Appendix 8.7 Millennium East Wind Farm EIA Report

Groundwater Dependent Terrestrial Ecosystems (GWDTE) Assessment

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1 Introduction

This report presents the findings of the potential groundwater dependentent terrestrial ecosystems (GWDTEs) for the Millennium East Wind Farm ('the Proposed Development') and forms an appendix (Appendix 8.7) to Chapter 8: Hydrology, Geology, Hydrogeology and Peat of the Environmental Impact Assessment Report (EIAR) and should be read with reference to this chapter and associated figures. This appendix is supported by figures contained in the chapter and within this appendix.

The Millennium East Wind Farm ('the Proposed Development') is proposed to consist of 8 wind turbines and associated infrastructure, including hardstandings and access tracks. The Site covers an area of approximately 19.2 km^2 located approximately 7 km due west of Fort Augustus and circa 7.5 km due north of Invergarry, south of Glen Moriston in the Scottish Highlands. The Site sits close to the Inchnacardoch Forest. The Site is wholly within the Highland Council administrative area.

The Site (**Figure 8.1** of the EIAR) is characterised by an existing access track from the River Moriston valley in the north to undulating upland terrain mostly covered by open moorland. The Site generally slopes to the north into numerous tributaries of the River Moriston with some areas on the top sloping to the northeast into the River Oich and southeast and south into the River Garry surface water catchments. The highest point on Site is Mam a' Chroisg at 715 m Above Ordnance Datum (AOD) Site in the west.

GWDTEs are protected environments under Water Framework Directive (WFD) legislation and assessments are regulated by the Scottish Environment Protection Agency (SEPA). This is an assessment of areas of potential GWDTEs within proximity of the Proposed Development infrastructure, considering the hydrological/hydrogeological setting, topography, geology and existing infrastructure to inform the assessment of effects on GWDTEs in **Chapter 8: Hydrology, Geology, Hydrogeology and Peat** of the EIAR.

2 Methodology

A detailed National Vegetation Survey (NVC) survey for the Study Area has been completed by Avian Ecology (August, 2024) and is presented within **Chapter 6: Ecology, Figure 6.2: Habitat Survey** and **Appendix 6.1** of the EIA Report. The Study Area adopted for baseline habitat surveys was based upon the layout of the Proposed Development and a preliminary (now superseded) development boundary. A total of 855 polygons was 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) in accordance with Land Use Planning System SEPA Guidance Note 31 (LUPS 31, version 3, 2017) initially by the ecologists identifying 223 potentially GWDTEs polygons and 30 Target Notes associated with potentially GWD features.
- This was then updated for the recent release (March 2025) of the new SEPA Guidance on Assessing the Impacts of Developments on Groundwater Dependent Terrestrial Ecosystems (August, 2024) in response to National Planning Framework 4 (NPF4,

February 2023). This resulted in a total of 148 potentially GWDTE polygons and 28 target notes associated with potentially GWD features.

- The relevant buffer zones for GWDTE were then created for all proposed infrastructure (provided expected dewatering rates do not exceed 10m^3/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;
    - 250 m from subsurface activities turbines where excavation could exceed 1 m depth, e.g. turbines and borrow pits.
- The SEPA 2024 guidance presents the NVC categories to be considered as potentially GWD and refers to the UKTAG (2008) List of NVC Communities and Associated Groundwater Dependency Scores, Annex 1 (updated October 2009) for their Scottish scores (which relates to whether they are considered potentially low, moderate or high groundwater dependence). 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 8.7.1** of this appendix:
    - 10 potentially highly GWDTEs polygons;
    - 7 mosaic polygons containing potentially high GWDTEs;
    - 3 mosaics polygons containing potentially moderately and highly GWDTE polygons;
    - One mosaic containing high potential GWDTEs
    - 54 moderate potential GWDTE polygons;
    - 18 mosaic polygons containing moderate potential GWDTEs; and
    - 5 target notes associated with potentially highly GWDTE features.
- 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:
    - Moderate Potential or Mosaic Containing Moderate Potential GWDTE Polygons underlain by non-aquifer bedrock and / or non- aquifer superficial geology;
    - Mosaic containing High Potential GWDTE Polygons underlain by non-aquifer bedrock and / or non-aquifer superficial geology with no clear mechanism of groundwater discharge or potential source zones visible from aerial photography; and
    - High Potential and Mosaic containing High Potential that are associated with surface water features.
- This resulted in a remaining 6 polygons and 4 target notes potential for groundwater dependency within the buffer zones of the proposed development. These are presented in **Table 2**, Section 4.

This report provides an assessment of groundwater dependency of the remaining polygons and target notes 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 8.7** of the EIA Report which presents the hydrogeological potential of the bedrock and shows the type and extent of any superficial deposits (including actual peat depth data from Peat Survey Report **Appendix 8.2**), 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 waterbody 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'.*

Almost the entirety of the Site is underlain by low groundwater productivity metamorphic bedrock of the Tarvie Psammite Formation, part of the Loch Eil Group.Where the access track meets the A887 public road, there are west highland granite gneiss intrusions comprising granite and gneissose sedimentary bedrock from the Neoproterozoic Era which is also a low groundwater productivity strata.

The low productivity aquifer underlying the Site means that any groundwater flow will be through secondary porosity and permeability within the upper weathered zone and via fractures and other discontinuities within the bedrock.

The British Geological Survey (BGS) online mapping shows much of the Site to be underlain by Devensian Diamicton, Sand and Gravel, Till, and Peat deposits. Small areas in the west and southwest of the Site encompassing the areas of high ground associated with Carn Mhic Raonuill, Mam a' Chroisg and Meall Damh, are mostly devoid of superficial geological deposits, with just limited soil cover over bedrock. Onsite peat surveys have shown that the central and eastern areas have significant peat deposits. The northern section of the Site, to the north of the A887 road, where there is no Proposed Development has alluvium deposits which have the potential to act as localised aquifers.

Peat and till deposits are low permeability, while the sand and gravel components of the Diamicton are permeable. The hydrogeological setting therefore suggests that any potential GWDTE in areas of Till 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 a fault zone, and are unlikely to be common in this site environment.

Areas of Diamicton, Sand and Gravel may contain some groundwater resource, the extent of which is dependent on the composition of this layer. This could potentially support GWDTEs in the context of the Site, however this would be limited to smaller areas. Large continuous areas of moderate potential 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.

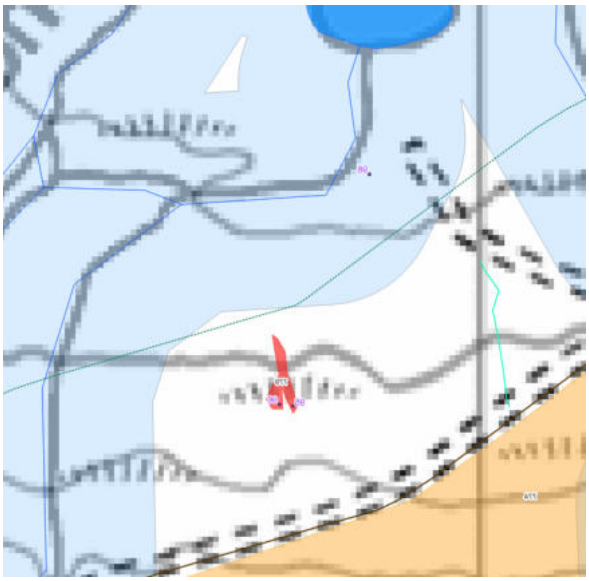
Table 1 provides a summary of the results of the iterative process described in **Section 2**, detailing the habitats and polygons considered not GWD on the basis of a combination of the following criteria: being underlain by non-aquifer bedrock or superficial geology; lacking any clear mechanism of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

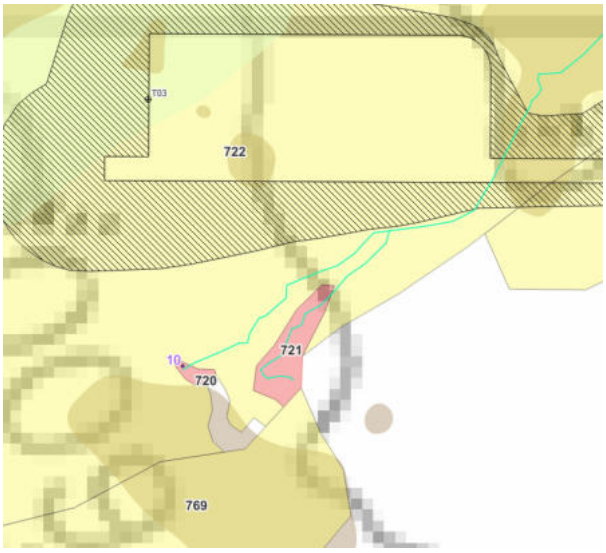
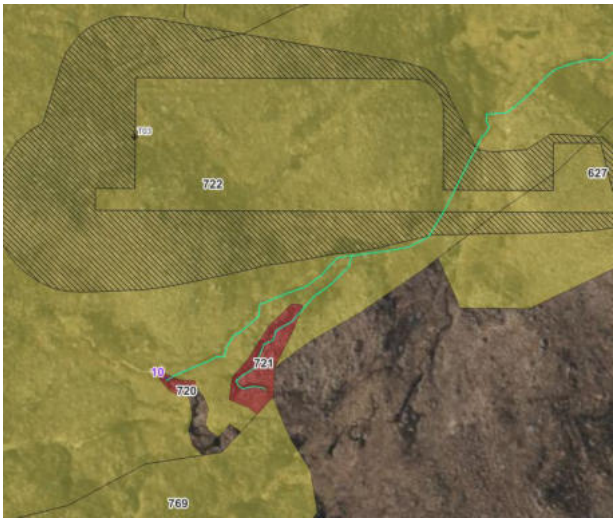
Table 2 provides an assessment of each of the habitats within the buffer zones of the Proposed Development infrastructure footprint that are potentially highly GWD and are not scoped out of the assessment following the methodology described in **Section 2**. It is identified whether they are actually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

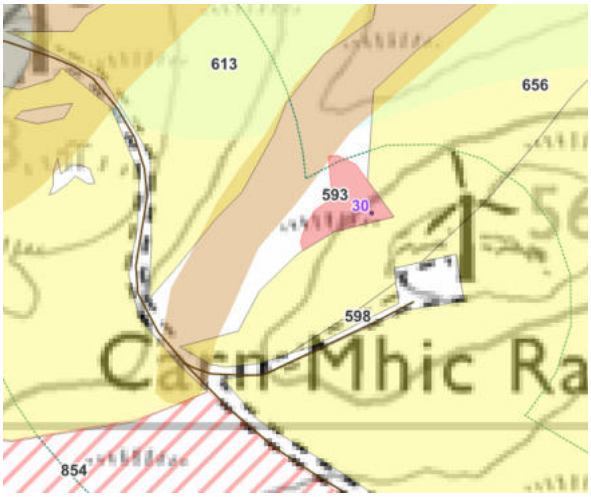
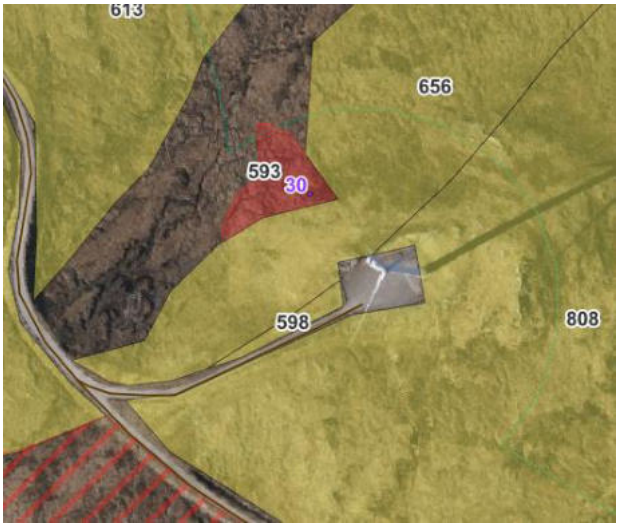
Table 1 Polygons and Target Notes Scoped out of Assessment

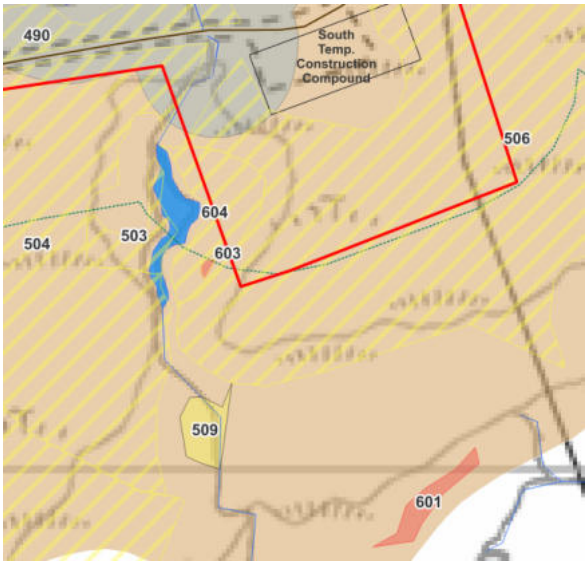
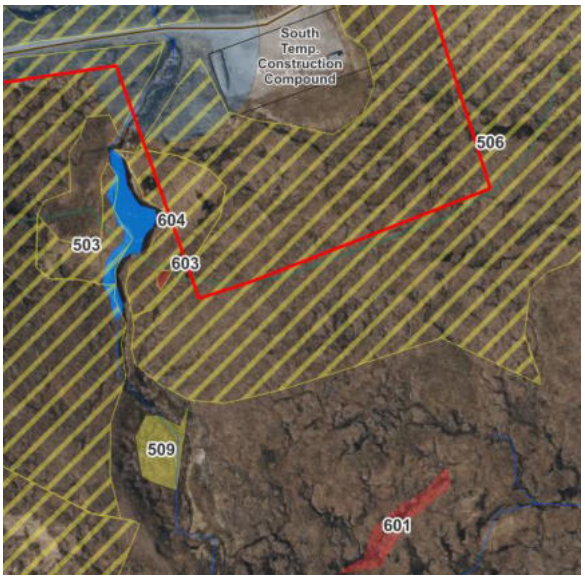
Rationale	Target Note or Potential GWDTE Polygon FID
Moderate Potential or Mosaic Containing Moderate Potential GWDTE Polygons underlain by non-aquifer bedrock or superficial geology (70 polygons)	51, 154, 483, 490, 503, 504, 506, 508, 526, 604, 607, 633, 661, 713, 801, 853, 8, 23, 125, 144, 202, 206, 413, 431, 433, 435, 449, 467, 474, 477, 488, 509, 528, 529, 598, 599, 600, 613, 627, 629, 631, 632, 635, 636, 644, 648, 654, 656, 666, 671, 678, 679, 690, 722, 747, 754, 755, 757, 762, 769, 772, 786, 787, 807, 808, 809, 846, 849, 850 and 851.
Mosaic containing High Potential GWDTE Polygons underlain by non-aquifer bedrock or superficial geology with no clear mechanism of groundwater discharge or potential source zones visible from aerial photography (three polygons)	92, 842 and 854
High Potential and Mosaic containing High Potential that are associated with surface water features (five polygons)	470, 690, 681, 774 and 775.

Table 2 Assessment of Potential GWDTEs with Infrastructure Buffer Zones

NVC or Target Note Area	GWDTE Assessment
Area 779, target notes 95 and 96  	NVC Category: M10 – *Carex diocia – Pinguicula vulgaris* mire Classification: Potentially highly GWD Assessment: This habitat is considered to be GWD due the presence of two springheads observed during the habitat surveys. It is situated approximately 50 m downgradient of the existing wind farm track. There is not considered to be any hydrogeological impact on this habitat as the relevant infrastructure is already existing. Impacts to the habitat may be possible however, related to dust from construction traffic, sedimentation from track drainage/run-off and potential oil/fuel spills. Any such direct impacts on this habitat may be avoided following the good practice guidance given in **Appendix 8.1** of the EIA Report. Toolbox talks should be given to operators working in the vicinity of the habitat.

NVC or Target Note Area	GWDTE Assessment
Areas 720 and 721; target note 10   	NVC Category: M16 (area 721) *Erica tetralix – Sphagnum compactum* wet heath and M32 (area 720, target note 10) *Philonotis fontana – Saxifraga stellaris* spring Classification: Potentially highly GWD Assessment: Habitat 720 is considered GWD due to the presence of a mapped springhead, Target note 10. Habitat 721 has a high potential to also be GWD as it is situated on an area devoid of superficial deposits and therefore may be sustained by shallow groundwater within the near-surface weathered zone of the bedrock. Hydrogeological impact are unlikely on these habitats as, whilst they are located only 25 m distance from the proposed T03 turbine hardstanding earthworks, as the infrastructure is at a similar elevation as the habitats and on the other side of minor topographical valley to the spring and therefore will not intercept any potential groundwater input to the habitats.

NVC or Target Note Area	GWDTE Assessment
Area 593 and Target note 30   	NVC Category: M16 - *Erica tetralix - Sphagnum compactum* wet heath and M31 *Anthelia julacea – Sphagnum auriculatum* spring Classification: Potentially highly GWD Assessment: This habitat is likely to be groundwater dependent given the presence of the mapped springhead. It is located downslope of the existing turbine at the summit of Carn-Mhic Raonuill,and is upgradient of any proposed works. For this reason there is not considered to be any potential hydrogeological impact from the proposed activities.

NVC or Target Note Area	GWDTE Assessment
Areas 601 and 603   	NVC Category: M16 - *Erica tetralix - Sphagnum compactum* wet heath Classification: Potentially highly GWD Assessment: These habitats are each underlain by BGS mapped peat deposits; and the peat surveys undertaken by Fluid show in these areas to be situated on peat and peaty soils. There may be some groundwater component to these habitats from the near-surface weathered zone of the bedrock. Area 601 is located a substantial (>240 m) distance from existing hard standing of the proposed southern temporary construction compound and therefore no hydrogeological impact is considered. Area 603 is located 100 m distance from the proposed existing hardstanding to be used for the southern temporary construction compound. Based on the topography of the area and its situation next to a small surface waterbody and watercourse that drains south directly adjacent to the southern temporary construction compound, it is more likely to be surface water dominated. Furthermore, the existing southern temporary construction compound will be restored back to peatland habitat as part of the habitat management plan.

Note: As per **Figure 8.7.1**: Red line – Site boundary; blue line = watercourse; yellow fill = moderate potential GWD polygon; yellow cross hatch = Mosaic containing moderate potential GWD polygon; orange fill = mosaic containing moderate potential GWD polygon; red cross hatch =mosaic containing high potential GWD polygon; red fill = high potential 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 low productivity of the underlying bedrock and superficial deposits across the Site means that groundwater dependence is unlikely for most NVC-mapped habitats. There may be very

minor shallow groundwater flow in the upper weathered layer of bedrock, but this is likely to be very limited and insufficient to support any large areas of habitat.

Three habitats within the infrastructure buffers are considered to be GWD due to the presence of springheads mapped during habitat surveys, and an additional three habitats have some potential to be GWD considering the topography and lack of any potential aquitard superficial geology layers. Hydrogeological impacts are considered unlikely on these habitats however, due to a lack of upgradient proposed new infrastructure and minor topographical separation.

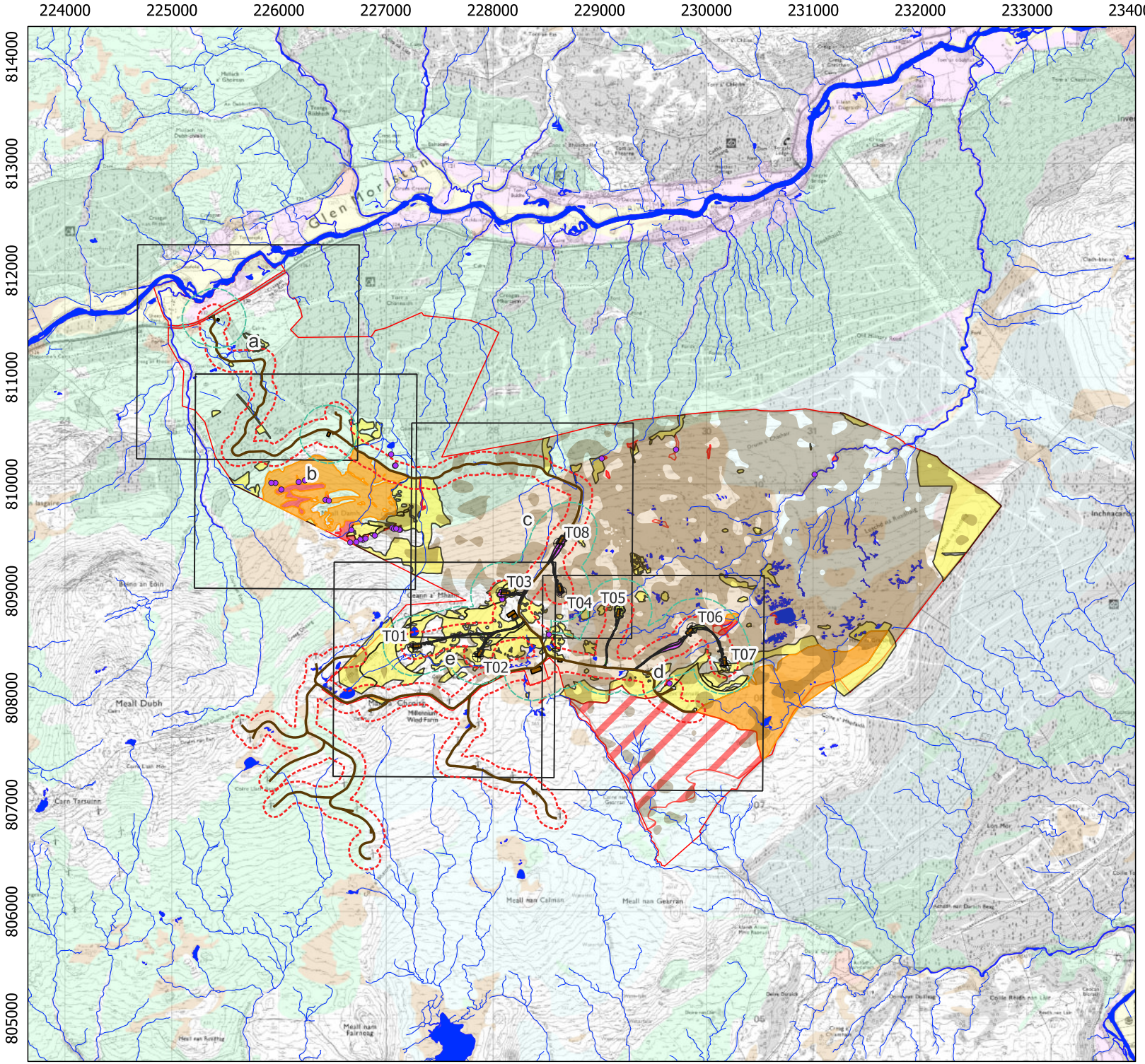
The M10, M31 and M32 spring and flush communities assessed as being likely groundwater dependent were described as being moderately to highly species-rich examples of these NVC communities (**Appendix 6.1).** Both M31 and M32 are qualified as 'upland flushes, fens and swamps' on the Scottish Biodiversity list, indicating local to regional ecological importance, particularly given their likely dependence on groundwater. M10 is an Annex I habitat (7230 – alkaline fens) and is listed on the Scottish Biodiversity List. Species-rich examples of M10 may therefore be of potentially national ecological importance. M16 is also an Annex I habitat (4010 – Northern Atlantic wet heaths with Erica tetralix) and is of moderate ecological value. It is not considered to be nationally important however may be of local or regional importance unless an exceptionally high quality example of the habitat[1].

In summary, the results of this analysis are that no areas or target notes have been identified where there is either a requirement for the design of specific mitigation measures, or a residual risk of impact on potentially groundwater fed wetland features. However, as a precautionary measure it is recommended that the locations of the springs are demarked and any micro siting of the Proposed Development should not move them closer or upgradient of these identified GWDTEs, shown on **Figure 8.8**.

The assessment considers that there are unlikely to be any significant effects on any of the potentially GWD habitats, due the impact of either topographical separation, a lack of hydrological/hydrogeological connection or due to most habitats in this location being predominantly rainwater or surface water fed.

[1] Maddock, A. (Ed.) (2008). UK Biodiversity Action Plan Priority Habitat Descriptions. Joint Nature Conservation Committee (JNCC), Peterborough. Available from: https://data.jncc.gov.uk/data/881f6ff2-34d3-49f3-9a9c-050c84fd37e2/UKBAP-BAPHabitats-2008.pdf

6 Figures



Key

Infrastructure

- Site Boundary
- Proposed turbine locations
- Proposed infrastructure
- Earthworks cut
- Earthworks fill
- Existing wind farm track
- New track
- 100 m infrastructure buffer
- 250 m infrastructure buffer

Hydrology

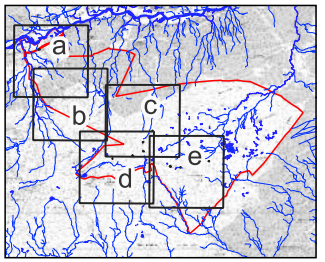
- Surface waterbody
- OS Mapped Watercourse

Potential GWDTEs

- High
- Moderate
- Mosaic containing Moderate
- Mosaic containing High
- Mosaic containing High and Moderate
- Target notes

Superficial Geology

- Peat
- Alluvium - clay, silt, sand and gravel
- Glaciofluvial ice contact deposits - gravel, sand and silt
- Hummocky (moundy) glacial deposits - diamicton, sand and gravel
- Till, Devensian - diamicton
- Fluid peat depth survey: peat >0.5 m depth



0 1,000 2,000 3,000 m

PROJECT
Millennium East

SCALE
1: 10,000 @ A3

Figure 8.7.1
Potential Groundwater Dependent Terrestrial Ecosystems

FLUID ENVIRONMENTAL CONSULTING

Drawn by: CF Date: 4/4/2025