Appendix 8.7: Ground Water Dependent Terrestrial Ecosystems Assessment

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1 Introduction

This Ground Water Dependent Terrestrial Ecosystems (GWDTEs) Assessment is an Appendix to **Chapter 8: Hydrology, Geology, Hydrogeology and Peat** and has been prepared by Fluid Environmental Consulting (Fluid) on behalf of the Applicant to support the Environmental Impact Assessment (EIA) for Lynemore Wind Farm (the 'Proposed Development'). The Site (**Figure 8.1: Hydrological Setting** of the EIA Report) is located within the Dalmagarry Estate on the hills 2 km west of the A9 at Moy within the Highland Council area. Access to the proposed development site is proposed from the A9 via upgraded and new junction and access tracks via Lyneberg Road.

The Proposed Development will comprise 14 wind turbines, with a blade tip height of up to 200 m, Battery Energy Storage, associated infrastructure and ancillary development. The total installed capacity of the Proposed Development is expected to be over 50 MW.

The Site is mostly open moorland, managed primarily for stalking and grouse shooting. The named hill of Carn na h-Easgainn (616 m) is located within the southern edge of the site boundary. Areas of open deciduous woodland and commercial plantation lie to the north of the Site. The Farr/ Glen Kyllachy Wind Farm complex lies approximately 2 km to the southwest of the Site.

The Site is mostly underlain by relatively impermeable bedrock overlain by relative impermeable glacial till and peat drift deposits and more permeable localised alluvial deposits area associated with larger watercourses.

The majority of the Site drains to the north-east via four watercourses and their tributaries, which discharge to Loch Moy either directly or via its tributary Allt Creag Bheithin. Loch Moy flows to Funtack Burn, which joins the River Findhorn 4 km to the east of the Site near Milton of Moy. A very small area in the west of the Site drains north-west to Allt na Fuar-ghlaic, which in turn drains to the River Nairn 5 km north-west of the Site

GWDTEs are protected environments under Water Framework Directive (WFD) legislation and assessments are regulated by SEPA. This assessment has been completed due to the presence of potential GWDTEs within proximity of the Proposed Development infrastructure and informs the assessment of effects on GWDTEs in **Chapter 8** of the **EIA Report**. Where possible as part of the Proposed Development design iterations, the most important and good quality potential GWDTEs have been avoided by design.

2 Methodology

A detailed National Vegetation Survey (NVC) survey for the whole Site has been completed by Avian Ecology and is presented within **Chapter 6** of the **EIA Report**. A total of 198 polygons and 13 target notes were identified across the Site.

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

- Review of all NVC categories to determine which are potentially groundwater dependent in accordance with the Land Use Planning System (LUPS) Guidance Notes issued by the Scottish Environment Protection Agency (SEPA). guidance. This resulted in a total of 30 polygons with a High potential for groundwater dependency (GWD), 30 polygons that are mosaics containing a habitat with High potential for GWD, 2 polygons

with a Moderate potential for GWD and 3 polygons that are mosaics containing a habitat with a Moderate potential for GWD. None of the target notes related to groundwater dependent habitats.

- Buffer zones were then created around the Proposed Development infrastructure at a distance of 250 m from turbines and crane hardstandings or other infrastructure where excavation would exceed 1 m depth, and at 100 m around tracks where excavation would be less than 1 m depth. A total of 42 polygons with potential groundwater influence according to the LUPS guidance fell within these buffers, ruling out 23 polygons. These are presented on **Figure 8.7.1.**
- Habitats that were not hydrologically connected to the Proposed Development due to being either upgradient or separated by a watercourse were then ruled out. A further 13 polygons were ruled out at this stage leaving 29 polygons.
- Habitats were then grouped by hydrogeological setting – habitats underlain by aquitard superficial geology layers with no distinguishable mechanism of groundwater discharge were ruled out from further assessment. This ruled out four polygons as being not GWD leaving 25 polygons.
- Finally, polygons that were in clear association with surface water features within topographical basins were ruled out on the basis of being surface water or rainfall fed. This ruled out an additional 10 polygons as being not GWD.
- After applying these criteria, a total of 15 polygons were identified as having potential groundwater dependence and were taken forward for further assessment.
- A site walkover was then undertaken by Fluid Environmental Consulting Ltd in January 2025 to identify any potential features that could imply groundwater dependency in any of the remaining polygons and aid in the desk-based assessment and identify any potential mechanisms of groundwater discharge. A further 11 polygons were ruled out at this stage leaving four for final assessment: polygon numbers 7, 8, 26 and 156.

This report provides an assessment of likely groundwater dependency of each NVC polygon and Target Note identified to be potentially groundwater dependent considering the geological, hydrogeological, hydrological and topographical regime.

In a number of instances, infrastructure is located in a separate sub-catchment even though the habitat of concern is less than 250 m distant, and therefore the potential GWDTE was scoped out of the assessment. Due to the low permeability bedrock and low permeability superficial deposits the assessment currently considers that topographical barriers and watercourses will act as boundaries to groundwater flow. In such instances, the groundwater dependency of the NVC communities is not assessed.

3 Hydrogeological Assessment

A hydrogeological assessment has been undertaken on features that have been identified as being potentially groundwater dependent and where other factors do not rule out the habitat as either being linked to the development or being groundwater dependent. This assessment is based primarily on the information presented in **Figure 8.7.1**. **Figure 8.7.1** of this Appendix presents the assessed groundwater dependency based on the hydrogeological potential of the bedrock and shows the type and extent of any superficial deposits, as well as the topographical

setting. The particular hydrogeological setting at each location is discussed in relation to the habitat in Section 4: 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[1] 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 whole of the Site is characterised as a being underlain by a low productivity aquifer where virtually all flow is through fractures and other discontinuities.

The superficial deposits are generally either glacial till and/or peat, which do not support any significant volume or supply of water.

Some localised permeable alluvium deposits, which can act as a perched aquifer, are likely present along the bottom of main watercourse valleys. These watercourse valleys have been avoided by design where possible.

There is likely to be some very shallow groundwater flow in the upper metre of bedrock where it is weathered however any flow below this depth will be very limited and associated with faults or fractures. The hydrogeological setting therefore suggests that any potential GWDTE should be considered as having a low likelihood of groundwater dependency, however when discrete point sources (springs) give rise to small habitats of high base rich floristic content, then a higher level of groundwater dependency must be considered. These are likely to be connected to very specific zones of permeability, fractures or fault zones, and are unlikely to be common in the Site environment.

Due to the limited groundwater in the bedrock any excavation is only going to encounter very limited groundwater flow in the weathered bedrock layer unless a permeable fault or fracture is encountered which will likely be evident on the ground as a spring. Where groundwater within the weather bedrock is intercepted, its volume is likely to be very low and due to the Site being so highly saturated because of the widespread low permeability peat and high rainfall any effect is likely to be very limited in extent.

[1] SNIFFER (2007), WFD66 Wetland hydrogeomorphic classification for Scotland

4 GWDTE Assessment

As part of the iterative process defined in **Section 2: Methodology** the following polygons have been ruled out on the basis of being habitats located on aquitard superficial deposits that lacked any clear mechanism of groundwater discharge:

- Polygons 138, 161, 167 and 169.

The following polygons were scoped out of the assessment on the basis of being in clear association with surface water features and therefore likely surface water or rainfall fed:

- Polygons 19, 86, 88, 89, 139, 140, 142, 143, 193, 153.

The following polygons that are were determined not be hydrologically connected to the Proposed Development infrastructure either due to topographical catchment or interception of potential groundwater from watercourses:

- Polygons 76, 80, 82, 83, 84, 100, 165, 166, 172, 129, 151, 187 and 190.

M6 flushes were widespread across higher elevations where the Site is underlain by blanket peat deposits. Observations from the Site walkover confirmed that these typically occurred within gullies and valleys within the peatland where the peat layer has eroded either due to natural processes or deleterious impacts from past land use practices. Where the peat layer has eroded, this commonly exposes the near-surface weathered grit layer of the bedrock. This shallow superficial layer is permeable and allows for lateral flow of shallow groundwater.

The M6 and mosaic containing M6 habitats located on mapped peat deposits within erosional gullies are therefore likely to have a degree of groundwater input from the weathered zone of the bedrock. However, these erosional gullies also act as a preferential pathway for surface flow and are generally located where they are for this reason. Additionally, seepage from the peat layer itself is common where bare peat faces are present within the gully walls. As such, whilst there is a degree of groundwater influence within these habitats, they are all considered to be predominantly surface water and rainfall fed. This applies to the following polygons:

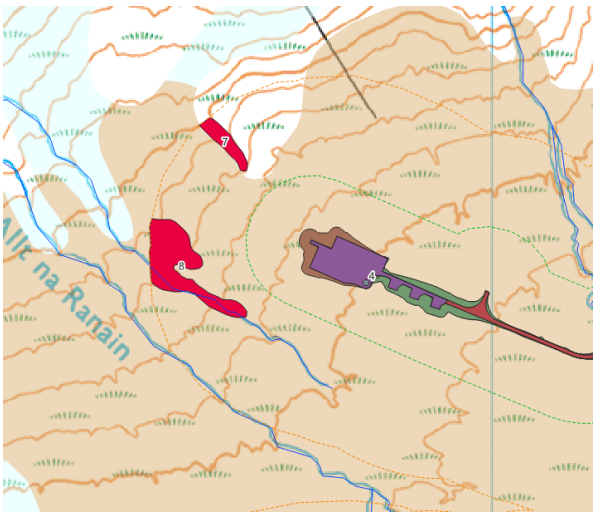
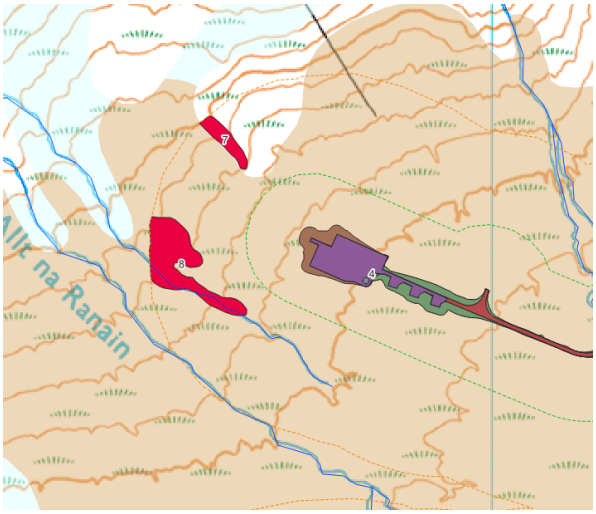
- Polygons 17, 31, 30, 36, 35, 29, 23, 22, 21, 20, 25

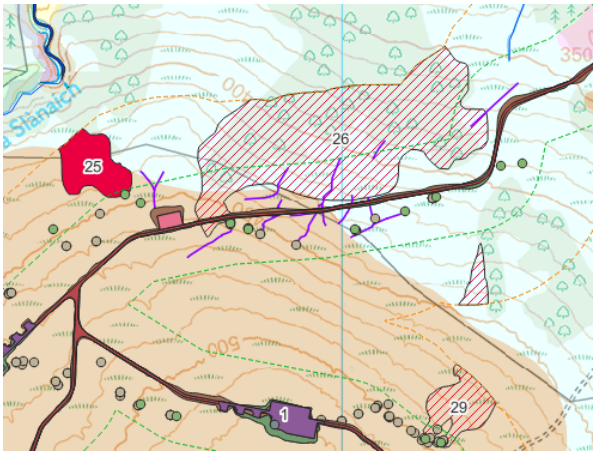
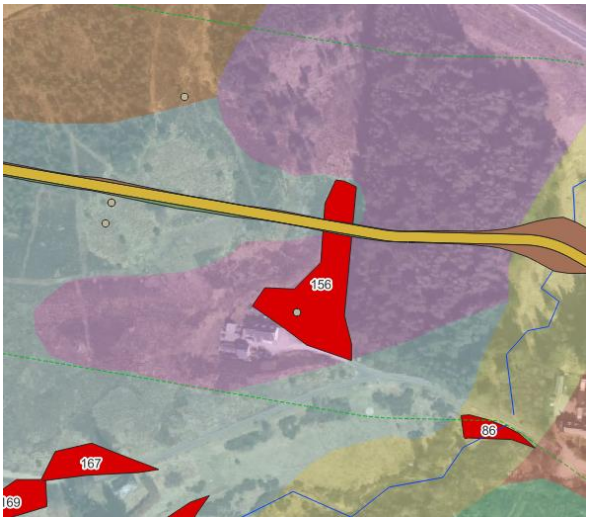
The following table provides an assessment of each of the habitats that are potentially groundwater dependent and identifies whether they are considered to be truly groundwater dependent. These habitats are presented on **Figure 8.7.1** of this appendix and the key for the symbology is also on **Figure 8.7.1**. The acronym GWD is used for groundwater dependent within the table.

Based on the information presented in **Figure 8.7.1**, potential GWDTE that are hydrologically or hydrogeologically disconnected from the Proposed Development are not assessed for determining likely groundwater dependence.

These habitats are presented on **Figure 8.7.1** of this appendix and the key for the symbology is also on **Figure 8.7.1.** The acronym GWD is used for groundwater dependent within the table.

Table 1 GWDTE Assessment of NVC Polygons and Target Notes Identified as Potential groundwater dependent

NVC Polygon	GWDTE Assessment
Polygon 7  Nearby infrastructure: T4	NVC Category: M6c LUPS Classification: Highly GWD Hydrological/Hydrogeological Context: This habitat maps to a gully feature at the boundary of the BGS mapped peat deposits below a small hill to the northeast. It is underlain by non-aquifer bedrock. Assessment: The track runs close to the catchment divide and there is no significant or sustainable groundwater resource here due to the non-aquifer bedrock and lack of any upgradient catchment, so effects on the habitat are unlikely. Groundwater Dependency: Unlikely
Polygon 8  Nearby infrastructure: T4	NVC Category: M6c LUPS Classification: Highly GWD Hydrological/Hydrogeological Context: This habitat maps to a gully feature at the boundary of the BGS mapped peat deposits below a small hill to the northeast. It is underlain by non-aquifer bedrock. Assessment: The track runs close to the catchment divide and there is no significant or sustainable groundwater resource here due to the non-aquifer bedrock and lack of any upgradient catchment, so effects on the habitat are unlikely. Groundwater Dependency: Unlikely

NVC Polygon	GWDTE Assessment
Polygon 26  Nearby infrastructure: Access track, CC2	NVC Category: H12a(40%)/W17d(40%)/M6c(20%) LUPS classification: Mosaic containing Potentially Highly GWD Hydrological/Hydrogeological Context: The habitat is located at the boundary between the BGS mapped peat and glacial till layers, immediately downgradient of the proposed access track on a moderate gradient. There are some mapped artificial drainage ditches throughout the southern extent of the habitat. Assessment: Given the size of the habitat and the aquitard superficial geology, true GWD is unlikely in this habitat. This was noted in the NVC survey: '*M6c flush may be high GWDTE, but unlikely here due to limited extent*'. It is likely predominantly rainfall fed and therefore there is no impact anticipated on this habitat from the Proposed Development. Groundwater Dependency: Unlikely
Polygon 156  Nearby infrastructure: Access track	NVC Category: M23b LUPS classification: Potentially Highly GWD Hydrological/Hydrogeological Context: This habitat is situated on moderately permeable glaciofluvial ice contact deposits comprised of gravel, sand and silt overlying impermeable bedrock. It is situated immediately north of a residential property and existing access track and a drainage ditch runs along the northwest boundary. Assessment: This habitat is likely rainfall fed. No groundwater sources were identified during the site visit and the residential property and track south of the habitat likely act as a barrier to any potential groundwater flow. Groundwater Dependency: Unlikely

5 Discussion

The analysis above has considered both the hydrological/hydrogeological setting and the ecological value of the potential GWDTEs identified in the baseline NVC surveys.

The low productivity of the underlying bedrock and superficial deposits across the Site means that groundwater dependence is highly unlikely for the vast majority of 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.

Shallow groundwater flow within the upper weathered bedrock was observed to contribute particularly to M6 flush habitats that occurred with eroded peat gullies, however these features typically also acted as preferential flow paths for surface water and were as such determined to be predominantly surface water and rainfall fed. These features are also a result of degradation of peatland. Groundwater emergence locations with these habitats are determined by the extent of the eroded peat layer and as such are somewhat ephemeral in nature. As the peat layer erodes further it is likely that these habitats will migrate upgradient with the retreating boundary of the degraded peat. The habitats themselves are widespread across higher elevations within the Site and elements of M6 vegetation was observed in many locations where the peat layer has eroded to reveal the underlying weathered bedrock. Their ecological importance is therefore limited within the context of the Site environment.

In summary, the results of this analysis are that none of the mapped habitats are considered to be groundwater dependent, other than some minor contribution from groundwater, where there is a potential connection to infrastructure.

Other GWDTEs

The assessment considers that there are unlikely to be any significant effects on all the other potentially groundwater dependent habitats, due either to topographical separation, a lack of hydrological/hydrogeological connection or due to most habitats in this location being predominantly rainwater or surface water fed. However, there is still some potential for some minor effects in some areas in close proximity to the infrastructure such as where tracks cut across contour within an area of potential groundwater dependency.

The effect is due to some potential interception of minor groundwater flow in the weathered bedrock. The following is best practice mitigation is therefore recommended:

- Where infrastructure excavations are required, any water captured should be discharged in close proximity and down gradient 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.