

Appendix 14.8: Groundwater Dependent Terrestrial Ecosystems (GWDTE) Assessment

Table of Contents

1	Introduction	1
2	Methodology	1
3	Hydrogeological Assessment	3
4	GWDTE Assessment	4
5	Discussion	8

Figures

Figure 14.8.1 Potential Groundwater Dependent Terrestrial Ecosystems

1 Introduction

This Groundwater Dependent Terrestrial Ecosystems (GWDTE) Assessment has been prepared by Fluid Environmental Consulting (Fluid) on behalf of the applicant to support Environmental Statement (ES) for Scout Moor Wind Farm (the 'Project for Assessment'). The Assessment Boundary (**Figure 1.1** of the ES) is comprised of predominantly upland moorland and grassland over an elevated plateau on a north to south ridge reaching an elevation of 480 m Above Ordnance Datum (AOD). Slope angles are generally low to moderate across the Assessment Boundary encompassing Prickshaw Brook, Naden Brook, Scout Moor Brook, Cowpe Brook, Well Clough and Cown Brook surface water catchments.

The Project for Assessment will comprise 12 wind turbines, with a blade tip height of up to 180 m, associated infrastructure and ancillary development.

Groundwater Dependent Terrestrial Ecosystems (GWDTEs) are protected under the Water Framework Directive (WFD), as implemented in England through the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017. Assessments are regulated by the Environment Agency (EA). This assessment identifies areas of potential GWDTEs in proximity to the Proposed Development infrastructure, considering the hydrological and hydrogeological setting, topography, geology, and existing infrastructure. The findings inform the evaluation of effects on GWDTEs presented in **Chapter 14: Hydrology, Hydrogeology and Peat** of the ES.

2 Methodology

A detailed National Vegetation Survey (NVC) survey for the Study Area has been completed by Atmos Consulting Ltd (Atmos, July to September, 2024) and is presented within **Chapter 9: Ecology** of the ES. The Study Area adopted for baseline habitat surveys was based upon the layout of the proposed development infrastructure and a preliminary (now superseded) development boundary. A total of 855 polygons were identified across the Study Area.

The methodology for the identification of potential GWDTEs is as follows:

- Review of all NVC categories to determine which are potentially groundwater dependent (GWD), originally undertaken by Atmos making reference to Land Use Planning System SEPA Guidance Note 31 (LUPS 31, version 3, 2017), modified from the UKTAG (2008) List of NVC Communities and Associated Groundwater Dependency Scores, Annex 1 (updated October 2009) (which relates to whether they are considered potentially low, moderate or high groundwater dependence) for potentially GWD NVC communities¹. This identified 154 potentially GWDTEs polygons and seven Target Notes associated with potentially GWD features. All but one of these Target Notes are associated with habitats already mapped as polygons and do not

¹ The SEPA LUPS 31 guidance has since been superseded in Scottish guidance (SEPA, August 2024). For the potentially GWD habitats present within the Study Area however, there are no significant changes between the updated SEPA guidance and the UKTAG UK GWD scores. The classification originally undertaken by ATMOS is therefore compatible with the UKTAG guidance which is the relevant document for GWDTE assessments undertaken on English sites and the scores for Scotland have been used to take a worst-case scenario.

offer additional information relevant to the assessment. For simplicity, only this one Target Note has been included in the assessment.

- The relevant buffer zones for GWDTE were then created for all proposed infrastructure (provided expected dewatering rates do not exceed 10 m³/day*) at a distance of:
 - 10 m radius of all activities;
 - 100 m around subsurface activities where excavation would be less than 1 m depth; and
 - 250 m from subsurface activities turbines where excavation could exceed 1 m depth, e.g. turbines.
- The identified potentially GWDTE polygons and Target Notes within the buffers were then categorised into potentially moderately GWDTEs and potentially highly GWDTEs based on the UKTAG scores. This resulted in the following potential GWDTEs within the buffers presented on **Figure 14.8.1** of this appendix:
 - 13 potentially highly GWDTE polygons;
 - 30 potentially moderately GWDTE polygons; and
 - One target note associated with a potentially highly GWDTE feature.
- An iterative process was then undertaken to scope out from further assessment habitats that are unlikely to be truly GWD based on the following criteria:
 - Potentially Moderately GWDTE Polygons underlain by non-aquifer bedrock and / or non-aquifer superficial geology;
 - Potentially Moderately GWDTE polygons that are unlikely to be groundwater dependent as a result of their extent and/or morphology: Potentially Moderately GWDTE polygons covering a large continuous area with no clear mechanism of groundwater discharge observed on site or implied from habitat morphology are unlikely to be GWD in the context of the site environment;
 - Potentially Moderately or Highly GWDTE polygons that are unlikely to be impacted as a result of topographical separation - i.e. Habitats located in a separate surface water catchment to proposed infrastructure, habitats that are a significant distance upgradient of proposed infrastructure and/or habitats that separated from proposed infrastructure by a watercourse that would intercept groundwater flow;
 - Mosaic containing Potentially Highly GWDTE Polygons underlain by non-aquifer peat deposits with no clear mechanism of groundwater discharge or potential source zones visible from aerial photography; and
 - Potentially Highly GWDTE polygons that are associated with surface water features.
- This resulted in 9 remaining polygons with potential for groundwater dependency within the buffer zones of the proposed development infrastructure. These are presented in **Table 2**, Section 4.

* The <10 m³/day dewatering rate is used as a screening assumption for buffer definition only. Dewatering will be temporary and localised, and actual requirements will be confirmed pre-construction and managed through the CEMP.

This report provides an assessment of groundwater dependency of the remaining polygons that are considered to be potentially GWD based on the geological, hydrogeological and topographical setting.

3 Hydrogeological Assessment

A qualitative hydrogeological assessment has been undertaken on features that have been identified as being potentially GWD within the buffers and where other factors do not rule out the habitat as either being linked to the development or being GWD.

This assessment is based primarily on the information presented in **Figure 14.7** of the ES which presents the hydrogeological potential of the bedrock and shows the type and extent of any superficial deposits (including actual peat from Peat Surveys (**Appendix 14.2 Peat Survey Report**), as well as the topographical setting. The particular hydrogeological setting at each location is discussed in relation to the habitat in **Section 4** of this GWDTE Assessment.

The degree of groundwater dependence of a water body varies from wetland to wetland and is dependent on hydrogeological connectivity. The Sniffer 2007 guidance document 'Wetland Hydrogeomorphic Classification for Scotland' produced a hydrogeomorphic classification for potential wetland areas within the Scottish landscape. The document states that *'The dependence of wetlands on groundwater bodies is also a result of the hydrological connectivity. The degree of dependency will vary depending upon whether the wetland is underlain by a low productivity or high productivity aquifer and whether there is a hydrological linkage mechanism between groundwater and the surface wetland.'*

There are three qualitative levels of groundwater dependency depending on whether the wetland is underlain by a low or high productivity aquifer:

- *'high likelihood of groundwater dependency: intergranular high productivity drift aquifer and dominantly intergranular high productivity aquifer;*
- *moderate likelihood of dependency: intergranular moderate productivity drift aquifer and fractured very low productivity aquifer; and*
- *low likelihood of dependency: intergranular low productivity drift aquifer and fractured very low productivity aquifer'.*

The BGS geological mapping (**Figure 14.3** of the **ES**) shows the Study Area to be underlain by a combination of Upper Haslingden Flags and Rough Rock formation comprising sandstone bedrock, with minor bands of Rossendale Formation mudstone and siltstone in the southwestern half of the Study Area. Predominantly in the south, north-east and western areas there are the Woodhead Hill Rock, Ganister Rock and Darwen Flags Formations comprising sandstones and Pennine Lower Coal Measures Formation (PLCM) comprising mudstone, siltstone, sandstone and coal seams, in some cases which are shown to be shallow or close to the surface. There are small areas of Great Arc Sandstone and Helpet Edge Rock Formations comprising of sandstone around the centre of the Study Area.

The Upper Haslingden Flags are primarily sandstone whilst the Rossendale Formation is more complex, consisting of fine- to very coarse-grained feldspathic sandstone interbedded with grey siltstone, mudstone, marine black shales, thin coals, and seatearths. It includes a lower mudstone-dominated sequence containing prominent marine bands and an upper sandstone-dominated sequence featuring the Rough Rock and Rough Rock Flags.

The Pennine Lower Coal Measures Formation comprises interbedded mudstone, siltstone, and pale grey sandstone, with marine fossils in the lower part and thicker coal seams in the upper part. It typically overlies the Rossendale Formation and is defined by key marker horizons, such

as the Subcrenatum Marine Band at its base. The Woodhead Hill Rock, a sandstone unit within the Pennine Lower Coal Measures, has little recorded detail but contributes to the overall stratigraphy in the northern and southern portions of the Study Area.

There are three north-west to south-east faults and one north-east to south-west shown on the geological mapping within the Study Area.

The Study Area's hydrogeology is controlled by underlying bedrock and superficial deposits, with groundwater movement mainly through fractures, faults, and permeable sandstone layers. The British Geological Survey 1:625,000 scale Hydrogeological Mapping shows the Study Area to be underlain by a moderately productive aquifer in which flow is virtually all through fractures and other discontinuities. The Pennine Lower Coal Measures Formation is a complex multi-layered Secondary A aquifer in which flow is virtually all through fractures and other discontinuities, though historical coal mining may have locally increased the secondary permeability. The Upper Haslingden Flags and Rossendale Formation are also a Secondary A aquifer. Secondary A aquifers comprise permeable layers that can support local water supplies, and may form an important source of base flow to rivers

The BGS geological mapping shows that large areas of the Study Area are absent of superficial deposits, but several large areas of peat are shown across the centre of the Study Area. This was further confirmed by peat depth surveys undertaken by Fluid which have been used to aid in this assessment. A small section of Diamicton Head is located at the southern edge of the Assessment Boundary, though its extent is minimal.

Peat deposits typically act as a water-retaining material that maintains a high-water table and contributes to baseflow in nearby streams. Its disturbance could alter local drainage patterns and affect recharge processes. The small area of Diamicton Head, likely composed of clay-rich material, has low permeability and is expected to limit vertical groundwater movement while promoting surface water runoff.

The combination of these geological units results in a hydrogeological setting where groundwater flow is largely fracture-controlled, with springs potentially emerging at lithological boundaries, and where local variations in permeability, historical mining, and superficial deposits may influence groundwater availability and interaction with surface water features. Peat and Diamicton Head deposits are low permeability. The hydrogeological setting therefore suggests that any potential GWDTE in areas of Diamicton Head and / or Peat deposits should be considered as having a low likelihood of dependency. However, when discrete point sources (springs) give rise to small habitats of high base rich floristic content, then a higher level of dependency must be considered. These are likely to be connected to very specific zones of permeability, fractures or fault zones.

Large continuous areas of potentially highly or moderately GWDTE habitat are unlikely to be supported by a groundwater resource present in this layer, however where smaller high potential GWDTE polygons are present or a discrete source such as a spring or flush is present then a higher likelihood of groundwater dependency has been considered.

4 GWDTE Assessment

The following section considers the hydrological/hydrogeological setting and the likelihood of effects considering topography, geology and existing infrastructure.

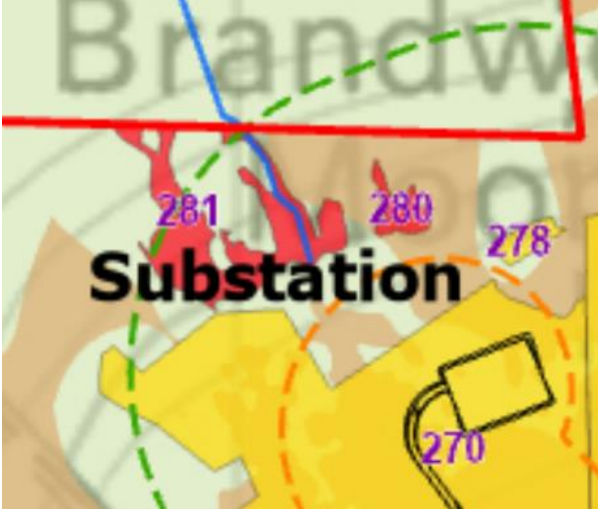
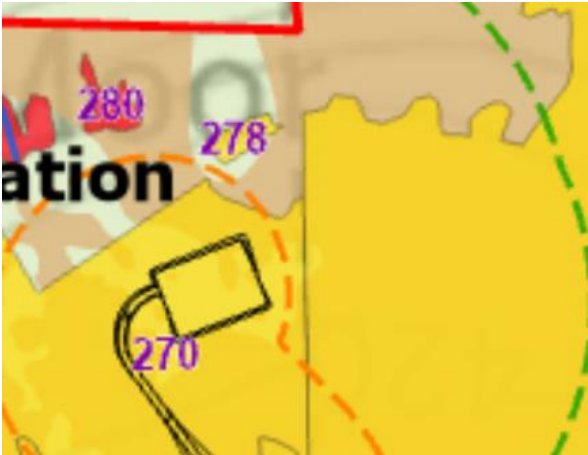
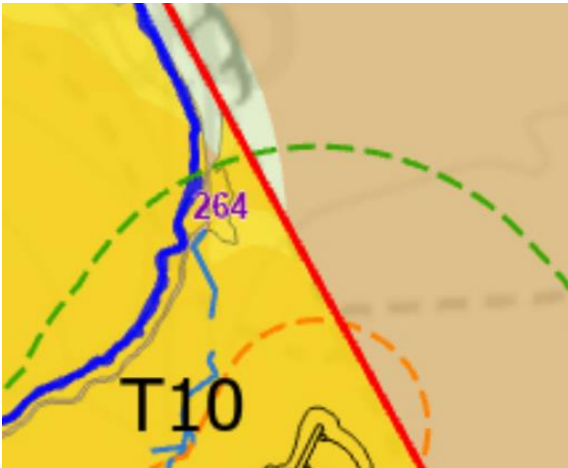
Table 1 provides a summary of the results of the iterative process described in **Section 2**, detailing the habitats and polygons considered not GWD on the basis of a combination of the following criteria: being underlain by non-aquifer bedrock or superficial geology; lacking any clear mechanism of groundwater discharge or potential source zones visible from aerial photography; and, being associated with mapped surface water features and therefore considered surface water fed.

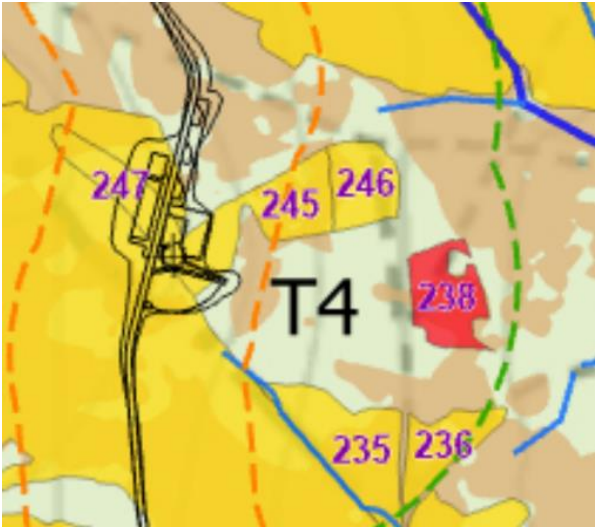
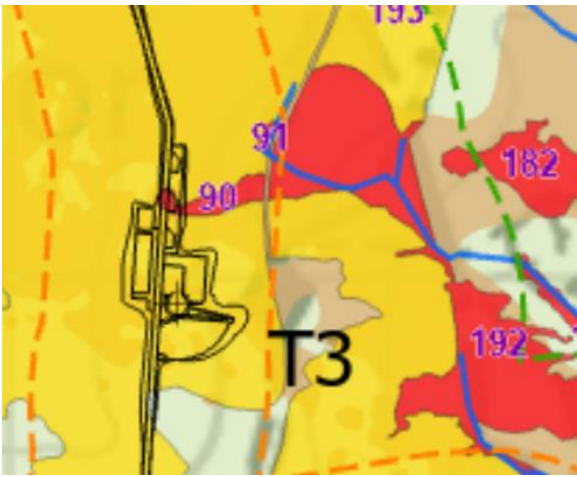
Table 2 provides an assessment of each of the habitats within the buffer zones of the proposed development infrastructure footprint that are potentially highly GWD and are not scoped out of the assessment following the methodology described in **Section 2**. It is identified whether they are actually GWD and if so, if they are actually connected to the Project for Assessment.

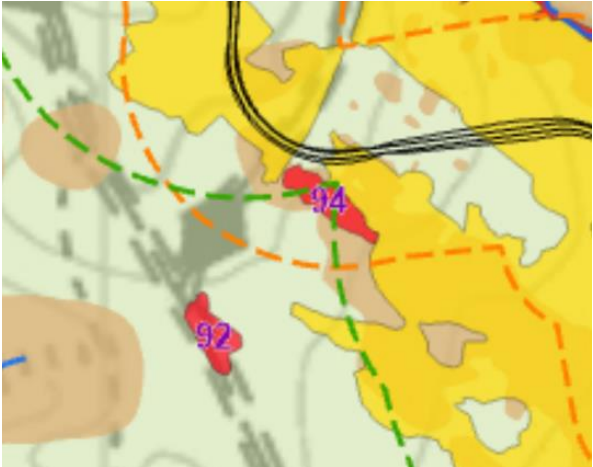
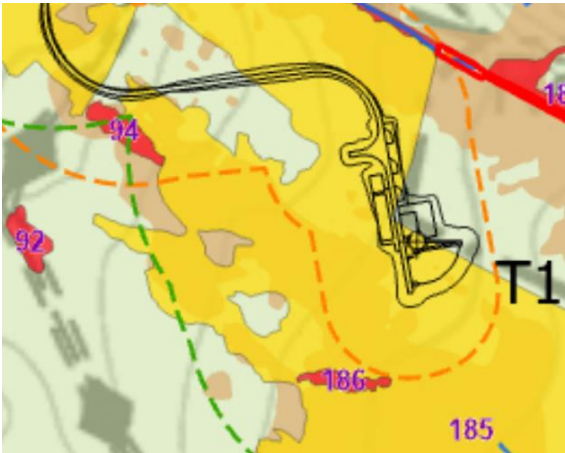
Table 1 Polygons and Target Notes Scoped out of Assessment

Rationale	Target Note or Potential GWDTE Polygon FID
Potentially Moderately GWDTE Polygons underlain by aquitard peat deposits (six polygons)	236, 247, 272, 273, 274 and 285.
Potentially Moderately GWDTE polygons that are unlikely to be groundwater dependent because of their extent and/or morphology (21 polygons)	52, 79, 80, 82, 83, 84, 85, 88, 164, 185, 193, 233, 235 245, 246, 249, 254, 255, 270, 278 and 289.
Potentially Moderately or Highly Potential GWDTE polygons and target notes that are unlikely to be impacted because of topographical separation (two polygons and a target note)	74 and 182; target note 9.
Potentially GWDTE polygons that are associated with surface water features (three polygons)	91, 180 and 184.
Potentially GWDTE polygons with no potential upgradient groundwater catchment (one polygon)	308

Table 2 Assessment of Potential GWDTEs with Infrastructure Buffer Zones.

NVC or Target Note Area	GWDTE Assessment
Area 281 	NVC Category: M6c Classification: Potentially Highly GWD Assessment: This habitat is primarily GWD, with groundwater emerging on a break in slope in the sandstone plateau, issuing from a sandstone aquifer at its boundary with a lower permeability mudstone and siltstone layer downslope from the plateau itself. The habitats are situated approximately 100 m downgradient of the proposed substation. There is a potential for impact on these habitats from the proposed infrastructure. Potential mitigation is further discussed in Section 6 below.
Area 280 	NVC Category: M6c Classification: Potentially Highly GWD Assessment: This habitat may have some groundwater influence as it is located on a break of slope similar to Area 281, however it is underlain by relatively impermeable peat and therefore is more likely to be rain or surface water fed. It is located over 100 m from the access track and offset from the substation so even if there is a degree of groundwater dependency there is unlikely to be any effect from the proposed infrastructure.
Area 264 	NVC Category: M25b Classification: Potentially Moderately GWD Assessment: This habitat is located within an artificial depression resulting from historic mining activity. It is underlain by permeable sandstone geology devoid of superficial deposits, however no groundwater source was identified during the site visit. The habitat is therefore likely surface water and rainfall fed, with water accumulating within the habitat because of the artificial topography of the area.

NVC or Target Note Area	GWDTE Assessment
Area 238 	NVC Category: M6c Classification: Potentially Highly GWD Assessment: This habitat is situated approximately 200 m downgradient of the proposed T4 hardstanding. Hydrology within the area is constrained by the presence of a track upgradient and stone wall downgradient. The habitat is underlain by peat deposits downgradient however these are absent at the upgradient side of the habitat. The underlying geology is moderately permeable sandstone. There is a potential for some groundwater input however it is likely predominantly surface water and rainfall fed, with water collecting within the habitat as a result of the bounding wall and track. The habitat is considered to be of low ecological value as it is species poor and is not a natural feature as hydrology within the habitat is controlled by road and wall. It is therefore unlikely to be impacted by the Project for Assessment
Areas 90 and 192 	NVC Category: M6c Classification: Potentially Highly GWDTE Assessment: Polygons 90 and 192 are situated downgradient of the T3 to T2 spur track and T3 and T2 infrastructure. These habitats may have some groundwater influence as they are located on a break of slope, however they are underlain by relatively impermeable peat and associated with surface water, therefore they are more likely to be rain or surface water fed.

NVC or Target Note Area	GWDTE Assessment
Polygons 92 	NVC Category: M6c Classification: Potentially Highly GWD Assessment: This habitat has a potential for groundwater dependency from the underlying sandstone aquifer; however, the habitat is oriented parallel to the direction of slope and extends upgradient from the closest infrastructure. The Proposed Development is therefore not anticipated to intercept groundwater flow to these habitats, so no hydrogeological impact on these habitats is anticipated.
Polygons 94 and 186 	NVC Category: M6c Classification: Potentially Highly GWD Assessment: These habitats are unlikely to be GWD as they are located on relatively impermeable peat deposits which are predominantly habitats fed by rainfall and surface water.

Note: As per Figure 14.8.1: Red line – assessment boundary; blue line = watercourse; yellow fill = potentially moderately GWD polygon; red fill = potentially highly GWD polygon.

5 Discussion

The analysis above has considered the hydrological/hydrogeological setting and the likelihood of effects considering topography, geology and existing infrastructure.

The bedrock across the Assessment Boundary consists primarily of sandstones with interbedded mudstone and siltstone units, resulting in variable but generally moderate groundwater productivity. Superficial deposits are absent across much of the Study Area, except for extensive peat deposits on the plateau. The peat deposits are considered to have low permeability and are unlikely to support groundwater-fed habitats over large areas being oligotrophic or rainwater fed predominantly.

Several potential GWDTE polygons have been scoped out of further assessment due to their location on aquitard peat deposits, morphology and extent, clear surface water association, or topographical separation from potential groundwater sources. These are detailed in Table 1.

Nine polygons have been identified within the infrastructure buffers where a potential for groundwater dependency remains. Eight of these habitats (Areas 238, 264, 280, 90, 92, 94, 192 and 186) are either considered to be not GWD or not hydrologically connected to the Project for Assessment. In these cases, surface water and rainfall appear to be the dominant hydrological inputs, and no significant hydrogeological impacts are expected.

One area (Area 281 M6c *Carex echinata* -*Sphagnum recurvum mire*) is considered to be GWD and has the potential to be hydrogeologically connected to the Project for Assessment as it is located approximately 130m downgradient of the substation. As such, a potential for impact exists. In order to mitigate potential negative effects on the habitat the following specific mitigation will be undertaken:

- Where possible the substation should be microsituated to maximise the distance from infrastructure to GWDTE habitats; and
- Any groundwater intercepted from the excavation of the substation should be discharged immediately downgradient in a diffuse manner to avoid an interruption to groundwater flow.

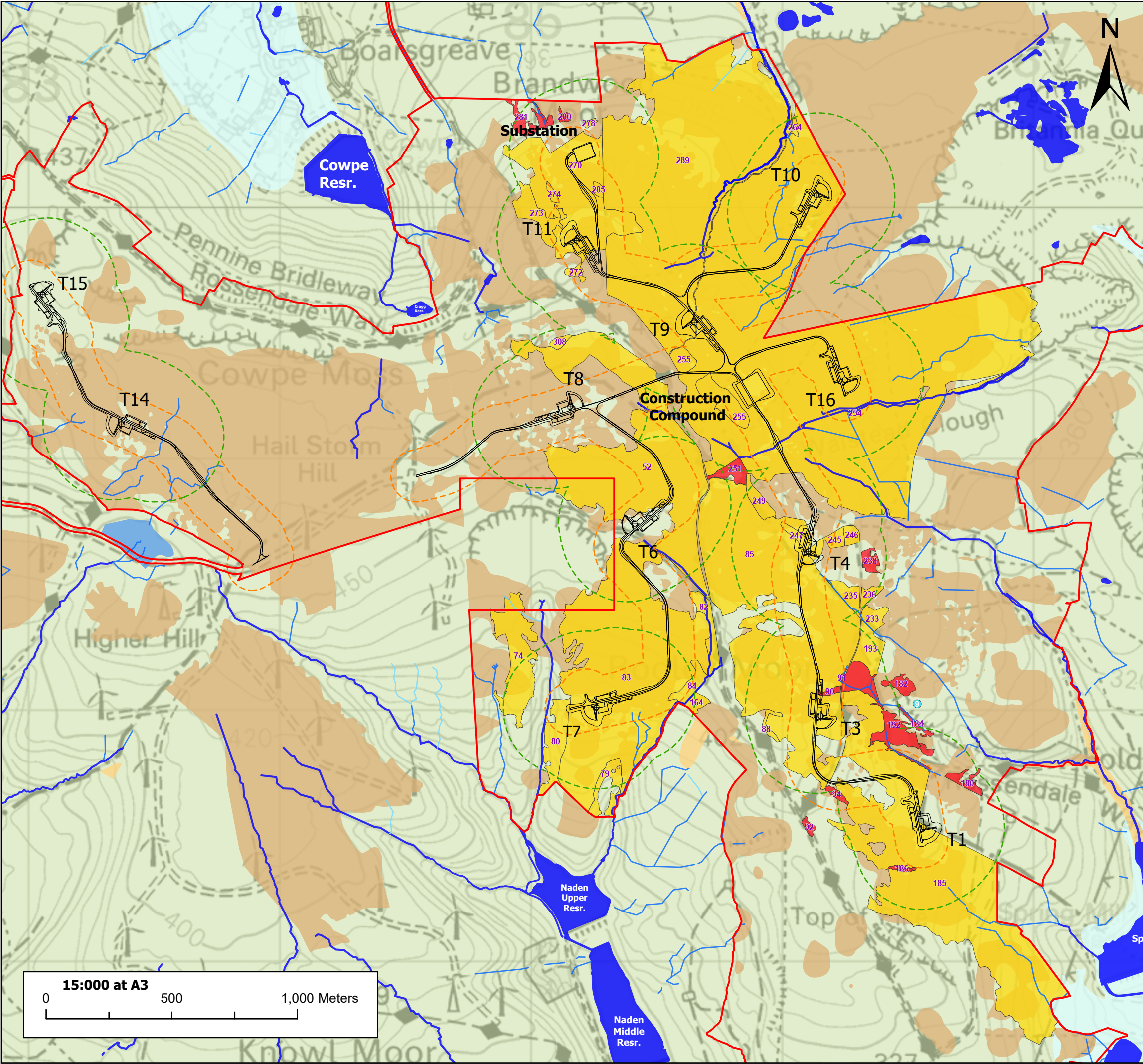
It should be noted that M6 doesn't directly apply to any principal corresponding Habitats Directive Annex I type/s. It is not considered to be an Annex I habitat but is a Priority habitat (Chapter 9 Ecology). M6 may occur as a component of blanket bog and within the UKTAG England scores, it scores as 2 rather than 1 in Scotland equating to a moderately GWDTE, however for the purposes of this assessment the score of 1, highly GWD, the worst-case scenario was used.

The Ecology assessment assessed the M6 habitat as being of County importance using CIEEM terms (Chapter 9 Ecology).

The following good practice methods are also recommended in general across the Assessment Boundary:

- Where infrastructure excavations are required, any water captured should be discharged in close proximity and downgradient of the infrastructure and in a diffuse manner to maintain continuity of flow;
- Drains running parallel to tracks should be routed to regular and frequent cross drains to avoid the tracks acting as interceptors to both surface and groundwater flow; and
- If more diffuse zones are crossed a series of small culverts to promote hydrological continuity are recommended.

Figures



- Application Boundary

Infrastructure

Turbine Locations

Infrastructure Layout

Hydrology

Watercourses (1:50K OS Map)

Watercourses (1:25K OS Map)

Watercourses (1:10K OS Map)

Standing Surface Water

Superficial Geology

ALLUVIUM

GLACIOFLUVIAL DEPOSITS, DEVENSIAN

HEAD, DIAMICTON

LACUSTRINE DEPOSITS

PEAT

TILL, DEVENSIAN

Hydrogeology

Aquifer Classification

Moderately Productive Aquifer

Aquifers in which flow is virtually all through fractures and other discontinuities.

Potential GWDTE

High

Moderate

Buffer 100 m

Buffer 250 m

Target Notes

Contains British Geological Survey materials © UKRI [2026].
Contains OS data © Crown copyright Open Data 2026.
© Crown copyright and database rights 2025 Ordnance Survey 0100031673.

Project Name:

SCOUT MOOR II

Figure 14.8.1:
Potential Groundwater Dependent Terrestrial Ecosystems (GWDTE)