implementation of the mitigation measures outlined in Section 9.5.3.9, the residual effect will be likely, not significant, permanent and negative.

9.6.1.9 Excavation for Substation Foundations

Following the implementation of the mitigation measures outlined in Section 9.5.3.9, the residual effect will be likely, not significant, permanent and negative.

9.6.1.10 Natural Resources

Following mitigation, the residual effect on natural resources will be likely, not significant, permanent, negative.

9.6.1.11 Human health

Potential human health risks associated with quality effects to soils arising from the proposed wind farm during the construction phase have been identified as follows:

- Potential risk to receptors (i.e., construction workers) through direct contact, ingestion or inhalation with any soils which may potentially (unlikely) contain hydrocarbon concentrations from site activities (potential minor leaks and spills of fuels, oils, etc).

However, this risk will be addressed by implementation of the mitigation measures outlined previously. Taking account of the baseline environmental setting and the proposed mitigation measures during the construction phase, no human health risks associated with exposure to contaminants (via. direct contact, ingestion, or inhalation) resulting from the proposed wind farm are anticipated.

In summary, no significant effects are likely to occur with respect to Land, Soils and Geology and Human Health, as a result of the proposed development.

9.6.2 Residual Effects- Operation

The key potential effect requiring mitigation during the operation phase of the proposed development is identified in Section 9.4.3 as the potential for release of fuel and lubricating oils from machinery and equipment, during maintenance work, or from substation equipment during operation. The potential release of hydrocarbons during the operation phase could potentially cause contamination of soils and groundwater. Following the implementation of the mitigation measures outlined in 9.5.4, the residual effect of this is reduced to unlikely, long-term, not significant and negative.

9.6.3 Residual Effects- Decommissioning

Following the implementation of the mitigation measures discussed in Section 9.5.5, the residual effects of the decommissioning phase of the proposed development will be reduced. The effect of temporary excavations during decommissioning will be not significant, short term and negative. The effect of the turbine bases remaining in place will be not significant, permanent and neutral. The effect of the roads remaining in place for amenity use will be not significant, permanent and positive.

9.6.4 Summary of Residual Effects

A summary of the residual effects discussed in the previous subsections is provided in Table 9-26.

Table 9-26: Summary of post-mitigation residual effects on the receiving environment during the construction, operation and decommissioning phases

Receptor	Potential Effects	Importance (sensitivity)	Duration and Frequency (pre-mitigation)	Significance (pre-mitigation)	Duration and Frequency (post-mitigation)	Significance (post-mitigation)
Construction Phase						
Soils (excluding peat)	• Potential loss of / negative effects on the superficial geological resource (soils) due to temporary excavations for windfarm infrastructure.	Negligible	Permanent and likely	Slight Negative	Permanent and likely	Not Significant Negative
Peat (carbon resource)	• Potential loss of / negative effects on the peat soils due to temporary excavations for windfarm infrastructure. • Potential loss of / negative effects on the peat soils due to deep temporary excavations at turbine foundation locations. • Peat compaction associated with construction traffic may reduce soil permeability and increase surface runoff. • Potential increased erosion of superficial soils due to tree felling and loss of surface vegetation.	High	Permanent and likely	Slight Negative	Permanent and likely	Not Significant Negative
Peat (landslide)	• Potential landslide of peat caused by risk factors such as cutting, loading, vibration, alterations to surface water drainage, vegetation removal, or inappropriate storage of peat, leading to effects on surface water, infrastructure and people.	High	Short term and unlikely	Significant Negative	Short term and unlikely	Not significant Negative
Geology (resource)	• Potential loss of negative effects on the solid geological resource beneath temporary excavations for windfarm infrastructure.	Low	Permanent and likely	Not Significant Negative	Permanent and likely	Not Significant Negative
Karst	• Potential risk of encountering hidden karst features during construction of turbines and infrastructure	Medium	Permanent and unlikely	Moderate Negative	Short term and unlikely	Not significant negative
Groundwater bodies	• Potential localised increase in alkalinity from spillages of concrete or unset cement causing pollution of groundwater. • Potential accidental release, leakage or spillage of hydrocarbons, fuel or oils from storage tanks/construction plant during construction causing contamination of groundwater. • Potential localised alteration of the groundwater regime during construction of the turbine base structures and windfarm infrastructure. • Potential exposure of bedrock and increase in groundwater vulnerability.	Medium	Short term and unlikely	Moderate Negative	Short term and unlikely	Slight Negative
Contamination	• Mobilisation of contamination in soils as a result of additional sediment loading or leaching.	Low*	Long term and unlikely	Moderate Negative	Long term and unlikely	Not Significant Negative
Operational Phase						
Soils (excluding peat)	• Potential loss of / negative effects on the superficial geological resource (soils) due to permanent excavations for windfarm infrastructure maintenance.	Negligible	Permanent and unlikely	Imperceptible	Permanent and unlikely	Imperceptible

Receptor	Potential Effects	Importance (sensitivity)	Duration and Frequency (pre-mitigation)	Significance (pre-mitigation)	Duration and Frequency (post-mitigation)	Significance (post-mitigation)
Peat (carbon resource)	• Potential loss of / negative effects on the peat soils due to permanent excavations for windfarm infrastructure maintenance. • Peat compaction associated with construction traffic may reduce soil permeability and increase surface runoff. • Potential increased erosion of superficial soils due to tree felling and loss of surface vegetation..	High	Permanent and likely	Slight Negative	Permanent and likely	Not Significant Negative
Peat (landslide)	• Ongoing potential landslide of peat caused by risk factors during the operation phase such as cutting, loading, vibration, alterations to surface water drainage, vegetation removal, or inappropriate storage of peat, leading to effects on surface water, infrastructure and people.	High	Short term and unlikely	Significant Negative	Short term and unlikely	Slight Negative
Geology (resource)	• Potential loss of / negative effects on the solid geological resource beneath permanent excavations for windfarm infrastructure.	Low	Permanent and likely	Not Significant Negative	Permanent and likely	Not Significant Negative
Groundwater bodies	• Potential accidental release, leakage or spillage of hydrocarbons, fuel or oils from storage tanks/ plant during operation causing contamination of groundwater. • Potential localised alteration of the groundwater regime due to turbine base structures and windfarm infrastructure. • Potential contamination of groundwater by leachable contamination from imported fill materials. • Reduction in infiltration caused by increased hardstanding cover or compaction of soils, resulting in impacts on groundwater.	Medium	Short term and unlikely	Moderate Negative	Short term and unlikely	Not Significant Negative
Contamination	• Mobilisation of contamination in soils as a result of additional sediment loading or leaching.	Low	Short term and unlikely	Not Significant Negative	Long term and unlikely	Not Significant Negative
Decommissioning Phase						
Soils	• Potential increased erosion of superficial soils during the Soils (excluding decommissioning process due to temporary exposure of ground peat) during removal of infrastructure and prior to restoration.	Negligible	Permanent and unlikely	Imperceptible	Permanent and unlikely	Imperceptible
Peat (carbon resource)	• Potential loss of / negative effects on the peat soils during any excavations necessary for decommissioning	High	Permanent and likely	Not Significant Negative	Permanent and likely	Not Significant Negative
Peat (landslide)	• Potential landslide of peat caused by risk factors such as cutting, loading, vibration, alterations to surface water drainage, vegetation removal, or inappropriate storage of peat, leading to effects on surface water, infrastructure and people.	High	Short term and unlikely	Significant Negative	Short term and unlikely	Not significant Negative
Geology	• None	Low	Temporary and unlikely	Imperceptible	Temporary and unlikely	Imperceptible

Receptor	Potential Effects	Importance (sensitivity)	Duration and Frequency (pre-mitigation)	Significance (pre-mitigation)	Duration and Frequency (post-mitigation)	Significance (post-mitigation)
Groundwater bodies	• Potential accidental release, leakage or spillage of hydrocarbons, fuel or oils from storage tanks/ plant during decommissioning causing contamination of groundwater. • Potential localised alteration of the groundwater regime due to removal of turbine base structures and windfarm infrastructure. • Changes to infiltration caused by reduced hardstanding cover or compaction of soils, resulting in impacts on groundwater.	Medium	Long term and unlikely	Moderate Negative	Long term and unlikely	Slight Negative
Contamination	• Mobilisation of contamination in soils as a result of additional sediment loading or leaching	Low*	Short term and unlikely	Not Significant Negative	Long term and unlikely	Not Significant Negative

9.6.5 Cumulative Effects

The potential for cumulative effects of the proposed development with other existing and proposed developments in the region has been undertaken. A list of proposed developments reviewed as part of this section are listed in Chapter 5 (Policy, Planning and Development Context).

As listed in Chapter 5, there are a number of live applications for renewable energy projects including solar farms, battery energy storage systems, substations, grid uprate works in the region of the proposed wind farm site. The location of these projects are outside the proposed wind farm site and therefore no significant cumulative effects are envisaged.

Permission has been granted for an underground electrical cable and transformer compound to connect permitted solar farms to the national grid at Lough Ree Power Station (22275). Construction is currently underway on this cable which crosses sections of the Derryaroge Bog. The construction of the cable will not overlap with the construction phase of the proposed wind farm, therefore, there is potential for an imperceptible, temporary cumulative effect during the construction of the cable route outside of the wind farm site due to the temporary stripping of soils and excavations needed for cable trenching.

Permission has been granted for a network of walking and cycling trails (24/60132) on lands to the west and north of the proposed wind farm site. These trails will be outside of the wind farm site and thus their construction and operation will not result in significant cumulative effects.

Indirect effects that may arise due to the use of public roads as haul roads to bring these materials to site and the effect of the use of imported stone from available local quarries. Section 9.4.2.13 outlines the volumes of imported stone required for the proposed wind farm. Due to the proposed utilisation of on-site borrow pits the volumes of stone request for import from external quarries is severely minimised, with no significant cumulative effects envisaged.

9.7 CONCLUSION

Overall, the construction of the proposed development will have a not significant negative long-term effect on the soil and geological environment through the application of identified mitigation measures and appropriate management throughout the construction phase of the wind farm. The operation phase of the proposed development will have a not significant negative long-term effect on the soil and geological environment through the application of identified mitigation measures and appropriate management throughout the operation phase of the wind farm. The decommissioning phase of the proposed development will be not significant negative long-term effect on the soil and geological environment through the application of identified mitigation measures and appropriate management throughout the decommissioning phase of the wind farm. Leaving the amenity access roads in place as amenity tracks will have a not significant long-term positive effect.

The site is relatively flat lying with cutaway/cutover peat overlying a soft to very soft glacial lacustrine marls and firm to stiff glacial till materials overlying largely limestone bedrock, with some clastic (sandstone) bedrock encountered in the far south of the site. Due to the relatively flat, drained cutaway nature of the site, the risk of a regional scale landslide is low. Due to the nature of the peat and subsoils at the site, construction of the proposed wind farm will require deep excavations at the turbine locations. Instability of soils will be localised to the extent of excavations for the various infrastructure locations. Identified temporary works will be put in place to successfully mitigate this risk. This is likely to be in the form of a battering back of excavations to a safe angle (as determined by a detailed slope stability assessment by a competent temporary works designer) or temporary granular berm or sheet pile wall. Following a peat stability assessment, the risk of long-term instability is considered low following mitigation procedures and completion of the construction phase. It should be noted that the excavations will be backfilled to the existing ground level.

The wind farm site is not a sensitive site in terms of the soils and geological environment. In terms of the soil and geological environment, the effects of the proposed development will be not significant, permanent and negative. Cumulative effects of the proposed development with other developments in the region are discussed in Section 9.5.5 and in Chapter 15 (Traffic and Transport). Section 9.4.2.11 outlines the volumes of imported stone required for the proposed development. Due to the proposed utilisation of on-site borrow pits the volumes of stone request for import from external quarries is severely minimised. A review of the local planning applications to An Bord Pleanála and Longford County Council would suggest that the volumes of stone required for import should have a not significant, temporary and negative cumulative effect on other developments in the region.

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