

Technical Appendix 8.2: GWDTE Assessment

Technical Appendix 8.2: Groundwater Dependent Terrestrial Ecosystems

1.1 Introduction

- 1.1.1
- This Technical Appendix provides a summary of Groundwater Dependent Terrestrial Ecosystems (GWDTEs) within the context of the Proposed Development. It provides a description of geological and hydrogeological conditions underlying the Site. Characterisation of the Site considers National Vegetation Classification (NVC) surveying conducted by SLR Consulting in September-November 2024 and July 2025 and hydrological surveying carried out by Ramboll in October 2025. Hydrogeological assessment of the identified potential GWDTEs is provided with associated mapping.
- 1.1.2
- This TA is supported by the following:

 - Figure 8.3: Superficial Geology;
 - Figure 8.4: Bedrock Geology;
 - Figure 8.5: Hydrogeology;
 - Figure 8.7: Carbon and Peatland Soils;
 - Figure 8.2.1: NVC GWDTE Classification; and
 - Figure 8.2.2: Ramboll GWDTE Assessment.
- 1.1.3
- Excavation of soil and bedrock during the construction phase of the Proposed Development may cause localised disruption and interruption to groundwater flow. Interruption of groundwater flow would potentially reduce the supply of groundwater to GWDTEs thereby causing an alteration/ change in the quality and/or quantity of and/or the physical or biological characteristics of the GWDTE. Contamination of groundwater may also cause physical or chemical contamination to the GWDTE.
- 1.1.4
- Following the identification of potential GWDTEs from NVC mapping data, the hydrological and hydrogeological desktop study information has been used to qualitatively determine the sensitivity of each potential GWDTE.
- 1.1.5
- Assessment has been carried out in line with SEPA guidance¹, which applies to all developments requiring an Environmental Impact Assessment (EIA). The following steps have been followed in this assessment:

 - Step 1: Identify any GWDTE features and assessment of groundwater dependency.
 - Step 2: Qualitative impact assessment.

1.2 Baseline

Bedrock Geology

- 1.2.1
- The British Geological Survey (BGS) 1:50,000 Digital Geological Map of Great Britain shows bedrock geology underlying the Site (**Figure 8.4, EIAR Volume 3a**) to be primarily of the Portpatrick Formation (Wacke) in the east and the Kirkcolm Formation (Wacke) in the west. Smaller strips of the Crawford Group (Pillowed basalt lava and chert), Moffat Shale Group (mudstone) extend through the centre of the Site.

Superficial Geology

- 1.2.2
- The BGS 1:50,000 Digital Geological Map of Great Britain indicates that the majority of the Site is not underlain by superficial deposits (**Figure 8.3, EIAR Volume 3a**). Areas of Till, Devensian are located between the turbines across the proposed access tracks in both the east and west of the Site.
- 1.2.3
- Peat soils are identified across the Site on the National Soil Map of Scotland and the Carbon and Peatland Map (2016) (**Figure 8.7, EIAR Volume 3a**). Turbines 3, 6, 7, 16 and 21 are underlain by Class 1 peat soils, which are characterised as nationally important carbon-rich soils. Turbine 2 is underlain by Class 3 peat soils, these are characterised by dominant vegetation cover that is not classified as priority peatland habitats, with most soils being carbon rich and some areas containing deep peat. Turbines 4 and 8 in the west of the Site are underlain by Class 5 peat soils, these are defined as no peatland habitat and may include areas of bare soil. The soils are carbon-rich and deep peat.
- 1.2.4
- Stage 1 peat surveying, undertaken by Ramboll in December 2024 and January 2025, followed by Stage 2 surveying in November 2025, confirmed the presence of peat soils across much of the Site. Typically, peat soils maintain a high capacity for water retention where they are found to be in undegraded condition. When saturated, the porous peat matrix retains volumes of water leading to slow drainage and elevated water table levels.

Hydrogeology

- 1.2.5
- According to the BGS and the Hydrogeological and Groundwater Vulnerability Maps of Scotland (1:625,000), the underlying bedrock formation is recognised as a Low productivity aquifer (**Figure 8.5, EIAR Volume 3a**). Such aquifers are characterised as having limited groundwater potential, with small amounts of groundwater limited to near surface weathered zones and secondary fractures (e.g. rare springs). Low productivity aquifers do not widely contain groundwater in exploitable quantities; however, some bedrock formations can locally yield water supplies in sufficient quantities for private/domestic use.

1.3 Groundwater Dependent Terrestrial Ecosystems

- 1.3.1
- As shown in **Figure 8.6 (EIAR Volume 3a)**, NVC surveying identified a total of 462 dominant polygons within the Site boundary. Given the large number and spatial complexity of these polygons, the assessment has been undertaken at a site-area level to provide a robust and proportionate evaluation of potential GWDTEs. Dominant habitats were first identified using NVC mapping data, following which hydrological and hydrogeological desktop study information was applied to qualitatively assess the potential sensitivity of GWDTEs within each site area.
- 1.3.2
- Where mosaics of NVC communities were recorded, the community occupying the greatest proportion of the mosaic was taken as representative of the site area, and therefore of its potential to support a GWDTE. Ecological field surveys were undertaken within the Site boundary and extending up to 250 m from the proposed infrastructure to inform this assessment.
- 1.3.3
- Ramboll has undertaken a site-specific assessment of potential dominant GWDTEs, informed by hydrogeological characteristics and groundwater dependency, and refined by site area to reflect the distribution and dominance of habitats. The assessment considered the following factors:
- ¹ SEPA 2024, Guidance on Assessing the Impacts of Developments on Groundwater Dependent Terrestrial Ecosystems. Available online:
- <https://www.sepa.org.uk/environment/land/planning/guidance-and-advice-notes/>
- Volume 4: Technical Appendices
- Technical Appendix 8.2: Groundwater Dependent Terrestrial Ecosystems
- TA8.2-1
- Ramboll

- The direct hydrological connectivity of a potential GWDTE to surface water sources;
 - Underlying geological conditions including the productivity of bedrock and superficial geology, the presence of peat soils and permeability of upgradient geology;
 - Topography and the presence of rills or runnels indicative of surface runoff;
 - The presence of indicative 'flush' patterns of vegetation communities;
 - Land use; and
 - The relative proportion of NVC communities and the potential dominance of non-GWDTE communities within surveyed areas.
- 1.3.4 Furthermore, the assessment takes into consideration SEPA guidance on features that are indicative of groundwater dependency²:
- Habitats associated with springs
 - Where soils are persistently waterlogged on otherwise well drained steep to moderate slopes, in the absence of surface water sources
 - Upper edge of GWDTE is aligned with concave breaks in slope
 - Diffuse groundwater emergence is often focused along linear geological features (fractures, faults etc)
 - Persistent flow even during dry weather
 - Limited variation in temperature
 - May be base enriched

Eastern Area - Including Turbines 10, 11 and 12

- 1.3.5 The eastern area of the Site, encompassing Turbines 10, 11 and 12, comprises a mosaic of M15, MG10, M23 and M6 NVC communities, predominantly occurring on sloping ground. Areas of M15 are located immediately to the north and east of turbine 10. The hydrological walkover survey confirmed that these habitats are situated upslope of the proposed infrastructure and are primarily sustained by rainfall inputs, with no evidence of groundwater influence.
- 1.3.6 M6 and M23 habitats are present to the north of Turbine 11. The hydrological walkover survey identified several watercourses traversing this area, draining towards Hershaw Burn to the northeast. Ground conditions were generally dry, with localised wetter areas confined to the immediate vicinity of the watercourses. The spatial association of the M6 and M23 habitats with these surface water features indicates that they are predominantly surface water-fed rather than groundwater-dependent.
- 1.3.7 Smaller extents of M15 and M6 habitats are distributed along the line of proposed access track between Turbines 11 and 12, and to the east and west of Turbine 12. During the hydrological site survey, M6 habitats in this area were observed adjacent to ephemeral flow paths upstream of Burnts Cleuch and are therefore considered to be reliant on surface water inputs. The M15 habitat adjacent to the existing access track is located on steeply sloping ground, with visible surface water flow paths draining towards the trackside drainage ditch. Similarly, M15 habitats located to the east and west of Turbine 12 are positioned upslope of the turbine and adjacent to the existing access road, where clear surface water pathways were observed. These observations support the conclusion that these habitats are maintained by surface water runoff rather than groundwater inputs.

Central Area – Including Turbines 9, 13, 14, 15

- 1.3.8 The central area of the Site, encompassing Turbines 9, 13, 14 and 15, is dominated by extensive areas of M15 habitat, with smaller areas of M6 present throughout. Large expanses of M15 are located to the east of turbines 9, 13 and 14, and in the vicinity of turbine 15. The land between turbines 14 and 15 is characterised by steeply sloping terrain intersected by tributaries of Glencaple Burn.
- 1.3.9 Hydrological analysis identified multiple overland flow pathways downslope of Turbines 9, 13 and 14, extending through areas of M15 habitat. Areas to the east of Turbine 9 are distributed along the upper slopes of a ridgeline characterised by shallow peat soils and based on the topography and underlying superficial geology, habitats in this area are considered most likely to be supported by direct rainfall and surface water runoff. Additionally, M15 habitats located downslope and to the east of turbine 15 occur on sloping ground adjacent to Glencaple Burn. The hydrological setting indicates that these habitats are primarily sustained by surface water processes, including the convergence of overland flow and proximity to surface watercourses, with no evidence to suggest a significant reliance on groundwater inputs.

Southern Central Area – Including Turbines 17, 18, 19, 20 and 21

- 1.3.10 The southern central portion of the Site, encompassing Turbines 17, 18, 19, 20, and 21, is largely dominated by M15 habitat, with smaller extents of M6 and M23 habitats. These habitats are primarily located within the valley between Turbines 18 and 19, on steeply sloping terrain. Hydrological observations indicate that the area is dominated by overland flow rather than groundwater discharge. During the site survey, most flow paths were dry, suggesting that water availability is driven predominantly by direct rainfall and surface runoff. Consequently, these habitats are not considered to be groundwater-dependent, as there is no evidence of sustained water supply from the underlying groundwater system.

Northern Central Area – Including B797 Road, Laggen Gill, Cleuch Burn and Glengonnar Water

- 1.3.11 The northern central area includes the B797 road as it extends south through the Site, Glengonnar Water which flows alongside the B797 road, Cleuch Burn to the east of Glengonnar Water and Laggen Gill to the east of Cleuch Burn. M6, M23 and M15 habitats are located across the banks of all three watercourses. The proposed access track in the north of the Site extends across habitats of M23 and MG10, these are situated within the floodplain of Glengonnar Water and land in this area was observed to be boggy underfoot. Due to the proximity of Glengonnar Water, these habitats are determined to be surface water fed.

Northern Western Area – Including Turbines 1, 2, 3 and 4

- 1.3.12 Ecological surveys indicate that extensive areas of M23 habitat are located downslope of Turbines 1 and 2, with smaller areas of M6 habitat observed along Glendorch Burn to the south of Turbine 1. Hydrological assessments identified multiple overland flow paths across this area. Both the M23 and M6 habitats are situated along these surface water pathways, indicating that they are primarily sustained by surface runoff rather than groundwater.
- 1.3.13 A small, isolated area of M6 habitat is situated downslope of Turbine 3, located along the banks of a tributary of the Glendorch Burn. Additionally, an area of M15 habitat is present downslope of Turbine 4. Although this area was not accessible during the hydrology survey, topographic and hydrological analysis indicates that steep slopes in the area channel overland flows across the habitat. Therefore, this M15 habitat is also considered to be surface water fed rather than groundwater-dependent.

Southern Western Area – Including Turbines 5, 6, 7 and 8

- 1.3.14 Extensive areas of M15 habitat are present around Turbine 5 in the southwest of the Site. Site observations indicate that this area was predominantly dry underfoot and situated along the side slopes of a steep valley that drains westwards towards Glenkip Burn. Several tributaries of Glenkip Burn traverse the valley sides and are considered to provide surface water inputs to the M15 habitats.
- 1.3.15 M6 habitats are present along the banks of Glenkip Burn and are therefore considered to be sustained by surface water flows rather than groundwater inputs.
- 1.3.16 A isolated area of M15 habitat is located directly downslope of Turbine 8. During the hydrological survey, this area was identified at the headwaters of a tributary of Glenkip Burn, where fast-flowing surface water was observed.
- 1.3.17 M23 habitats are located along a tributary of the Shar Water to the west of Turbine 8. These habitats occur within and adjacent to the channel banks and are therefore considered to be primarily surface water fed.
- 1.3.18 Areas of potential dominant groundwater dependency habitats either coincide within watercourse corridors or are located on sloped terrain characterised by land drains. This distribution is not typical of habitats sustained by groundwater. Linking the evidence from the hydrology field survey to the conceptual hydrological analysis, it is concluded that the dominant vegetation is predominantly supported by rainfall, surface water runoff and water logging of soils rather than by groundwater.

Target Notes

- 1.3.19 In addition to the potentially dominant habitats identified above, the NVC survey identified five target notes within 250 m of the site boundary, three of which are springs, one flush and one gully. These areas are isolated areas of potential GWDTE habitat which could be sensitive to alterations in groundwater supplies, or which could be significantly impacted were the quality or quantity of surface water supplies reduced. The gully is not identified to be a dominant habitat and has therefore not been included in the assessment.

Target Note 1

- 1.3.20 Target note 1 is labelled as a spring to the east of Turbine 17 and north of Turbine 18 a track runs east-west approximately 50 m north of this location. This area was not accessible during the hydrology site survey due to the steep banks. Further hydrological analysis indicates the target note is located on a slope where surface water flows paths may be present. Target Note 1 is upslope of an area of non-GWDTE habitat indicating that this feature does not support downslope GWDTE.

Target Note 3

- 1.3.21 Target Note 3 is labelled as a spring approximately 160 m to the east of Turbine 9. The location of the target note is characterised by steep banks with overland flow paths and land drains present. M32 habitat is recorded at the target note location and downslope habitat (Marsh/Marshy Grassland) is assessed to be an area on which NVC GWDTE habitats are sub-dominant and therefore of limited sensitivity to alterations in groundwater supplies. This area was not accessible during the hydrology site survey due to the steep banks. The target note is located on a slope where surface water flow paths are predicted in a northwest to south easterly direction. This target note is located close to the peak of a ridgeline (on which the Turbine 9 location is proposed) and on an area of relatively shallow peat (<0.5 m in depth based on interpolation of Phase 2 peat probing data). The upslope contributing area

is characterised by M15d Acid Dry Dwarf Shrub Heath /Wet Dwarf Shrub Heath Mosaic which is considered most likely to be supported by direct rainfall and surface water runoff.

Target Note 4

- 1.3.22 Target note 4 is identified as a flush 450 m to the northeast of Turbine 9 characterised by M10 flush, around 1x4m in area. Hydrological analysis indicates the flush is located within a drain that flows into a tributary of the Glencaple Burn and the linear nature of the observed habitat is indicative of a surface water flow path. It is therefore determined that target note 4 is not groundwater dependent.

1.4 Groundwater Dependency

- 1.4.1 SNIFFER (2007) guidance³ states that the dependence of wetlands on groundwater bodies is a result of hydrological connectivity. The degree of dependency will vary depending on 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. Likelihood of dependency is based upon the following:
 - High Likelihood: characterised by intergranular, high productivity drift aquifer and dominantly intergranular, highly productive aquifer;
 - Moderate Likelihood: characterised by intergranular, moderate productivity drift aquifer and fractured, very low productivity aquifer; and
 - Low Likelihood: characterised by intergranular, very low productivity drift aquifer and fractured, very low productivity aquifer.
- 1.4.2 As mentioned earlier, the Site is underlain by a bedrock aquifer with low productivity where the flow is virtually all through fractures and other discontinuities. Where drift deposits are present within the Site, these would be of low productivity. Therefore, it is assumed that there is low likelihood of groundwater dependency for all the GWDTEs within the Site, based on assessment of underlying hydrogeology.
- 1.4.3 As stated in the SEPA guidance⁴, SEPA expects developments and infrastructure to be designed and constructed such that the water environment, including GWDTE, is protected. The detailed design of the development and the proposed construction approach will be informed by consideration of potential effects on any identified GWDTE, including opportunities to avoid or minimise adverse impacts where practicable. The SEPA guidance referenced above sets out a framework for considering potential impacts, taking into account both the scale of effects and the importance of the GWDTE. This framework is summarised in the matrix presented in Table 8.2.1.

³ SNIFFER (2007) WFD66 – Wetland Hydrogeomorphic Classification for Scotland. Edinburgh: SNIFFER.

⁴ Scottish Environment Protection Agency (SEPA) (2024) *Guidance on assessing the impacts of developments on groundwater dependent terrestrial ecosystems* [Online]. Available at: <https://www.sepa.org.uk/media/a1yh0blq/guidance-on-assessing-the-impacts-of-developments-on-groundwater-dependent-terrestrial-ecosystems.docx> (Accessed January 2026)

Table 8.2.1: SEPA's Guidance on Identification of Sensitive GWDTE from Ecological and Hydrogeological Assessments					
		How much is it affected			
		Substantially	Moderately	Slightly	Negligibly or not at all
How important is it	High/important	Major	Major	Medium	Negligible/no effect
	Moderately important	Major	Medium	Low	Negligible/no effect
	Low importance	Medium	Low	Low	Negligible/no effect
	Unimportant	Unimportant effect	Unimportant effect	Unimportant effect	Negligible/no effect

- 1.4.4 SEPA guidance indicates that the following factors should be considered when assessing potential effects:
 - Notification as a feature on a designated nature conservation site;
 - The Scottish Biodiversity List, UKBAP, Habitats Directive Annex 1;
 - Habitat connectivity;
 - Ecosystem services provided – flood mitigation, baseflow maintenance, carbon storage, nutrient filtration;
 - Relative extent in Scotland;
 - Significant decline / unfavourable condition; and
 - Importance for supporting species.
- 1.4.5 In accordance with SNIFFER (2007) guidance, this assessment has determined that all previously identified dominant habitats within the Site are of a low likelihood of groundwater dependency (detailed in **Figure 8.2.1**). In line with SEPA guidance and the matrix included in Table 8.2.1, the dominant habitats identified within the Site are assessed as being of low importance in terms of groundwater dependency, reflecting the underlying low productivity aquifer, limited groundwater availability, and the absence of evidence for sustained groundwater inputs identified during hydrological walkover surveys.
- 1.4.6 Given that potential impacts on these habitats and target notes are anticipated to be negligible to slight, the matrix indicates that any resultant effects would be **negligible or of low** significance according to the SEPA matrix.
- 1.4.7 On this basis, the habitats identified do not meet SEPA's criteria for sensitive GWDTEs requiring the application of groundwater-specific protection buffers. Nevertheless, in accordance with best practice and SEPA expectations, appropriate mitigation and construction safeguards would be implemented to protect surface water pathways, maintain hydrological connectivity, and prevent deterioration in water quality during construction and operation of the proposed development.

1.5 Mitigation and Further Assessment

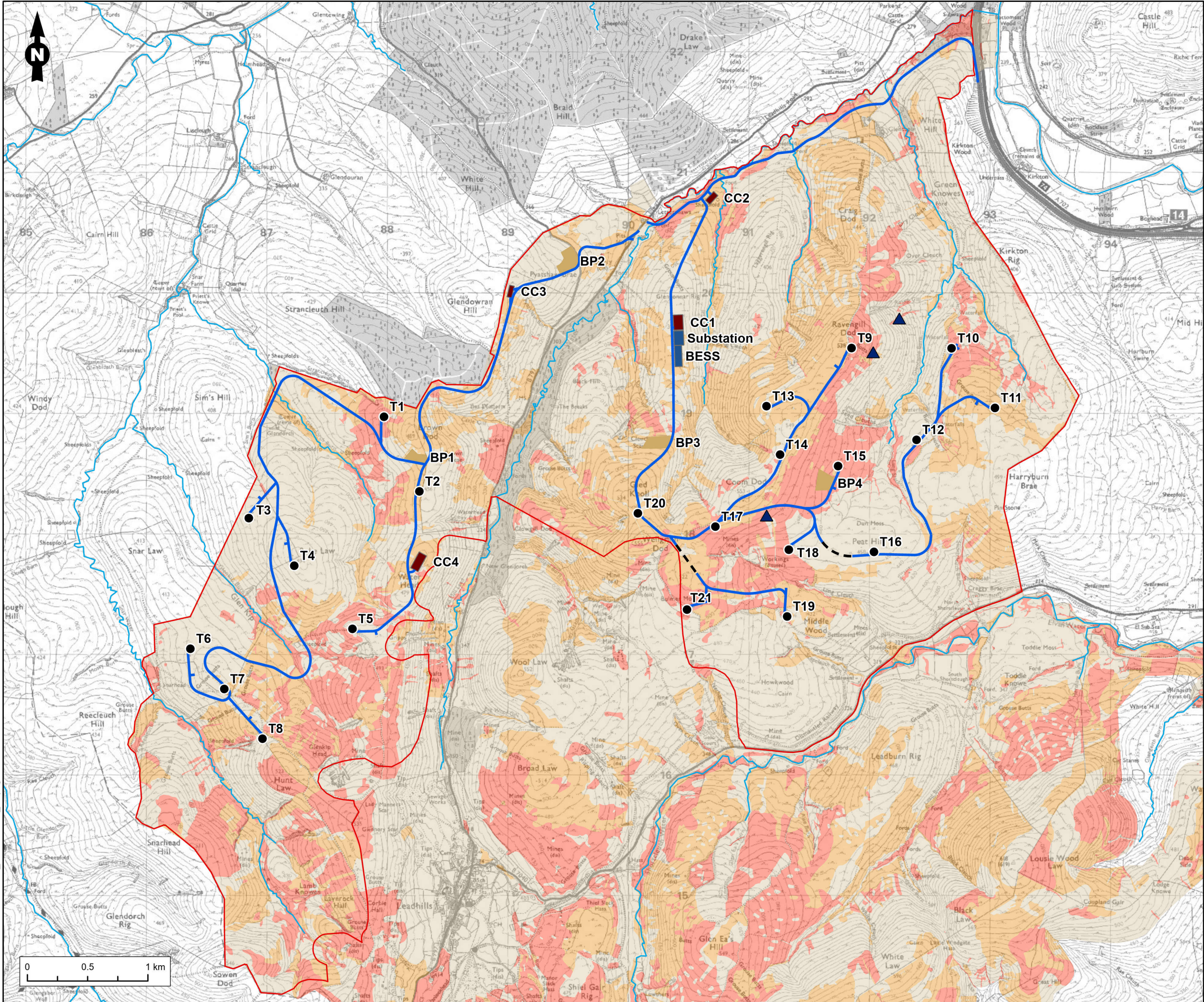
- 1.5.1 As the potential GWDTE areas assessed are not considered likely to be groundwater dependent, specific mitigation with respect to groundwater supplies is not considered to be applicable.
- 1.5.2 With regards to the protection of habitats identified by ecological target notes:

- The design of the track between Turbine 18 and Turbine 15 (to the north of Target Note 1) should ensure that the cross drainage of surface water is not prevented from upslope areas.
- Construction phase SuDS measures should ensure the suitable attenuation of runoff from the areas of Turbine 9 to allow settlement of any suspended sediments, prior to discharge to downslope vegetated areas.
- During the construction phase, the CEMP should clearly denote the location of habitats at Target Note locations and the ECoW should ensure that mitigation measures are implemented in line with standard best practice measures upslope of these areas.

- 1.5.3 It is noted that Stage 2 peat depth survey results indicate that Turbines 3, 6, 7, 16 and 21 are underlain by areas of shallow peat, generally up to approximately 0.5 m in depth. In these locations, consideration will be given to the maintenance of existing surface water flow pathways and hydrological connectivity across peatland and wetland habitats. The potential need for appropriate drainage and surface water management measures will be considered as part of the detailed design, with the aim of minimising disturbance to surface water distribution and avoiding adverse effects on peatland hydrology. Mitigation measures would include those presented in the draft Construction Environmental Management Plan (CEMP) to be provided with the Environmental Impact Assessment Report (EIAR) and cover the following:
 - Avoidance of direct impacts by construction activity in such areas;
 - Implementation of Sustainable Drainage System (SuDS) measures to maintain quality of water supply;
 - Maintenance of flow paths/redistribution of water where diverted;
 - Implementation of pollution control measures; and
 - Demarcation of the most sensitive habitat areas identified in ecological surveying, and monitoring of works in close proximity by the Ecological Clerk of Works (ECoW).

Annex 1: GWDTE Assessment Maps

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Legend

Site Boundary

Turbine Layout

Indicative Floating Track Centreline

Indicative Track Centreline

Borrow Pit Search Area

Indicative Construction Compound

Turbine Hardstand (Permanent)

Indicative Substation and BESS

Watercourse

Target Notes

GWDTE

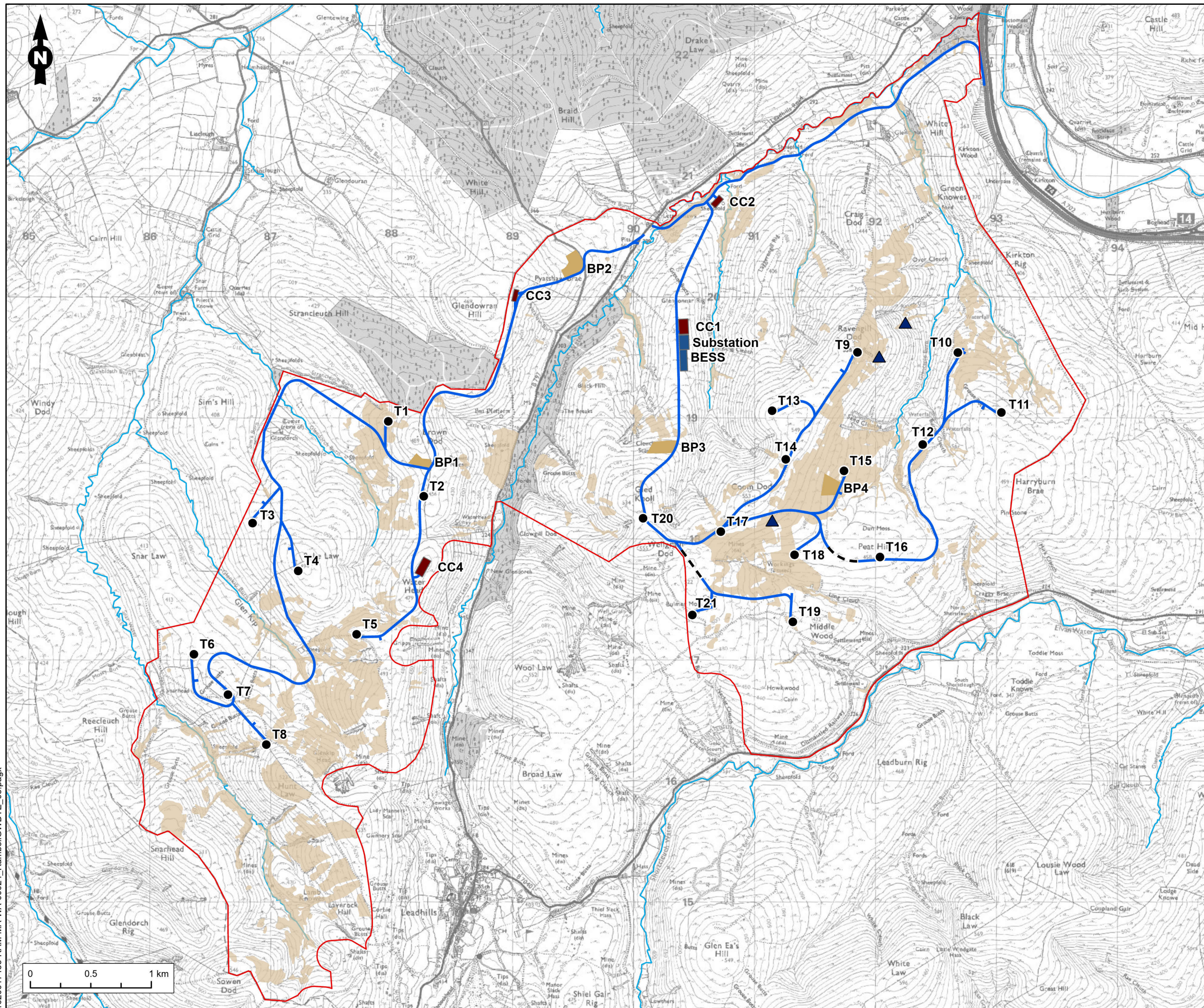
Non-Dominant

Sub-Dominant

Dominant

Figure Title		
NVC GWDTE Classification		
Project Name		
Ravengill Energy Park		
Project No./Filyery ID		
1620017435 / REH2024N04129		
Date	Figure No.	Revision
April 2026	8.2.1	1.0
Prepared By	Scale	
MH/LM	1:30,000 @A3	
Client		
Ravengill Energy Park Limited		
RAMBOLL		

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Legend

Site Boundary

Turbine Layout

Indicative Floating Track Centreline

Indicative Track Centreline

Borrow Pit Search Area

Indicative Construction Compound

Turbine Hardstand (Permanent)

Indicative Substation and BESS

Watercourse

Target Notes

Ramboll GWDTE

Non-Dominant

Figure Title		
Ramboll GWDTE Classification		
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1620017435 / REH2024N04129		
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Ravengill Energy Park Limited		
RAMBOLL		