

Beinn Ghlas Wind Farm Repowering EIA Report

Technical Appendix 8.6

Groundwater Dependent Terrestrial Ecosystems Assessment

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Figure 8.6.1 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 the Environmental Impact Assessment (EIA) for Beinn Ghlas Wind Farm Development (the 'Proposed Development'). The Site (**Figure 8.1** in Volume 3 of the EIA Report) is located to the south-east of Oban, south-west of Taynuilt, and north-west of Loch Nant in Argyll and Bute. Site Access is from the A85 to the north along the existing agricultural, forestry and wind farm access to the Site and to Barguilean Farm.

The infrastructure of the proposed layout comprises of the Site Access and Internal Access Tracks with a total length of approximately 12.83 km of which 2.71 km is new access track (1.6 km floating) with associated new watercourse crossings and 8.52 km is existing access track and watercourse crossings which would need to be upgraded, 7 turbine locations and associated crane hardstandings, two temporary construction compounds, and a permanent meteorological mast. 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: Hydrology, Geology and Hydrogeology** of the EIA Report.

2 Methodology

A detailed National Vegetation Survey (NVC) survey for the whole Site was completed by Avian Ecology Ltd between 12th and 14th October 2021, and is presented within **Technical Appendix 6.2** of the EIA Report. A total of 158 polygons were identified across the Site. NVC surveys for both the Site Access was subsequently completed by Dr. Kate Massey of Alba Ecology Ltd in February 2023 respectively, resulting in identification of a further 173 polygons, a combined total of 331 habitat polygons for investigation.

In addition, a GWDTE walkover survey of the proposed infrastructure was completed by Alba Ecology in April 2022, presented within **Technical Appendix 6.3** of the EIA Report, that includes 48 target notes potentially associated with GWDTEs of a total of 161 target notes.

Alba Ecology also completed a vegetation assessment of proposed turbine locations in February 2023, presented within **Technical Appendix 6.9** of the EIA Report that identified a further 38 target notes of which nine are potential GWDTEs. A combined total of 57 target notes are therefore potentially groundwater dependent.

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 Land Use Planning System SEPA Guidance Note 31 (LUPS-31, version 3, 2017) which presents the NVC categories to be considered. This resulted in a total of 44 potentially highly and 136 potentially moderately GWDTE polygons. In addition, 57 target notes were identified associated with potential GWDTEs.

- 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. There are 69 polygons and 19 target notes with potential groundwater influence according to the LUPS guidance within these buffers. These are presented on **Figure 8.6.1** with more detail provided on **Figures 8.6.1a, 8.6.1b and 8.6.1c**.
- A review with Alba Ecology of the remaining polygons and target notes was completed to rule out habitats that are considered likely to be moderately groundwater dependent under LUPS-31 and are i) spatially more extensive areas situated on areas of non-aquifer bedrock geology and drift deposits, ii) have low floristic value not usually associated with groundwater dependence, and iii) lack a clear mechanism of groundwater discharge, as the geological, hydrogeological and topographical setting of the Site cannot support GWDTEs possessing these three criteria. Habitats ruled out on this basis included the following: M15 - *Scirpus cespitosus* - *Erica tetralix* wet heath; M23 - *Juncus effusus/acutiflorus* – *Galium palustre* rush-pasture; M25 - *Molinia caerulea* – *Potentilla erecta* mire; W1 - *Salix cinerea* - *Galium palustre* woodland; MG10 - *Holcus lanatus* – *Juncus effusus* rush-pasture; MG9 - *Holcus lanatus* - *Deschampsia cespitosa* grasslands and U6 - *Juncus squarrosus* - *Festuca ovina* grassland, as the hydrogeological setting of these habitats was not considered able to support true groundwater dependence in these potentially 'moderate' likelihood GWDTEs. The rationale for this is further detailed in Section 3 of this Appendix and are listed below in Table 1. This resulted in 21 polygons and 19 target notes with potential groundwater dependence.

Table 1: NVC Areas Assessed as Non-GWDTE

Area (see Figures 8.6.1a, b and c)	NVC Community	Rationale
Areas 5, 10, 22, 23, 24, 26, 28 and 29	M15	Extensive areas of M15 habitat considered likely to be moderately groundwater dependent under LUPS-31 on non-aquifer bedrock and superficial geology; low floristic value not typically associated with groundwater dependence; lacks clear mechanism of groundwater discharge.
Area 20	M15/H10a/U4/U5d	Area of non-aquifer bedrock and superficial geology containing M15 considered likely to be moderately groundwater dependent under LUPS-31; low floristic value, and lacks clear mechanism of groundwater discharge; other communities not considered groundwater dependent.
Area 17	M15/H10a/U4/U5d/U6a	Area of non-aquifer bedrock and superficial geology containing M15 considered likely to be moderately groundwater dependent under LUPS-31; low floristic value, no clear mechanism of discharge; other communities not considered groundwater dependent.
Area 14	M15/H10a/U5d/U4	Area of non-aquifer bedrock and superficial geology containing M15 considered likely to be moderately groundwater dependent under LUPS-31; low floristic value, and lacks clear mechanism of groundwater discharge; other communities not considered groundwater dependent.

Area (see Figures 8.6.1a, b and c)	NVC Community	Rationale
Area 1	M15/U4	Area of non-aquifer bedrock and superficial geology containing M15 considered likely to be moderately groundwater dependent under LUPS-31; low floristic value, no clear mechanism of discharge; other communities not considered groundwater dependent.
Area 21	M15/U5d	Area of non-aquifer bedrock and superficial geology containing M15 considered likely to be moderately groundwater dependent under LUPS-31; low floristic value, no clear mechanism of discharge; other communities not considered groundwater dependent.
Areas 2 and 13	M15/U6a	Areas of non-aquifer bedrock and superficial geology containing M15 considered likely to be moderately groundwater dependent under LUPS-31; low floristic value, no clear mechanism of discharge; other communities not considered groundwater dependent.
Areas 32, 51, 52, 53, 55, 59, 67, 70, 71, 72	MG10a	Areas of non-aquifer bedrock and superficial geology containing subtype of MG10 considered likely to be moderately groundwater dependent under LUPS-31, low floristic value and lacks clear mechanism of groundwater discharge.
Area 47	MG10a/MG9/U20	Area of non-aquifer bedrock and superficial geology containing MG10 considered likely to be moderately groundwater dependent under LUPS-31 and MG9 considered likely to be moderately groundwater dependent under LUPS-31 (both low floristic value, no clear mechanism of discharge); U20 not considered groundwater dependent.
Areas 56 and 66	MG10a/U5/U20	Areas of non-aquifer bedrock and superficial geology containing MG10 considered likely to be moderately groundwater dependent under LUPS-31 (low floristic value, no clear mechanism of discharge); U5 and U20 not considered groundwater dependent.
Areas 60 and 62	MG10a/U5/U4/U20	Areas of non-aquifer bedrock and superficial geology containing MG10 considered likely to be moderately groundwater dependent under LUPS-31 (low floristic value, no clear mechanism of discharge); U5, U4, U20 not considered groundwater dependent.
Areas 34, 41, 42	MG9	Areas of non-aquifer bedrock and superficial geology containing MG9 considered likely to be moderately groundwater dependent under LUPS-31, low floristic value and lacks clear mechanism of groundwater discharge.
Area 63	U20/MG10a/U5	Area of non-aquifer bedrock and superficial geology containing MG10 considered likely to be moderately groundwater dependent under LUPS-31 (low floristic value, no clear mechanism of discharge); U20 and U5 not considered groundwater dependent.
Areas 54	U4/MG10a	Areas of non-aquifer bedrock and superficial geology containing MG10 considered likely to be moderately groundwater dependent under LUPS-31 (low floristic value, no clear mechanism of discharge); U4 not considered groundwater dependent.
Area 49	U4/MG10a/U20/Track	Area of non-aquifer bedrock and superficial geology containing MG10 considered likely to be moderately groundwater dependent under LUPS-31 (low floristic value, no clear mechanism of discharge); U4 and U20 not considered groundwater dependent.

Area (see Figures 8.6.1a, b and c)	NVC Community	Rationale
Areas 64 and 68	U5/MG10a	Areas of non-aquifer bedrock and superficial geology containing MG10 considered likely to be moderately groundwater dependent under LUPS-31 (low floristic value, no clear mechanism of discharge); U5 not considered groundwater dependent.
Area 43	U5/MG10a/MG9	Area of non-aquifer bedrock and superficial geology containing MG10 considered likely to be moderately groundwater dependent under LUPS-31 and MG9 considered likely to be moderately groundwater dependent under LUPS-31 (both low floristic value, no clear mechanism of discharge); U5 not considered groundwater dependent.
Areas 61 and 65	U5/MG10a/U20	Area of non-aquifer bedrock and superficial geology containing MG10 considered likely to be moderately groundwater dependent under LUPS-31 (low floristic value, no clear mechanism of discharge); U5 and U20 not considered groundwater dependent.
Area 6	U5d/U6a	Area of non-aquifer bedrock and superficial geology containing U6 considered likely to be moderately groundwater dependent under LUPS-31 (low floristic value, no clear mechanism of discharge); U5d not considered groundwater dependent.
Areas 3, 7, 12 and 15	U6a	Areas of non-aquifer bedrock and superficial geology containing U6a considered likely to be moderately groundwater dependent under LUPS-31, low floristic value and lacks clear mechanism of groundwater discharge.
Areas 58 and 69	W11/W1	Areas of non-aquifer bedrock and superficial geology containing W1 considered likely to be moderately groundwater dependent under LUPS-31. Ruled out due to low floristic value and lack of clear groundwater discharge mechanism; W11 is not typically groundwater dependent.

This report therefore provides an assessment of groundwater dependency of the remaining 21 polygons and 19 target notes considered to be potentially groundwater dependent based on the geological, hydrogeological and topographical setting together with the ecological characteristics of the habitat.

3 Hydrogeological Assessment

A qualitative hydrogeological assessment has been undertaken on features that have been identified as being potentially groundwater dependent within the infrastructure buffers 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** in Volume 3 of the EIA Report which presents 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 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.

British Geological Survey (BGS) mapping shows whole of the Site is underlain by a low productivity aquifer where virtually all flow is through the weathered zone, fractures and other discontinuities of the bedrock. There is likely to be some very shallow groundwater in the first metre of bedrock where it is weathered, however any flow below this depth will be very limited and associated with faults or fractures.

The BGS mapping shows the majority of the Site is devoid of any significant superficial deposits with just limited soil cover over bedrock, with the exception of a small section at the southern boundary of the Site which has a mapped area of alluvium and hummocky glacial deposits. Alluvial deposits are considered moderate to highly productive aquifers depending on their composition.

However, the peat surveys undertaken demonstrated peat cover is fairly sporadically spread across much of the Site; its distribution is controlled by the undulating nature of the topography with outcrops and depressions resulting in areas of deeper peat between crags and thinner peat or thin organic soils on the steeper slopes around rock outcrops, **Technical Appendix 8.2** of the EIA Report.

Although the peat can be considered 'blanket peat', it does not spread continuously across the Site, tending to be concentrated in topographical depressions located between rocky outcrops. The majority of the peat is relatively thin at <1.0 m in depth with locally deeper patches in broader flatter areas. The deepest depth penetration probes within the Site were localised to small pockets in areas of lower topographical gradient. Blanket bog is considered as oligotrophic, or rainwater fed, rather than groundwater fed. Much of the peatland was recorded to be modified, with only a small proportion being recorded as near natural or active peatland, which has been avoided where possible by design.

The hydrogeological setting therefore suggests that any potential GWDTE in the absence of any alluvial superficial 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. Potential GWDTEs situated on an area of alluvial drift deposits should be considered low to moderate likelihood of dependency.

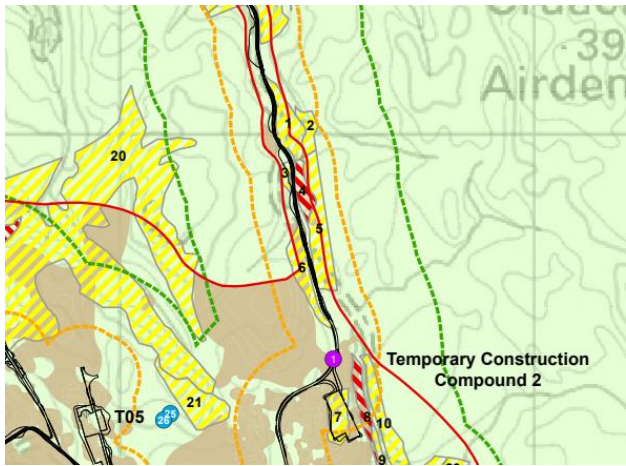
Where peat deposits area present, this can act as a relatively impermeable layer or aquitard to the weathered zone of the low productivity bedrock.

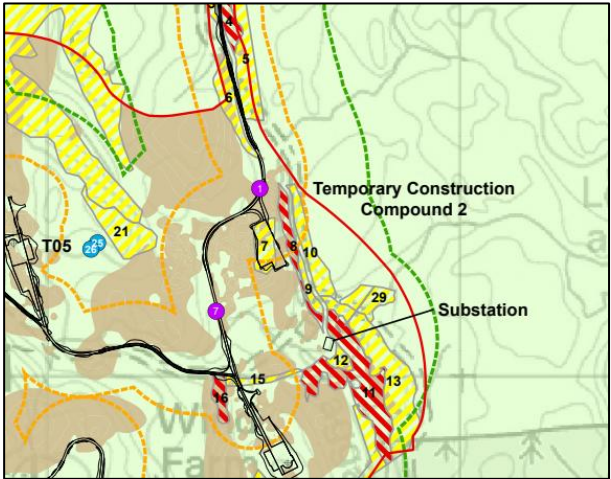
4 GWDTE Assessment

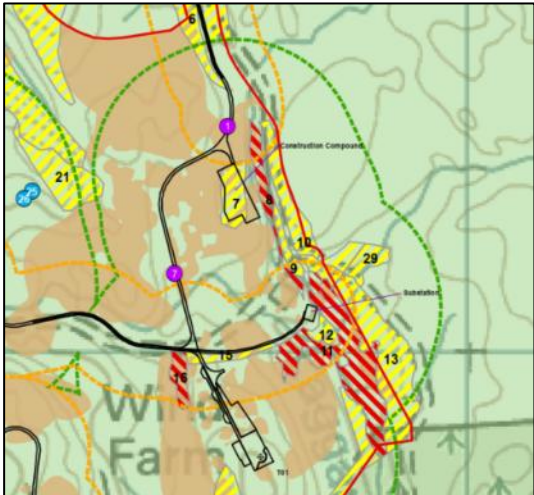
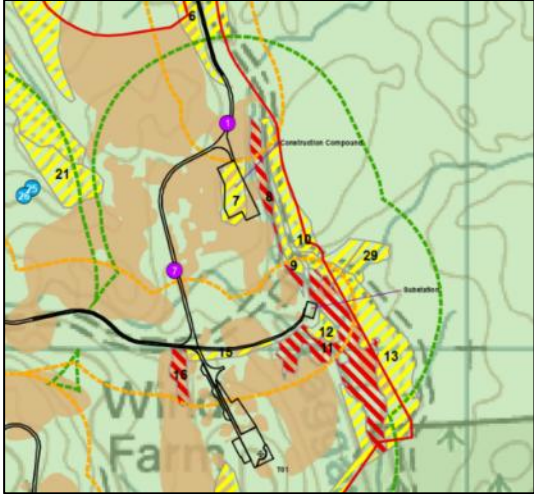
The following table provides an assessment of each of the habitats within the buffer zones (orange 100 m for excavations < 1 m depth and green 250 m for excavations > 1 m depth on the figures) of the Proposed Development infrastructure that are potentially groundwater dependent, identifies whether they are actually groundwater dependent and if so, if they are actually connected to the Proposed Development. These habitats are presented on **Figure 8.6.1**.

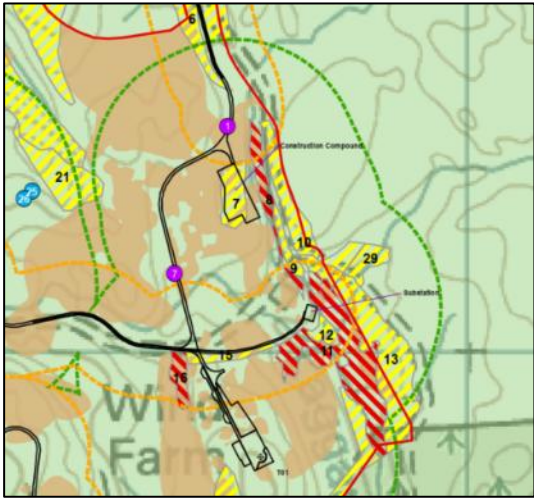
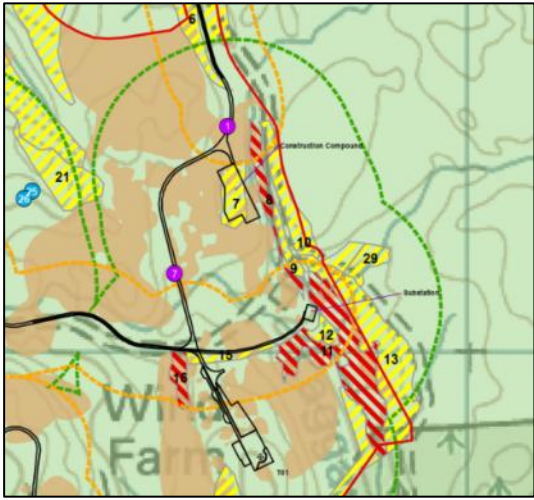
The 20 polygons (shown as yellow or red hatched polygons on figure sections below) and 18 target notes (shown within purple or blue circles on figure sections below) considered to require further assessment are presented in **Table 2** below. Those ruled out are presented in Table 1 above.

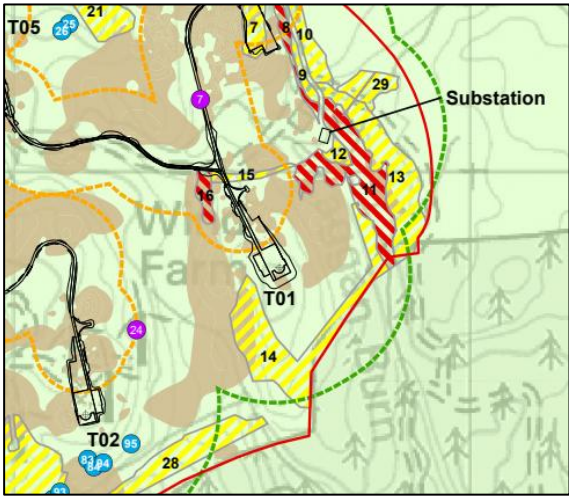
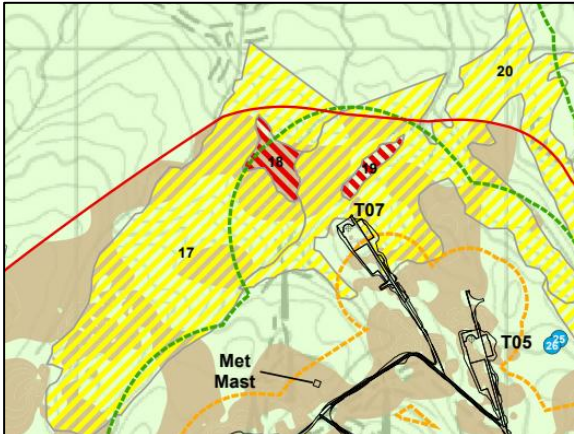
Table 2: Assessment of Potential GWDTEs within Infrastructure Buffer Zones

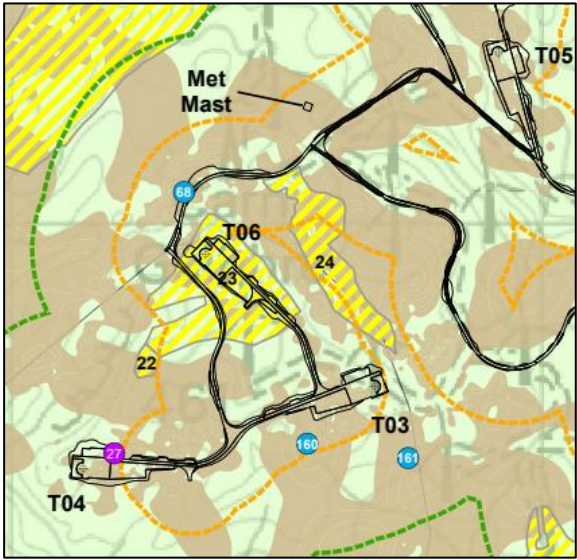
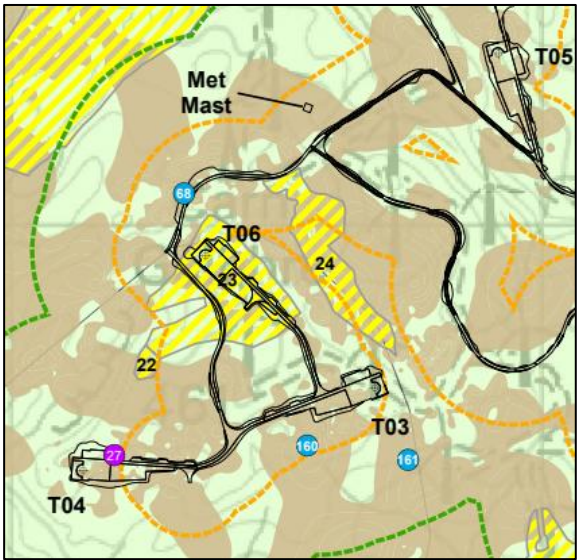
NVC or Target Note Area	GWDTE Assessment
<p>Area 4</p> 	<p>NVC Category: M23a - <i>Juncus effusus/acutiflorus</i> - <i>Galium palustre</i> rush-pasture</p> <p>LUPS Classification: Potentially Highly Groundwater Dependent</p> <p>Assessment:</p> <p>This habitat is situated in an area of low productivity bedrock with no superficial deposits directly downgradient of the existing track to be upgraded.</p> <p>Given the close proximity of the existing track which can be expected to already be interrupting the flow of any groundwater in the subsurface weathered zone of the bedrock, along with the absence of aquifer geology, track upgrade activities in this area are unlikely to have a significant hydrogeological influence on this habitat.</p>

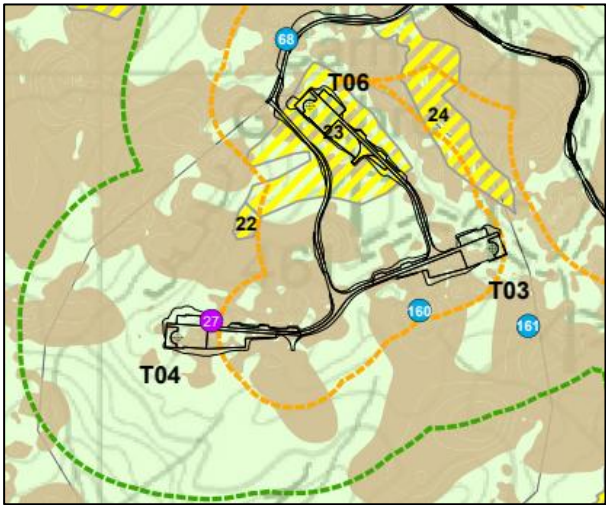
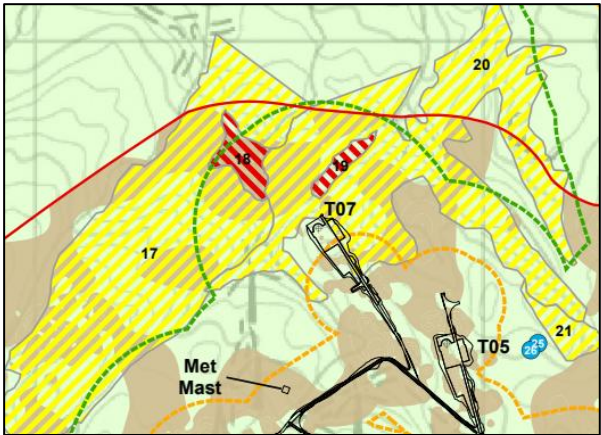
NVC or Target Note Area	GWDTE Assessment
<p>TN 7.9.1</p> 	<p>NVC Category: M11 <i>Carex demissa</i> - <i>Saxifraga aizoides</i> mire</p> <p>LUPS Classification: Potentially Highly Groundwater Dependent</p> <p>Assessment:</p> <p>This habitat is a flush feature that is dependent on shallow groundwater, likely flowing downgradient from the slopes to the north west. The habitat covers an area of approx. 7mx7m and does not feed any further habitat down gradient. Any effect on the habitat is therefore dependent on the proximity of the access track which is currently located just down gradient.</p> <p>Impact on this habitat can be avoided by micro-siting the track as far as possible to the south east, further downgradient of the feature. Pipe culverts should also be installed to avoid interruption of the flow coming from the flush.</p> <p>Although this feature is highly groundwater dependent there is not anticipated to be any impact from the development if the infrastructure is located at least 20 m down gradient. This is discussed further in Section 5 below.</p>

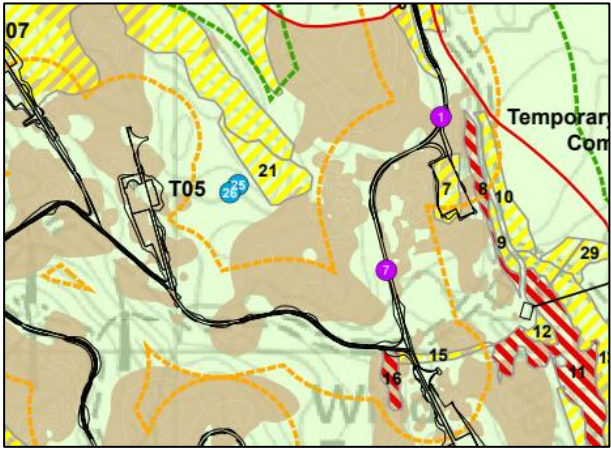
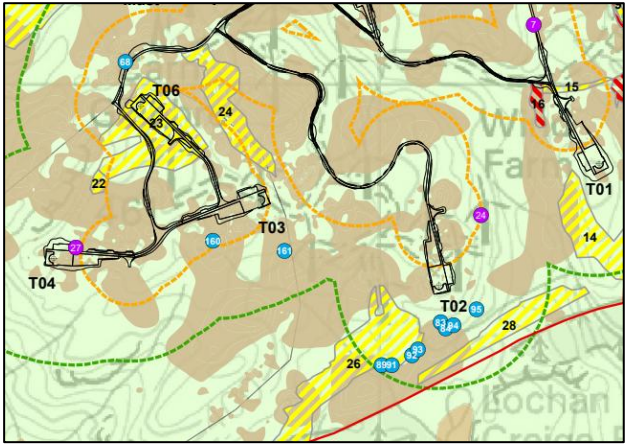
NVC or Target Note Area	GWDTE Assessment
<p>Area 8</p> 	<p>NVC Category: M23a - <i>Juncus effusus</i>/<i>acutiflorus</i> - <i>Galium palustre</i> rush-pasture</p> <p>LUPS Classification: Potentially Highly Groundwater Dependent</p> <p>This habitat is 35 m downgradient of the proposed construction compound on the steep slopes above the unnamed watercourse.</p> <p>It is underlain by non-aquifer bedrock geology and discontinuous peat. It is possible that this habitat is supported to some extent by a small amount of groundwater seepage and therefore, there may be some potential interception of groundwater from the excavations associated with the temporary construction however this is not anticipated to substantially support the habitat and is not considered to be groundwater dependent.</p>
<p>Area 9</p> 	<p>NVC Category: W1 - <i>Salix cinerea</i> - <i>Galium palustre</i> woodland</p> <p>LUPS Classification: Potentially Moderately Groundwater Dependent</p> <p>Assessment:</p> <p>This area of woodland is present along the east bank of an unnamed tributary of the Laggan Burn and therefore not hydrogeologically connected to the Development.</p>

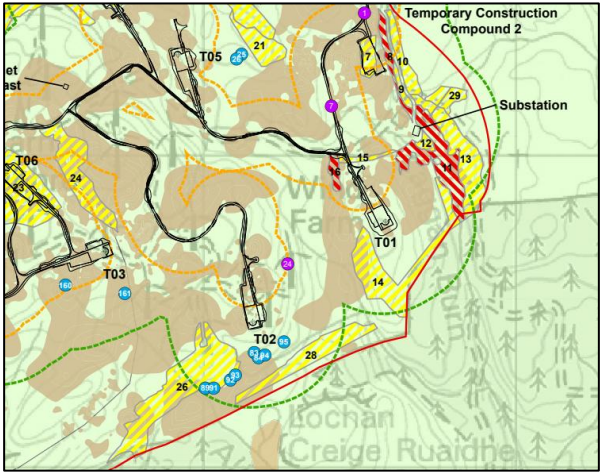
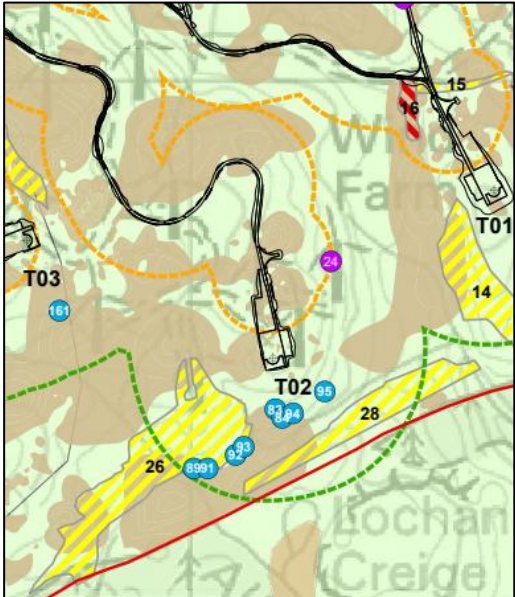
NVC or Target Note Area	GWDTE Assessment
<p>Area 11</p> 	<p>NVC Category: M23a - <i>Juncus effusus</i>/<i>acutiflorus</i> - <i>Galium palustre</i> rush-pasture</p> <p>LUPS Classification: Potentially Highly Groundwater Dependent</p> <p>Assessment:</p> <p>This habitat lies just upgradient of the existing track, underlain by non-aquifer bedrock geology and discontinuous peat. It is possible that this habitat is supported to some extent by groundwater seepage, however there is unlikely to be interception of any groundwater component as this habitat is located upgradient of the existing track, therefore no hydrogeological impact on this habitat is anticipated.</p>
<p>TN 7.9.7</p> 	<p>NVC Category: M6a - <i>Carex echinata</i> - <i>Sphagnum recurvum</i> mire</p> <p>LUPS Classification: Potentially Highly Groundwater Dependent</p> <p>Assessment:</p> <p>This habitat comprises of a narrow strip less than 1 m wide and approx. 120 m in length of M6a acid flush. It is associated with a very small, possibly ephemeral watercourse channel fed by groundwater seepage from bog habitats to the east and north and some topographical surface flow from the steep gradients to the west. The proposed new track will likely impact the hydrogeological regime in this area.</p> <p>This is discussed further in Section 5 below.</p>

NVC or Target Note Area	GWDTE Assessment
<p>Area 16</p> 	<p>NVC Category: M23a - <i>Juncus effusus</i>/<i>acutiflorus</i> - <i>Galium palustre</i> rush-pasture</p> <p>LUPS Classification: Potentially Highly Groundwater Dependent</p> <p>Assessment:</p> <p>This habitat is located within the base of a narrow valley and associated with an unnamed tributary to the Laggan Burn. Given the non-aquifer geology and the surrounding topography, it is likely that this habitat is fed predominantly by surface water and rainfall. It is possible that this habitat is supported to some extent by groundwater seepage.</p> <p>The only upgradient infrastructure is situated on the crest of a ridge and therefore will not intercept upgradient surface flow. No hydrogeological impact on this habitat is anticipated.</p>
<p>Area 18</p> 	<p>NVC Category: M23a - <i>Juncus effusus</i>/<i>acutiflorus</i> - <i>Galium palustre</i> rush-pasture</p> <p>LUPS Classification: Potentially Highly Groundwater Dependent</p> <p>Assessment:</p> <p>This habitat is separated from the upgradient proposed infrastructure by a watercourse and therefore is not hydrologically connected to the proposed development.</p>

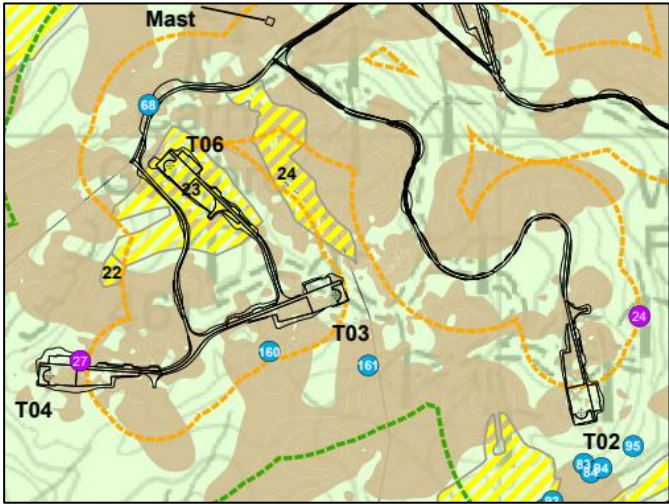
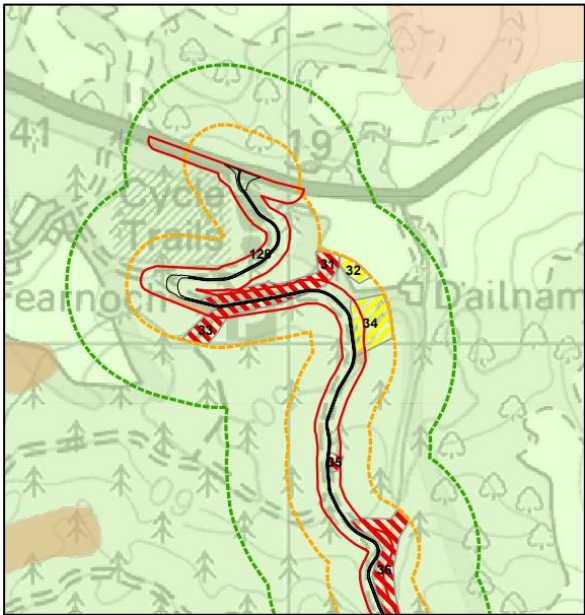
NVC or Target Note Area	GWDTE Assessment
<p>TN 7.3.68</p> 	<p>NVC Category: M11 <i>Carex demissa</i> - <i>Saxifraga aizoides</i> mire</p> <p>LUPS Classification: Potentially Highly Groundwater Dependent</p> <p>Assessment: This habitat is a flush feature that is dependent on shallow groundwater, likely moving downgradient from the slopes of Carn Gaibhre to the south. It is in very close proximity to proposed new floating track.</p> <p>The use of floating track may preserve ground flow to some extent; however hydrogeological impact on this habitat is possible from the proposed development.</p> <p>This is discussed further in Section 5 below.</p>
<p>TN 7.9.27</p> 	<p>NVC Category: M11 <i>Carex demissa</i> - <i>Saxifraga aizoides</i> mire</p> <p>LUPS Classification: Potentially Highly Groundwater Dependent</p> <p>Assessment: This habitat is a flush feature that is dependent on shallow groundwater, likely moving downgradient from the slopes of Carn Gaibhre to the north.</p> <p>It is on the edge of earthworks of the proposed hardstanding. As it is on the upgradient side of the proposed infrastructure there will be no interception of groundwater flow, however there is a risk of a direct impact from construction activities.</p> <p>This is discussed further in Section 5 below.</p>

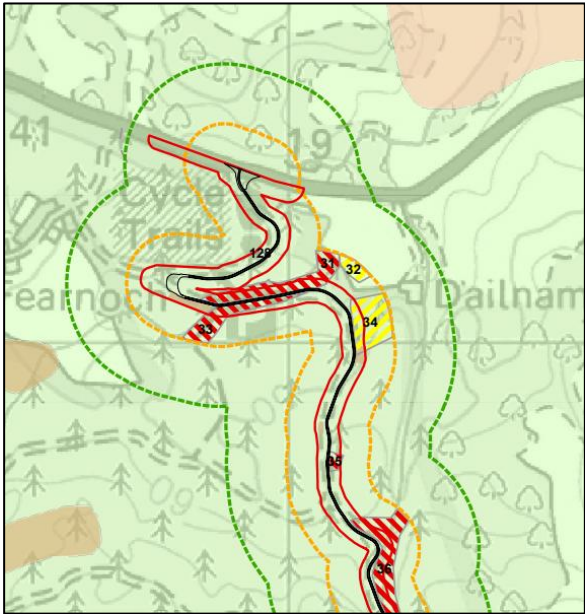
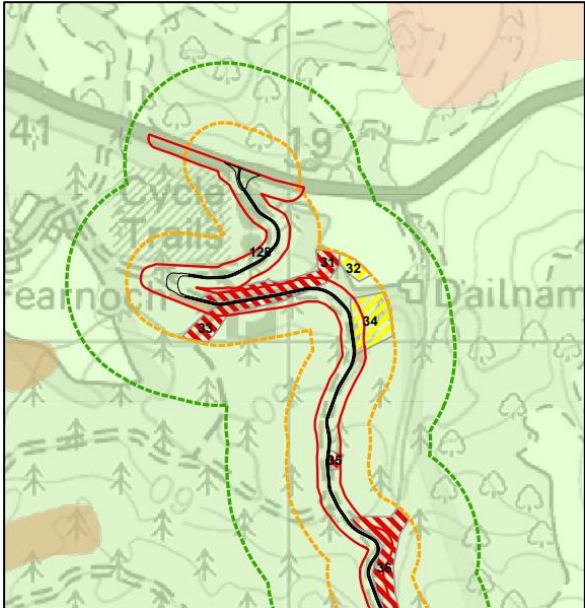
NVC or Target Note Area	GWDTE Assessment
<p>TN 7.9.38</p> 	<p>NVC Category: M29 <i>Hypericum elodes</i> - <i>Potamogeton polygonifolius</i> soakaway</p> <p>LUPS Classification: Potentially Highly Groundwater Dependent</p> <p>Assessment: This habitat is an M29 soakaway is part of an unnamed tributary to the Garbh Allt.</p> <p>Aerial photography shows the habitat is on the alignment of a surface water channel flowing from north west to south east following the base of topographical valley feature. There may be a minor groundwater component from the slopes on the valley sides of the habitat however the habitat is considered to be surface water fed and is not connected to the wind farm infrastructure.</p>
<p>Area 19</p> 	<p>NVC Category: M23a - <i>Juncus effusus</i>/<i>acutiflorus</i> - <i>Galium palustre</i> rush-pasture</p> <p>LUPS Classification: Potentially Highly Groundwater Dependent</p> <p>Assessment:</p> <p>This habitat lies at the headwaters of an unnamed tributary to the Allt Nathais. Given the non-aquifer bedrock it is likely fed by rainfall and shallow groundwater moving through fractures and discontinuities near the surface of the bedrock, channelled here by the surrounding topography.</p> <p>The upgradient proposed infrastructure associated with T10 is situated on the crest of a ridge feature that has very little connection to this feature and is therefore unlikely to have a hydrogeological impact on this habitat.</p>

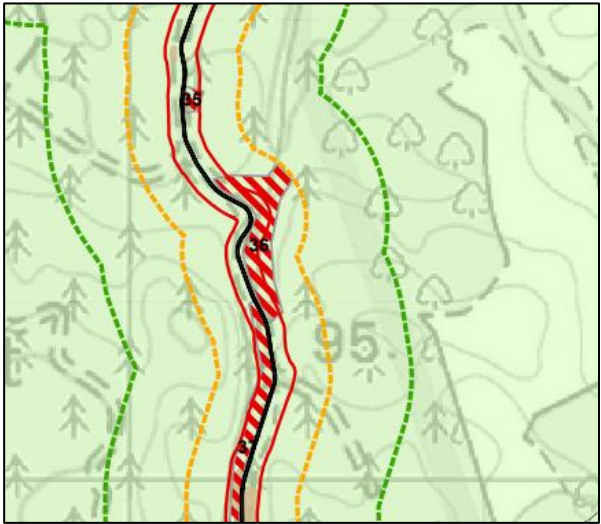
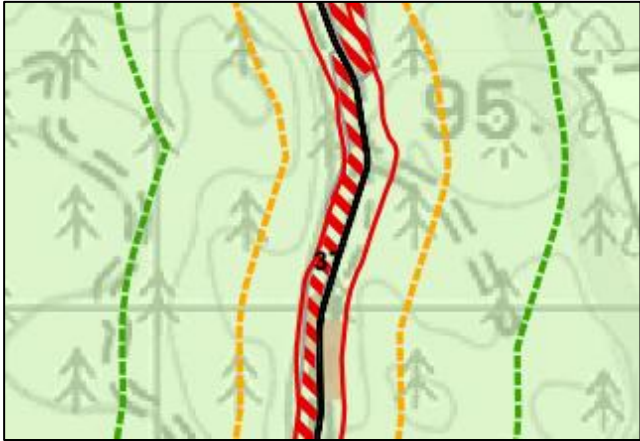
NVC or Target Note Area	GWDTE Assessment
<p>TN 7.3.25 and 7.3.26</p> 	<p>NVC Category: M11 <i>Carex demissa</i> - <i>Saxifraga aizoides</i> mire</p> <p>LUPS Classification: Potentially Highly Groundwater Dependent</p> <p>Assessment:</p> <p>These habitats are M11 flush features that are likely to be dependent on shallow groundwater. The topography suggests that they are fed by groundwater flowing downgradient from the slopes of the two small summits north of the habitat. The closest planned infrastructure is west of the habitats separated by a small valley feature and therefore will have no hydrogeological impact on these habitats.</p>
<p>TN 7.3.160</p> 	<p>NVC Category: M11 <i>Carex demissa</i> - <i>Saxifraga aizoides</i> mire</p> <p>LUPS Classification: Potentially Highly Groundwater Dependent</p> <p>Assessment: This habitat is an M11 flush feature that is dependent on shallow groundwater. It is less than 100 m downgradient of the proposed track and turbine infrastructure which may intercept some groundwater flow from the upper slopes of Carn Gaibhre.</p> <p>This habitat may therefore be impacted by the development however due to the distance it is likely to be minimal.</p> <p>This is discussed further in Section 5 below.</p>

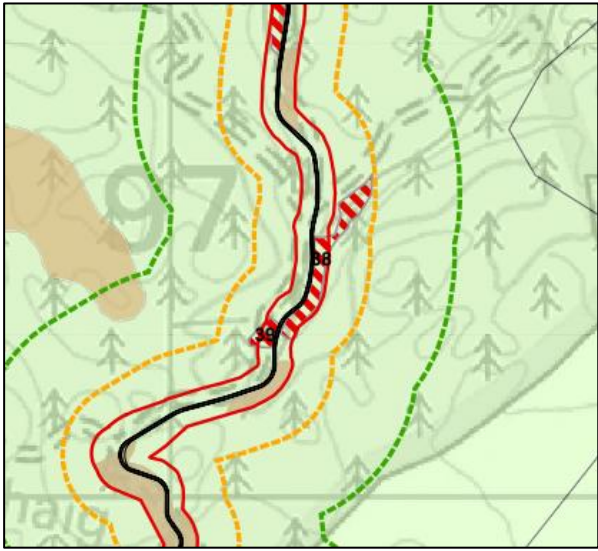
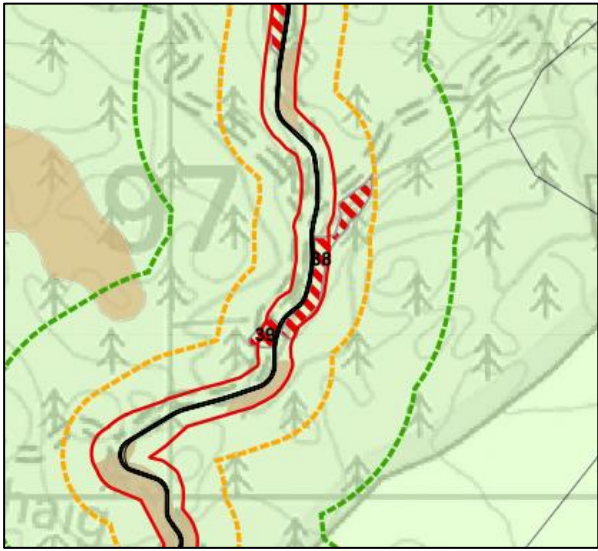
NVC or Target Note Area	GWDTE Assessment
<p>TN 7.9.24</p> 	<p>NVC Category: M11 <i>Carex demissa</i> - <i>Saxifraga aizoides</i> mire</p> <p>LUPS Classification: Potentially Highly Groundwater Dependent</p> <p>Assessment:</p> <p>This habitat is an M11 flush feature dependent on shallow groundwater flow from the west. The upgradient turbine infrastructure and track are located perpendicular to the direction of slope and so may have some impact on groundwater flow. This will likely be limited by the relatively small area of the catchment upgradient of the track.</p> <p>This is discussed further in Section 5 below.</p>
<p>TN 7.3.83, 7.3.84, 7.3.94 and 7.3.95</p> 	<p>NVC Category: M11 <i>Carex demissa</i> - <i>Saxifraga aizoides</i> mire</p> <p>LUPS Classification: Potentially Highly Groundwater Dependent</p> <p>Assessment:</p> <p>These habitats are M11 flush features dependent on shallow groundwater flow from the north. The upgradient infrastructure is located on the crest of a ridge and therefore will not interrupt a significant upgradient groundwater catchment, so is not likely to have a hydrogeological impact on these habitats. The presence of existing infrastructure in this location on the upgradient ridge confirms that an impact will be unlikely.</p>

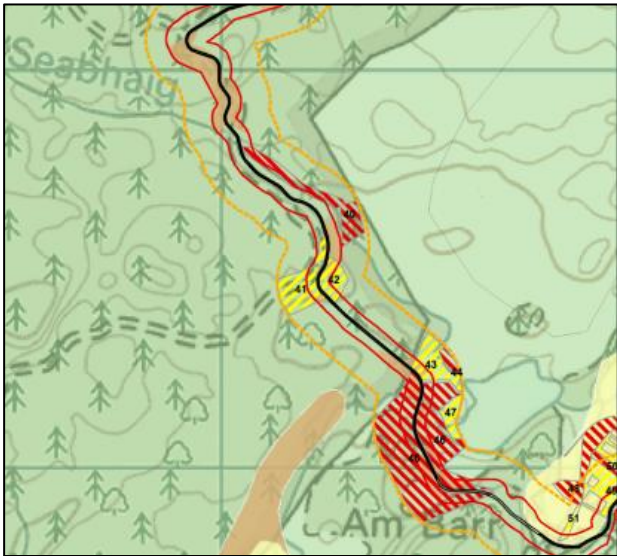
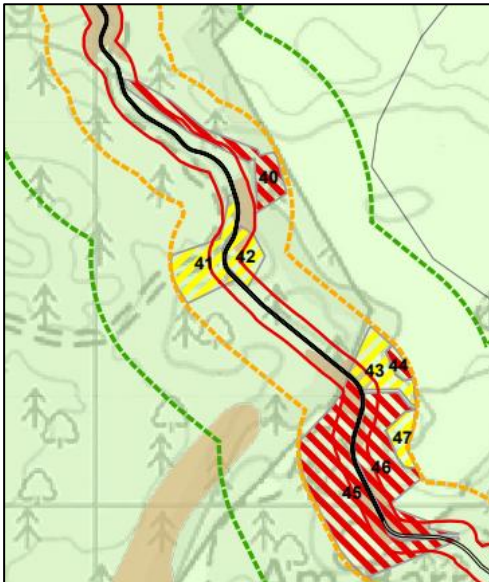
NVC or Target Note Area	GWDTE Assessment
<p>TN 7.3.89, 7.3.91, 7.3.92 and 7.3.93</p>	<p>NVC Category: M11 <i>Carex demissa</i> - <i>Saxifraga aizoides</i> mire</p> <p>LUPS Classification: Potentially Highly Groundwater Dependent</p> <p>Assessment:</p> <p>These habitats are M11 flush features dependent on shallow groundwater flow however the distance from the infrastructure, topographical setting and separation due to watercourses will result in no effect on flows from the proposed infrastructure.</p>
<p>TN 7.3.161</p>	<p>NVC Category: M11 <i>Carex demissa</i> - <i>Saxifraga aizoides</i> mire</p> <p>LUPS Classification: Potentially Highly Groundwater Dependent</p> <p>Assessment:</p> <p>This habitat is likely to be groundwater dependent, fed by shallow groundwater collecting on the slopes of Carn Gaibhre to the northwest.</p> <p>The upgradient proposed T05 infrastructure is 150 m upgradient at its closest point, however here it overlies existing infrastructure on a ridgeline and is unlikely to have any significant impact through interception of groundwater flow. The planned track to the south east is downgradient. There will therefore be no significant hydrogeological impact on this habitat.</p>

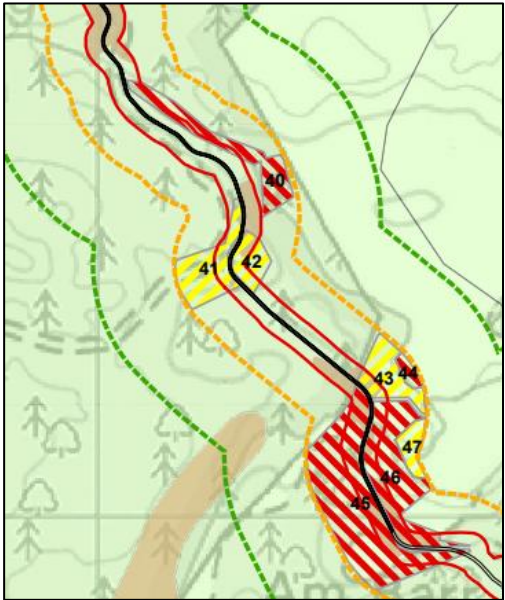
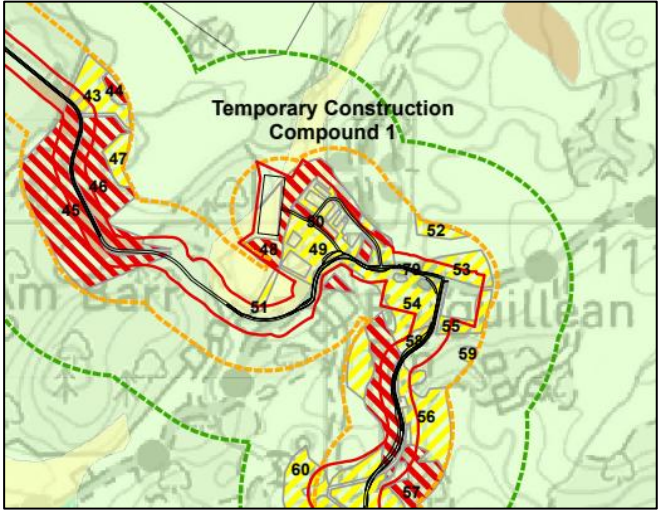
NVC or Target Note Area	GWDTE Assessment
<p>N 7.3.100</p> 	<p>NVC Category: M11 <i>Carex demissa</i> - <i>Saxifraga aizoides</i> mire</p> <p>LUPS Classification: Potentially Highly Groundwater Dependent</p> <p>Assessment: This habitat is likely to be groundwater dependent. The topography suggests that the habitat is likely fed from groundwater to the northwest.</p> <p>This habitat is highly unlikely to be affected due to the distance, approximately 240 m from infrastructure, and the location, on a ridge between two watercourses.</p>
<p>Area 31</p> 	<p>NVC Category: W4/W11 - <i>Betula pubescens</i> - <i>Molinia caerulea</i> woodland / <i>Quercus petraea</i> - <i>Betula pubescens</i> - <i>Oxalis acetosella</i> woodland (only W4 potentially GW dependent)</p> <p>LUPS Classification: Potentially Highly Groundwater Dependent</p> <p>Assessment:</p> <p>This habitat overlies an area of non-aquifer bedrock devoid of superficial deposits on a slope between the access track and the River Luachragan in the north of the Site Access track.</p> <p>The habitat is likely fed by a combination of rainfall and potentially surface water runoff from the steep gradients surrounding the watercourse and track upgrade activities are unlikely to have a hydrogeological influence on this habitat.</p>

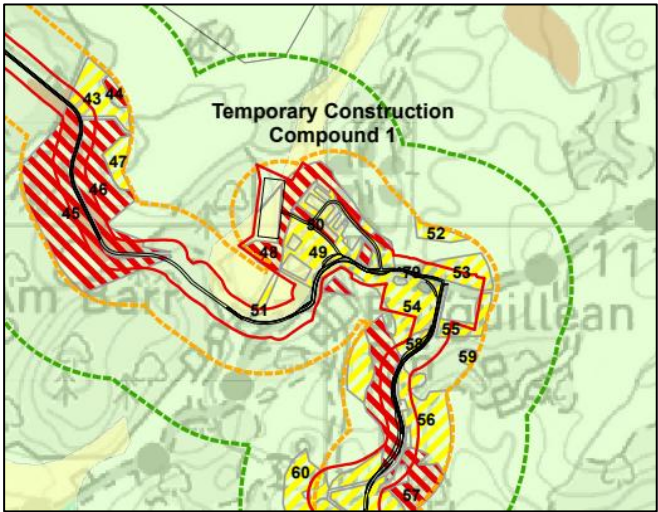
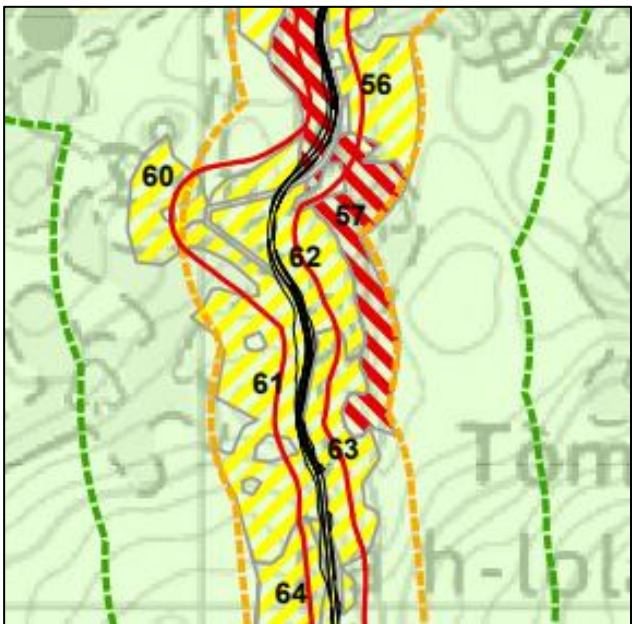
NVC or Target Note Area	GWDTE Assessment
<p>Area 33</p> 	<p>NVC Category: W4/W11 - <i>Betula pubescens</i> - <i>Molinia caerulea</i> woodland / <i>Quercus petraea</i> - <i>Betula pubescens</i> - <i>Oxalis acetosella</i> woodland- (only W4 potentially GW dependent)</p> <p>LUPS Classification: Potentially Highly Groundwater Dependent</p> <p>Assessment:</p> <p>This habitat overlies an area of non-aquifer bedrock devoid of superficial deposits on a slope immediately upgradient of the access track.</p> <p>The habitat is likely fed by rainfall and surface water and is situated downgradient of the habitat therefore there will be no hydrogeological influence on this habitat from the proposed activities.</p>
<p>Area 35</p> 	<p>NVC Category: W4 - <i>Betula pubescens</i> - <i>Molinia caerulea</i> woodland</p> <p>LUPS Classification: Potentially Highly Groundwater Dependent</p> <p>Assessment:</p> <p>This habitat is immediately downgradient of the Site Access track, underlain by non-aquifer bedrock and devoid of mapped superficial deposits. There is unlikely to be a significant groundwater input from the underlying geology and widening of the track is unlikely to alter the current hydrogeological regime as there will be no change to the current orientation of the track.</p>

NVC or Target Note Area	GWDTE Assessment
<p>Area 36</p> 	<p>NVC Category: W7/W11 - <i>Alnus glutinosa</i> - <i>Fraxinus excelsior</i> - <i>Lysimachia nemorum</i> woodland / <i>Quercus petraea</i> - <i>Betula pubescens</i> - <i>Oxalis acetosella</i> woodland- (only W7 potentially GW dependent)</p> <p>LUPS Classification: Potentially Highly Groundwater Dependent</p> <p>Assessment:</p> <p>This habitat overlies an area of non-aquifer bedrock devoid of superficial deposits following the banks of the Eas na Làraiche Mor.</p> <p>The habitat is likely fed by rainfall and surface water flowing from the slopes above and channelled towards the watercourse by the surrounding topography and saturating the ground at the base of the watercourse valley. Given the non-aquifer geology it is unlikely that there is a significant groundwater input to this habitat, therefore there will be no hydrogeological influence from the widening of the existing track.</p>
<p>Area 37</p> 	<p>NVC Category: W7/W11 - <i>Alnus glutinosa</i> - <i>Fraxinus excelsior</i> - <i>Lysimachia nemorum</i> woodland / woodland (only W7 potentially GW dependent)</p> <p>LUPS Classification: Potentially Highly Groundwater <i>Quercus petraea</i> - <i>Betula pubescens</i> - <i>Oxalis acetosella</i> Dependent</p> <p>Assessment:</p> <p>This habitat overlies an area of non-aquifer bedrock devoid of superficial deposits following the banks of the Eas na Làraiche Mor immediately upstream of Area 36.</p> <p>The habitat is likely fed by rainfall and surface water flowing from the slopes above and channelled towards the watercourse by the surrounding topography and saturating the ground at the base of the watercourse valley.</p> <p>Given the non-aquifer geology it is unlikely that there is a significant groundwater input to this habitat, therefore there will be no hydrogeological influence from the widening of the existing track.</p>

NVC or Target Note Area	GWDTE Assessment
<p>Area 38</p> 	<p>NVC Category: W4/W7 - <i>Betula pubescens</i> - <i>Molinia caerulea</i> woodland / <i>Alnus glutinosa</i> - <i>Fraxinus excelsior</i> - <i>Lysimachia nemorum</i> woodland</p> <p>LUPS Classification: Potentially Highly Groundwater Dependent</p> <p>Assessment:</p> <p>This habitat overlies an area of non-aquifer bedrock devoid of superficial deposits following the banks of the Allt Nathais.</p> <p>The habitat is likely fed by rainfall and surface water flowing from the slopes above and channelled towards the watercourse by the surrounding topography and saturating the ground at the base of the watercourse valley.</p> <p>Given the non-aquifer geology it is unlikely that there is a significant groundwater input to this habitat, therefore there will be no hydrogeological influence from the widening of the existing track.</p>
<p>Area 39</p> 	<p>NVC Category: W4 - <i>Betula pubescens</i> - <i>Molinia caerulea</i> woodland</p> <p>LUPS Classification: Potentially Highly Groundwater Dependent</p> <p>Assessment:</p> <p>This habitat overlies an area of non-aquifer bedrock devoid of superficial deposits adjacent to where the existing Site Access track crosses the Eas na Làraiche Mor.</p> <p>The habitat is likely fed by rainfall and surface water flowing from the slopes above and channelled towards the watercourse by the surrounding topography and saturating the ground at the base of the watercourse valley.</p> <p>The track itself may influence wetness in this habitat by forming a downgradient barrier to surface and shallow groundwater flow from the habitat.</p> <p>Given the non-aquifer geology, the presence of the existing track and its location downgradient of the habitat it is unlikely that the widening of the existing track will have a hydrogeological impact on this habitat.</p>

NVC or Target Note Area	GWDTE Assessment
<p>Area 40</p> 	<p>NVC Category: W4/W7 - <i>Betula pubescens</i> - <i>Molinia caerulea</i> woodland / <i>Alnus glutinosa</i> - <i>Fraxinus excelsior</i> - <i>Lysimachia nemorum</i> woodland</p> <p>LUPS Classification: Potentially Highly Groundwater Dependent</p> <p>Assessment:</p> <p>This habitat overlies an area of non-aquifer bedrock devoid of mapped superficial deposits following the banks of the Allt na Seabhaig.</p> <p>The habitat is likely fed by rainfall and surface water flowing from the slopes above and channelled towards the watercourse by the surrounding topography and saturating the ground at the base of the watercourse valley.</p> <p>Given the non-aquifer geology it is unlikely that there is a significant groundwater input to this habitat, therefore there will be no hydrogeological influence from the widening of the existing track.</p>
<p>Area 44</p> 	<p>NVC Category: W4 - <i>Betula pubescens</i> - <i>Molinia caerulea</i> woodland</p> <p>LUPS Classification: Potentially Highly Groundwater Dependent</p> <p>Assessment:</p> <p>This habitat overlies an area of non-aquifer bedrock devoid of mapped superficial deposits separated from the proposed track activities by the Allt na Seabhaig. There will therefore be no hydrogeological influence from the widening of the existing track on this habitat.</p>

NVC or Target Note Area	GWDTE Assessment
<p>Areas 45 and 46</p> 	<p>NVC Category: W11/W7/W4 - <i>Quercus petraea</i> - <i>Betula pubescens</i> - <i>Oxalis acetosella</i> woodland / <i>Alnus glutinosa</i> - <i>Fraxinus excelsior</i> - <i>Lysimachia nemorum</i> woodland / woodland <i>Betula pubescens</i> - <i>Molinia caerulea</i> - (only W4 and W7 potentially GW dependent)</p> <p>LUPS Classification: Potentially Highly Groundwater Dependent</p> <p>Assessment:</p> <p>These habitats overlie an area of non-aquifer bedrock devoid of mapped superficial deposits situated either side of the existing Site Access track. They are likely surface water and rainfall fed due to the non-aquifer bedrock therefore these habitats will not be affected by the proposed activities.</p>
<p>Area 48</p> 	<p>NVC Category: W7/W11 - <i>Alnus glutinosa</i> - <i>Fraxinus excelsior</i> - <i>Lysimachia nemorum</i> woodland / <i>Quercus petraea</i> - <i>Betula pubescens</i> - <i>Oxalis acetosella</i> woodland - (only W7 potentially GW dependent)</p> <p>LUPS Classification: Potentially Highly Groundwater Dependent</p> <p>Assessment:</p> <p>This habitat is underlain by a layer of mapped alluvium and impermeable bedrock. It is likely primarily surface water and rainfall fed and not truly groundwater dependent however there may still be some groundwater input from the alluvial layer. This potential small aquifer is likely recharged by the watercourse, therefore upgrading the track here is unlikely to have a significant hydrogeological influence on this habitat.</p>

NVC or Target Note Area	GWDTE Assessment
<p>Area 50</p> 	<p>NVC Category: W7/U20 - <i>Alnus glutinosa</i> - <i>Fraxinus excelsior</i> - <i>Lysimachia nemorum</i> woodland / <i>Pteridium aquilinum</i> – <i>Galium saxatile</i> - (only W7 potentially GW dependent)</p> <p>LUPS Classification: Potentially Highly Groundwater Dependent</p> <p>Assessment:</p> <p>This habitat is underlain by a layer of mapped alluvium and impermeable bedrock. It is likely primarily surface water and rainfall fed and not truly groundwater dependent however there may still be some groundwater input from the alluvial layer. This potential small aquifer is likely recharged by the watercourse, therefore upgrading the track here is unlikely to have a significant hydrogeological influence on this habitat.</p>
<p>Area 57</p> 	<p>NVC Category: W7/W11 - <i>Alnus glutinosa</i> - <i>Fraxinus excelsior</i> - <i>Lysimachia nemorum</i> woodland / <i>Quercus petraea</i> - <i>Betula pubescens</i> - <i>Oxalis acetosella</i> woodland - (only W7 potentially GW dependent)</p> <p>LUPS Classification: Potentially Highly Groundwater Dependent</p> <p>Assessment:</p> <p>This habitat is within the watercourse valley of an unnamed tributary to the Allt Nathais, underlain by impermeable bedrock geology and devoid of superficial deposits. It is crossed by the existing Site Access track that will be widened.</p> <p>The habitat is linked to the watercourse and will therefore have an influence from surface water, the watercourse and some groundwater discharge and this is unlikely to change due to the track upgrade.</p>

Note: As per Figure 8.6.1: Red line – site boundary; orange line = 100 m infrastructure buffer; green line = 250 m infrastructure buffer; blue line = watercourse; yellow cross hatch = potentially moderately GWD polygon; red cross hatch = 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.

In summary, the results of this analysis are that six 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 (presented on **Figure 8.8** in Volume 3 of the **EIA Chapter**).

The six target notes are all M11 flush habitats with the exception of target note TN 7.9.7. Target note 7.9.7 is an M6a acid flush and will likely be lost along with the associated ephemeral watercourse due to the proposed new track disrupting the hydrological regime.

The five M11 flush habitats that may be affected by the Proposed Development include:

- Target note 7.9.24 could be affected due to proposed track and turbine infrastructure upgradient. This infrastructure is situated close to a spur feature with a limited upgradient catchment, and is around 120 m upgradient of the feature at its closest point. It is therefore unlikely that this feature will be affected due to the proposed infrastructure, however monitoring of this habitat may be beneficial.
- Target note 7.3.68 could be affected due to its close proximity to proposed new floating track. While the use of floating track may preserve hydrogeological continuity, micro siting of new track 50 m to the north west is recommended for this habitat if feasible.
- Target note 7.3.160 is at risk of an impact due to the potential for the upgradient infrastructure to intercept flow. Monitoring is recommended during the construction phase for this habitat as there is a low to moderate likelihood that this habitat could be affected.
- Target note 7.9.1 could be affected due to its location directly downgradient of the track; however this could be substantially reduced through micro siting the track about 20 m downgradient and the use of pipe culverts to allow downgradient flow from the feature to cross under the proposed track.
- Target note 7.9.27 will likely be lost due to its proximity to the proposed turbine infrastructure unless micro siting is possible as it is located immediately adjacent to proposed excavations for T06.

Consideration of Habitat Value

The following refers to the habitats that may be affected by the Proposed Development and a consideration of their value in order to aid assessment:

The M6a flush at TN 7.9.7 is very small in size, ephemeral and is not a good example of the community type. It is not considered ecologically important to the Site as a whole.

M11 flush habitats are abundant across the Site, typically found below steep slopes where shallow groundwater in the sub-surface weathered zone of the bedrock exits to the surface. The GWDTE walkover survey (**Technical Appendix 6.3** of the EIA Report) identified a total of 33 M11 flushes across the extent of the Site whilst the vegetation assessment of proposed turbine locations (**Technical Appendix 6.9** of the EIA Report) identified a further seven M11 flush features just within the direct vicinity of proposed infrastructure. Whilst these habitats are groundwater dependent and highly sensitive, only four of the 40 M11 flush features recorded

during the Site survey are threatened by the development with the rest being avoided through design. None of these features were observed to feed into larger GWDTEs and therefore GWDTE impacts will be limited to these features themselves, which are small and of relatively low ecological importance individually.

For these reasons, and based on the methodology presented in **Chapter 8** of the EIA Report and the ecology assessment, the sensitivity of these GWDTEs are considered to be **Low**, magnitude of potential effect is **Medium** (for the indirect effects to M11 habitats) to **Very High** (for the direct effects to the M6a habitat), therefore, the adverse effect on these habitats through flow alteration over the Site as a whole has been assessed as having a **Minor (not significant)** for the M11 habitat to **Moderate (significant)** significance of effect for the M6a habitat.

The following good practice measures will be undertaken:

- 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.

In addition, if possible infrastructure will be located as far from these features as possible and monitoring will be undertaken. Although it is noted that a number of these features are present in close proximity to the existing wind farm infrastructure.