Corriemoillie BESS
Groundwater Dependent Terrestrial Ecosystem Assessment Report

for

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Groundwater Dependent Terrestrial Ecosystem Assessment Report
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1 Introduction

Fluid Environmental Consulting (Fluid) were commissioned by TNEI to complete a groundwater dependent terrestrial ecosystem (GTWDE) assessment for the proposed Battery Energy Storage System (BESS) of up to 200 MW with associated infrastructure (including cable route to substation), access and ancillary works (including landscaping and biodiversity enhancement). (the 'Proposed Development). The site (herein referred to as the Site) is situated approximately 5 km north west of the village of Garve in the Highlands, Ross-shire, Scotland.

GWDTEs are protected environments under Water Framework Directive (WFD) legislation and assessments are regulated by SEPA. This assessment has been undertaken due to the presence of several mapped diffuse drainage lines and habitats within the proximity of the Proposed Development, identified during habitat mapping surveys and with the potential of being groundwater dependent (GWD).

1.1 Site Description

The site is presented on **Figure 1**. The Proposed Development is located on a gentle south facing slope between 140 and 170 m above ordnance datum (AOD). An unnamed tributary of the Allt Coire Mhuilidh lies close to the southern boundary of the BESS footprint, draining to the south east. Sections of track exist to the west of the site, crossing the Allt Coire Mhuilidh, connecting to the existing substation around 200 m south west of the site and continuing south east to the A832 public road. The site boundary encompasses the BESS area, the cable route to the substation and the existing track to the public highway along with all landscaping and associated infrastructure.

Vegetation cover on the site is largely comprised of coniferous planted woodland with areas of wet heath within the forest rides and acid grassland at track margins in the west of the site. Small patches of scots pine woodland and upland birch woods are present in the south east of the site adjacent to the watercourse.

Several artificial drainage ditches have been mapped throughout the site, located within forest rides and as trackside drainage.

1.2 Objectives

The objectives of the assessment are:

- to provide a summary of the geological and hydrogeological setting of the Site and conceptualisation of the hydrogeology; and
- to complete a preliminary assessment of the National Vegetation Classification (NVC) habitats that are potentially groundwater dependent to determine the likelihood of actual groundwater dependence and therefore if they could be a constraint to development.

2 Hydrogeological Setting

2.1 Geology

The British Geological Survey (BGS) mapping of bedrock indicates that the underlying geology of the site is comprised entirely of Crom Psammite Formation psammite, an originally sedimentary bedrock that has since undergone metamorphism.

The BGS superficial geology mapping is presented on **Figure 2**. The majority of the site is underlain by glacial deposits comprised of diamicton till, gravel, sand and silt, with alluvial deposits within the watercourse valley of the unnamed tributary to the Allt Coire Mhuillidh to the south of the proposed development. An area of peat deposits lies beyond the south east boundary of the site.

There are no recorded geological faults within the vicinity of the site.

2.2 Borehole Records

Four borehole records are located within the Site, undertaken by Curtins Consulting Ltd. as part of some initial ground investigation of the proposed development. Boreholes at all locations recorded groundwater strikes at depths ranging from 0.40 m to 0.80 m below ground level (bgl).

Superficial deposits encountered during the ground investigation include peat at one location, with traces of peat at one further location and layers of sand and gravel of varying granularity and composition. Silt content was noted at all locations and clay content at one borehole location. These are likely to be glacial deposits which will be heterogenous both in composition and permeability.

All groundwater strikes occurred within the superficial layer with the borehole stopping on encountering solid obstruction from large cobbles, boulders or the bedrock layer. Obstructions were recorded at depths ranging from 0.70 m to 5.70 m bgl.

In addition to these borehole records, a geoenvironmental and geotechnical desk study undertaken by Gavin and Doherty Geosolutions Ltd. identified three potential groundwater abstraction borehole locations within 250 m of the site boundary.

This suggests the presence of perched groundwater within sand and gravel layers which is unlikely to have any substantial extent being limited by the thickness, composition and sorting of the superficial layer. This is discussed further in Section 3.2 below.

2.3 Hydrogeological Regime

The psammite bedrock underlying the entirety of the site is a relatively impermeable bedrock, described in the BGS Hydrogeological Map of Scotland as class 2c low productivity aquifer. Groundwater is only likely to be present in small quantities in the near-surface weathered zone of the bedrock, with virtually all groundwater flow occurring through fractures and other discontinuities in the bedrock.

The glacial and alluvial deposits however have the potential to form moderately productive aquifers. Their permeability is determined largely by their composition, with high proportions of sand and gravel increasing permeability, and clay, silt and diamicton till decreasing permeability and productivity as an aquifer.

All of the site investigation boreholes noted sand and gravel layers of varying composition, silt and clay content and thickness, as well as the presence of some shallow groundwater within this layer.

This suggest there is a degree of compartmentalisation occurring, with rainfall and surface water infiltrating the superficial deposits and accumulating in area of higher permeability above the impermeable bedrock. The extent of this aquifer is limited by the thickness of the superficial geology and impermeable bedrock.

3 Methodology

3.1 Identification of Areas of Potential Groundwater Dependency

A UK habitat classification (UKHab) survey for the whole Site has been completed by Sweco UK Ltd (Sweco). A total of nine habitat types were identified within the site boundary, as well sixteen diffuse drainage line point features. As part of this survey potentially groundwater dependent habitats were preliminarily identified based on their floristic composition and identified to National Vegetation Survey (NVC) level.

The data from these surveys was provided as a shapefile dataset containing habitat polygons covering the extent of the site, target notes and diffuse drainage line point features. In addition, several drainage ditches were mapped and provided in shapefile format; these have been included in Figures 1 and 2.

Potentially GWD habitats were reviewed in accordance with Land Use Planning System SEPA Guidance Note 31[1], which presents the NVC categories to be considered. Of the habitat polygons identified in the UKHab survey, only one habitat type was considered to correspond to an NVC category considered potentially GWD under the SEPA guidance: h1a7 – wet heathland with cross-leaved heath, upland (H4010). This was determined to correspond to NVC community M15 - *Scirpus cespitosus – Erica tetralix* wet heath, classified as potentially moderately GWD under the SEPA guidance.

In addition to the UKHab mapped polygons, the habitat survey identified sixteen diffuse drainage line point features. These were identified to NVC level and determined to be NVC

[1] Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems, Land Use Planning System Guidance Note 31 (LUPS-GU31), version 3 (SEPA, 2017)

community M15a - Car*ex panicea* sub-community of M15, classified as potentially moderately GWD under the LUPS guidance.

This resulted in a total of fifteen moderate potential GWDTE polygons and sixteen moderate diffuse drainage line point features.

This report therefore provides an assessment of groundwater dependency of each polygon and point feature that is considered to be potentially groundwater-dependent based on the geological, hydrogeological and topographical setting.

3.2 Rationale

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'[2] 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 site is underlain by a low productivity aquifer where virtually all flow is through the weather 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 superficial deposits across the majority of the site are either glacial deposits comprising glacial till, sand, gravel and silt or alluvium deposits along the watercourse comprising sand, gravel or silt. Alluvium deposits are considered moderate to highly productive aquifers depending on composition. Glacial deposits may also be considered moderately productive aquifers depending on their composition.

[2] WFD66: Wetland Hydrogeomorphic Classification for Scotland. Project Report. (SNIFFER (Scotland and Northern Ireland Forum for Environmental Research), 2007)

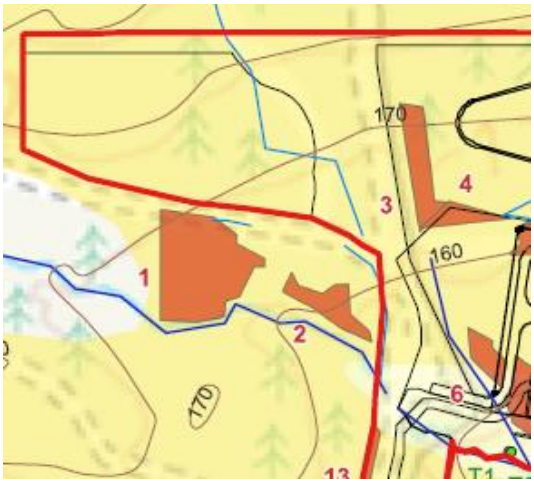
The hydrogeological setting therefore suggests that any potential GWDTE underlain by alluvial or glacial superficial deposits should be considered as having a low to moderate likelihood of dependency.

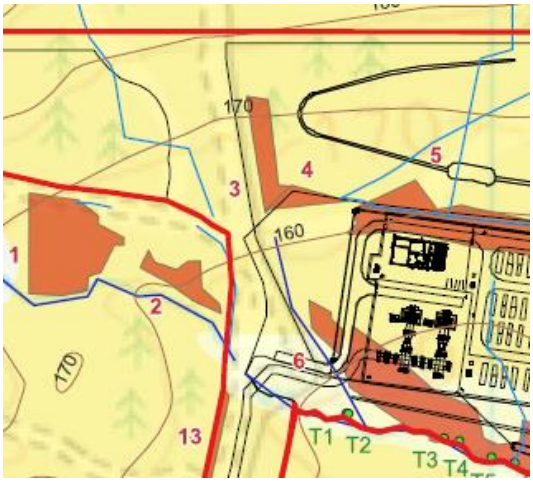
The locations of the diffuse drainage line features imply the potential for a higher likelihood of groundwater dependency; considered in the hydrogeological context of the site many of these features have the potential to have some degree of shallow groundwater input. In order to be truly GWD, SEPA LUPS Guidance Note 31 states that M15a habitats lie within the category that "may be considered GWDTE only in certain hydrogeological settings".' To be considered GWD these features therefore need to have a clear topographical mechanism of discharge and lack of significant surface water or rainfall input. In such cases the mapped diffuse drainage lines may be considered groundwater flush features rather than diffuse surface water drainage.

4 GWDTE Assessment

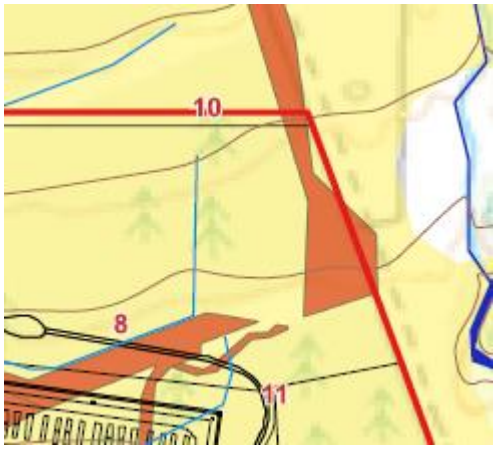
The following table provides an assessment of each of the habitats within the proximity of the Proposed Development infrastructure that are potentially groundwater-dependent, identifies whether they are actually GWD and if so, if they are actually connected to the development. These habitats are presented on **Figure 2.**

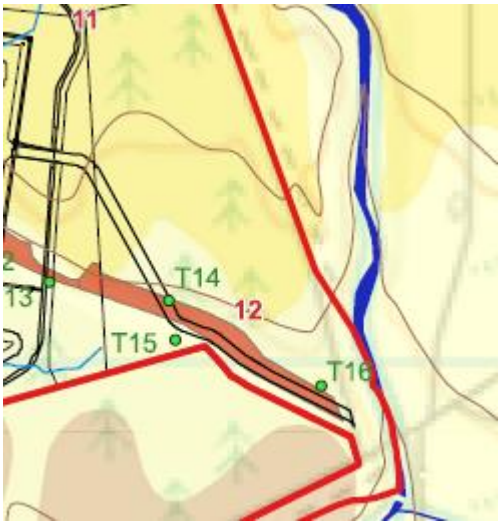
Table 1 Assessment of Potential GWDTEs within Infrastructure Proximity

NVC or Target Note Area	GWDTE Assessment
Areas 1 and 2 	NVC Category: M15 - *Scirpus cespitosus – Erica tetralix* wet heath LUPS Classification: Potentially Moderately Groundwater Dependent Assessment: These habitats lie on the northern banks of the unnamed tributary to the Allt Coire Mhuilidh. They are bounded by the existing track to the north and east as well as drainage ditches mapped during the habitat survey. They are likely fed predominantly by surface water run off gathering here due to the local topography with further surface water input from the watercourse itself and are therefore unlikely to be GWD.

NVC or Target Note Area	GWDTE Assessment
Areas 3 and 4 	NVC Category: M15 - *Scirpus cespitosus – Erica tetralix* wet heath LUPS Classification: Potentially Moderately Groundwater Dependent Assessment: Area 3 is situated directly east of and parallel to the existing track and fence line, within a shallow topographical depression. Area 3 is likely surface water fed, with water accumulating here due to local topography and presence of the existing track and fence line and therefore is not considered to be GWD. Area 3 is directly connected to area 4 immediately downgradient. Area 4 has clear surface water input from the mapped drainage ditch as well as from area 3, and is therefore not likely to be GWD.
Area 5 	NVC Category: M15 - *Scirpus cespitosus – Erica tetralix* wet heath LUPS Classification: Potentially Moderately Groundwater Dependent Assessment: Area 5 is associated with a forest ride and follows a drainage line. There is likely significant surface water input from the drain itself and additional surface water run-off from the above slopes accumulating within the forest ride. It is therefore not considered to be GWD.

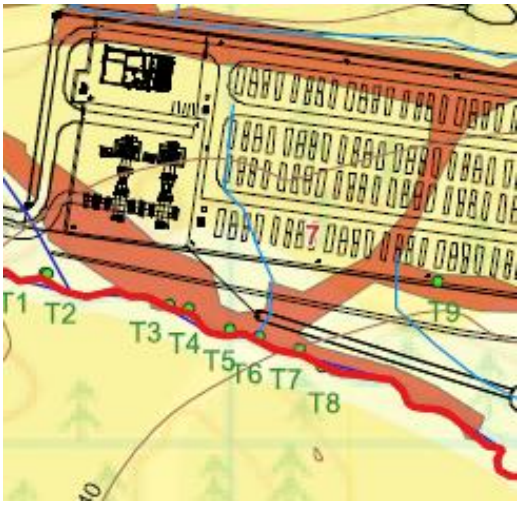
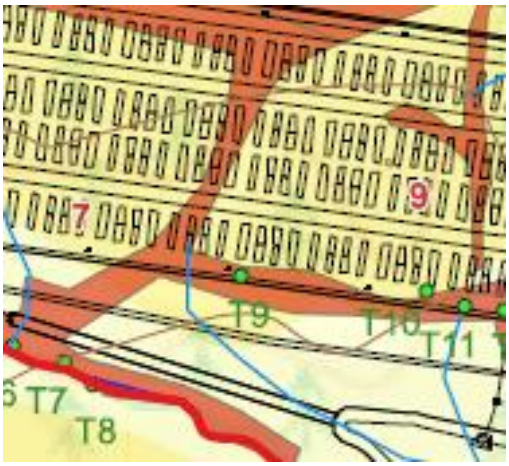
NVC or Target Note Area	GWDTE Assessment
Area 6  	NVC Category: M15 - *Scirpus cespitosus – Erica tetralix* wet heath LUPS Classification: Potentially Moderately Groundwater Dependent Assessment: Area 6 lies immediately downgradient of forestry and is bounded by a drain to the west and ATV track shown on aerial photography to the east. It is likely dependent on surface water run-off from forestry to the north accumulating here due to local topography and the presence of the surface water drain.
Areas 7 and 8  	NVC Category: M15 - *Scirpus cespitosus – Erica tetralix* wet heath LUPS Classification: Potentially Moderately Groundwater Dependent Assessment: Areas 7 and 8 are associated with forest rides following a south westerly drainage line. They are likely dependent on surface water discharge from forestry drains accumulating within the rides and within the lower topography of the watercourse valley. They are therefore not considered to be GWD.

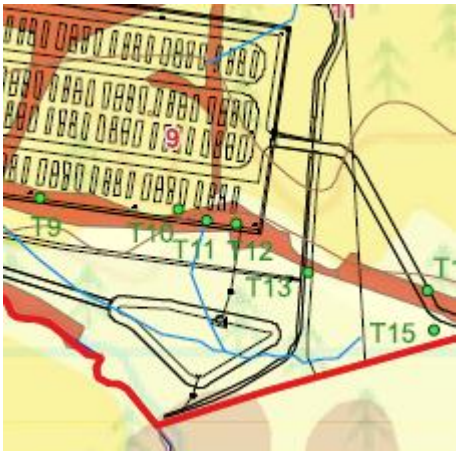
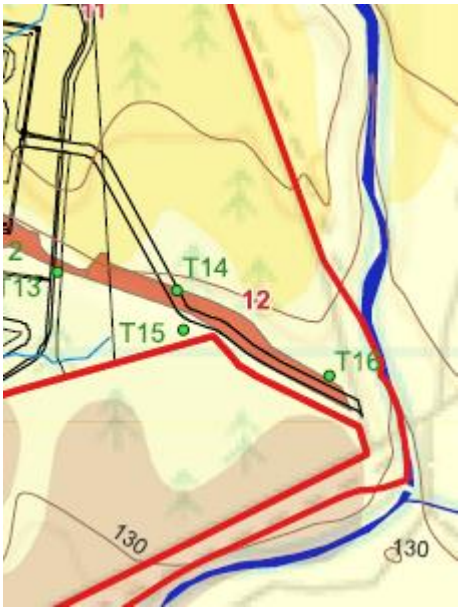
NVC or Target Note Area	GWDTE Assessment
Area 9  	NVC Category: NVC Category: M15 - *Scirpus cespitosus – Erica tetralix* wet heath LUPS Classification: Potentially Moderately Groundwater Dependent Assessment: Area 9 is associated with a forest ride and surface water drainage within a narrow valley feature. Surface water run-off will be directed here from the surrounding forestry and also various drains and is therefore not likely to be GWD.
Area 10  	NVC Category: M15 - *Scirpus cespitosus – Erica tetralix* wet heath LUPS Classification: Potentially Moderately Groundwater Dependent Assessment: Area 10 is located upgradient of any planned infrastructure activities and therefore will not by hydrologically affected by the proposed development.

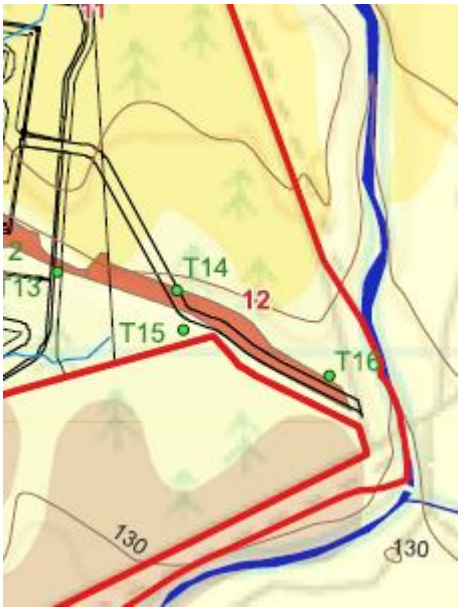
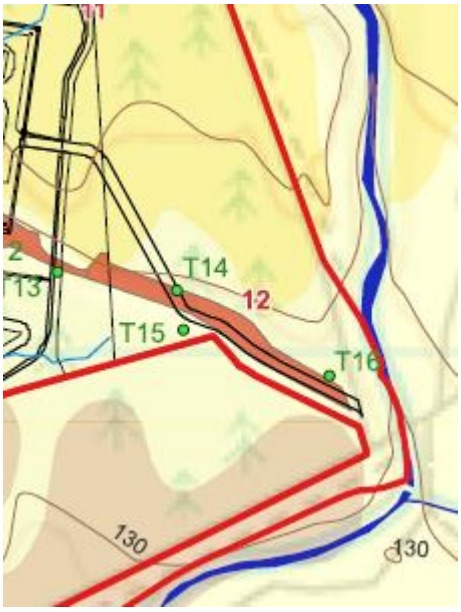
NVC or Target Note Area	GWDTE Assessment
Area 11  	NVC Category: M15 - *Scirpus cespitosus – Erica tetralix* wet heath LUPS Classification: Potentially Moderately Groundwater Dependent Assessment: Area 11 is the area immediately surrounding a mapped drainage feature and is therefore likely surface water fed with inputs from the drain itself and surrounding forestry, and therefore not truly GWD.
Area 12  	NVC Category: M15 - *Scirpus cespitosus – Erica tetralix* wet heath LUPS Classification: Potentially Moderately Groundwater Dependent Assessment: Area 12 is associated with a forest ride on the lower part of the slope on which the site is located and therefore likely has a significant surface water input from run-off from the above slopes and drainage discharges accumulating within the ride, and therefore unlikely to be truly GWD.

NVC or Target Note Area	GWDTE Assessment
Area 13 	NVC Category: M15 - *Scirpus cespitosus – Erica tetralix* wet heath LUPS Classification: Potentially Moderately Groundwater Dependent Assessment: Area 13 is a narrow strip of M15 vegetation immediately adjacent to the existing track, and is therefore likely dependent on surface water run-off moving downgradient from the west and accumulating here due to the barrier of the existing track. It is therefore unlikely to be truly GWD.
Area 14 	NVC Category: M15 - *Scirpus cespitosus – Erica tetralix* wet heath LUPS Classification: Potentially Moderately Groundwater Dependent Assessment: This habitat is located at the boundary of the forestry and is likely surface water fed with potential surface water input from the nearby track and drainage network. It is not considered to be GWD.
Area 15 	NVC Category: M15 - *Scirpus cespitosus – Erica tetralix* wet heath LUPS Classification: Potentially Moderately Groundwater Dependent Assessment: This habitat is situated immediately upgradient of the existing substation and contains a mapped drainage ditch. It is considered to be surface water fed with the substation acting as a barrier to flow and causing an accumulation of water in this area. It is therefore unlikely to be supported by any substantial groundwater component.

NVC or Target Note Area	GWDTE Assessment
Target notes T1 and T2 	NVC Category: M15a - *Scirpus cespitosus – Erica tetralix* wet heath - *Carex panicea* sub-community LUPS Classification: Potentially Moderately Groundwater Dependent Assessment: These diffuse drainage lines are located within an area of acid grassland. They are likely fed by surface water and rainfall that has infiltrated the superficial layer above the bedrock, exiting to the surface on the bank of the mapped watercourse feature where the superficial layer has given way to cobbles at the bank of the watercourse. Although there is potentially some very short residence time groundwater supplying these features the lack of any continuous permeable geological formation means that these are likely to be principally surface water fed. These features are outside of the footprint of the proposed infrastructure.

NVC or Target Note Area	GWDTE Assessment
Target notes T3 – T8  	NVC Category: M15a - *Scirpus cespitosus – Erica tetralix* wet heath - *Carex panicea* sub-community LUPS Classification: Potentially Moderately Groundwater Dependent Assessment: These diffuse drainage lines are located on the northern bank of the unnamed tributary of the Allt Coire Mhuillidh. They are likely fed by a combination of a) surface water and rainfall that has infiltrated the superficial layer above the bedrock in the immediate surrounding area and discharging on the bank of the watercourse feature where there may be slightly lower permeability deposits, and b) surface water runoff. Surface water moving downgradient via the ride of Area 7 as well as the mapped drainage ditch is likely providing further surface water input to diffuse drainage lines T6 to T8. These habitats are therefore unlikely to be truly GWD given the lack of a body of groundwater that would be able to sustain them. These features are outside of the footprint of the proposed infrastructure.
Target note T9  	NVC Category: M15a - *Scirpus cespitosus – Erica tetralix wet* heath - *Carex panicea* sub-community LUPS Classification: Potentially Moderately Groundwater Dependent Assessment: Target note T9 is situated within a forest ride and is likely dependent on surface run-off from the upgradient forestry as well as infiltrated rainfall within the shallow superficial layer above the bedrock. It is unlikely to have a substantial groundwater component due to the lack of a body of groundwater that would be able to sustain the flow to the habitat.

NVC or Target Note Area	GWDTE Assessment
Target notes T10 – T13  	NVC Category: M15a - *Scirpus cespitosus – Erica tetralix* wet heath - *Carex panicea* sub-community LUPS Classification: Potentially Moderately Groundwater Dependent Assessment: Diffuse drainage lines T10 to T13 are situated within a forest ride and are considered to rely on surface run-off from the upgradient forestry as well as infiltrated rainfall within the shallow superficial layer above the bedrock. They are unlikely to have a substantial groundwater component due to the lack of a body of groundwater that would be able to sustain the flow to the habitat and the larger surface water input.
Target note T14  	NVC Category: M15a - *Scirpus cespitosus – Erica tetralix* wet heath - *Carex panicea* sub-community LUPS Classification: Potentially Moderately Groundwater Dependent Assessment: Target note T14 is situated within a forest ride and is likely dependent on surface run-off from the upgradient forestry as well as infiltrated rainfall within the shallow superficial layer above the bedrock. It is unlikely to have a substantial groundwater component due to the lack of a body of groundwater that would be able to sustain the flow to the habitat.

NVC or Target Note Area	GWDTE Assessment
Target note T15 	NVC Category: M15a - *Scirpus cespitosus – Erica tetralix* wet heath - *Carex panicea* sub-community LUPS Classification: Potentially Moderately Groundwater Dependent Assessment: Target note T15 is situated at the discharge point of a mapped drain associated with the forestry within the BESS infrastructure. It is therefore likely surface water fed and not GWD.
Target note T16 	NVC Category: M15a - Scirpus cespitosus – Erica tetralix wet heath - Carex panicea sub-community LUPS Classification: Potentially Moderately Groundwater Dependent Assessment: Target note T16 is situated within a forest ride and is likely dependent on surface run-off from the upgradient forestry as well as infiltrated rainfall within the shallow superficial layer above the bedrock. It is not considered to have a substantial groundwater component due to the lack of a body of groundwater that would be able to sustain the flow to the habitat.

Note: As per Figure 2: Red line – site boundary; red = potentially moderately GWD polygon, green points = potentially GWD point feature.

5 Discussion

The assessment of each potential GWDTE has considered the hydrological/hydrogeological setting and the likely influence considering topography, geology and existing infrastructure.

The low productivity of the underlying bedrock and limited extent of any lenses or pockets of moderately productive more permeable deposits across the site means that substantial groundwater dependence is unlikely for the 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.

The ground investigation identified minor groundwater presence within the superficial geology where layers of sand and gravel are present which can contain minor amount of groundwater above the bedrock. These layers are relatively limited in thickness and lateral extent and therefore are highly unlikely to support large areas of habitat within the hydrogeological context of the site; however, they may provide some groundwater input to many of the potentially GWD habitats mapped within the site including the diffuse drainage lines.

The review of each habitat area and diffuse drainage line point feature has identified that surface water inputs are the main component upon which they are dependent. Although groundwater will likely provide some input into some, if not all, of these, it is considered limited and therefore none are likely to be GWD.

It is recognised that the groundwater within the superficial deposits is likely to be comprised of locally infiltrated surface water and rainfall input, and therefore due to its shallow depth and short residence times there is unlikely to be any significant difference in mineral content between this shallow groundwater and the surface water.

This is reflected in observations recorded during the habitat survey, with the recorded M15a habitats noted as lacking some of the species that are typically present due to heavy modification of the habitat within forest rides. Whilst M15 is an Annex I priority peatland habitat, this habitat is common in the region and in the area surrounding the site. Given the heavily modified context of the M15/M15a habitat on site, the restoration of wet heathland in offsite areas will compensate for the loss of this habitat on site in terms of biodiversity.

The assessment therefore considers that there are unlikely to be any significant effects on any of the potentially groundwater dependent habitats outside of the infrastructure footprint due to these habitats being predominantly rain water or surface water fed. Those within the infrastructure footprint will be lost however, these are also not considered to be GWD and therefore the loss of these habitats will be assessed within the ecology report.

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

- 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.
- If more diffuse zones are crossed a series of small culverts to promote hydrological continuity are recommended.

Figures

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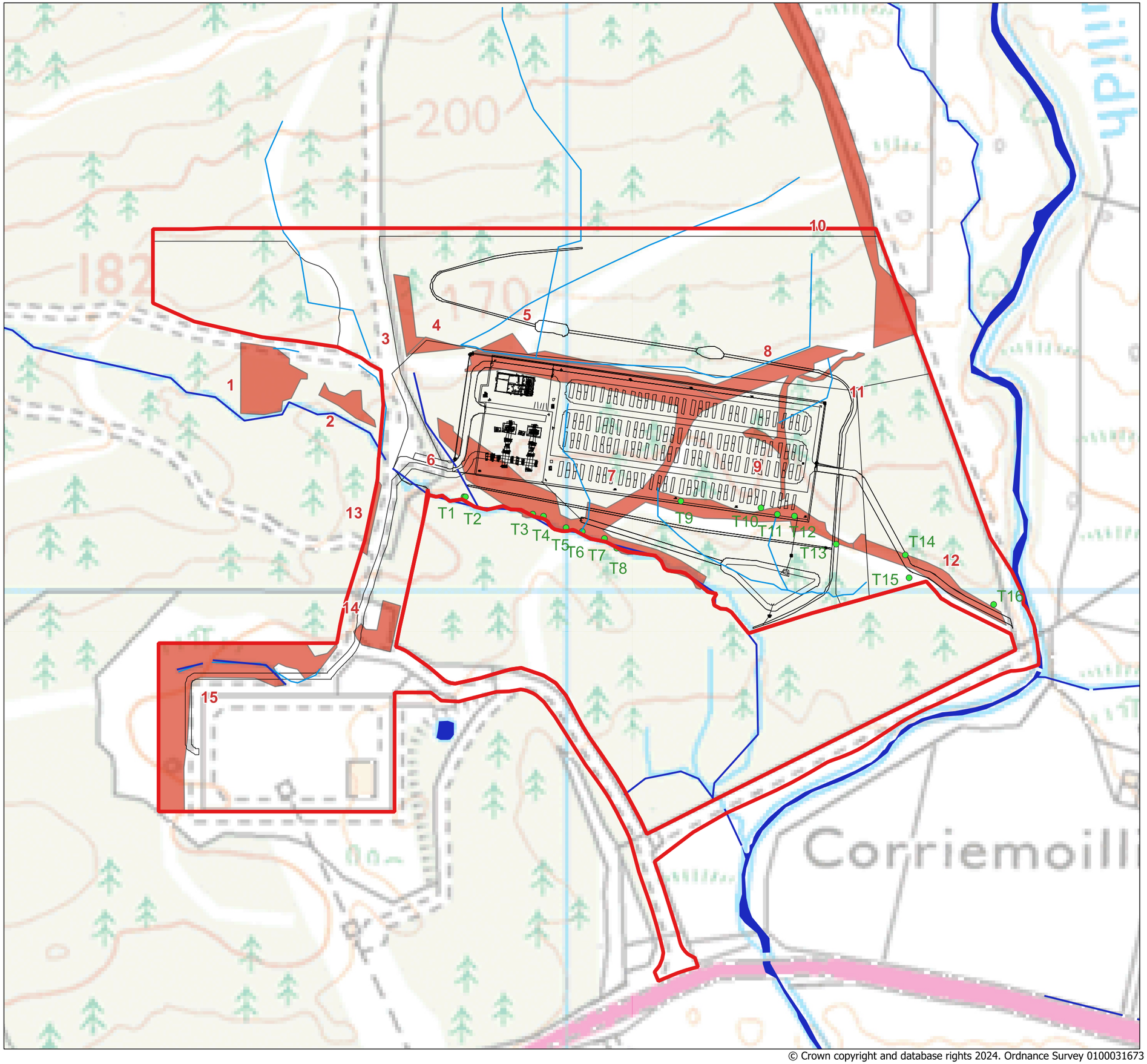

Key:

- Site Layout
- Site Boundary

Hydrology

- Watercourse
- Drainage ditch (UKHab survey)
- Surface water body

Potential GWDTE

- Potential GWDTE
- Target note, potentially GWD

0 50 100 150 200 m

PROJECT

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SCALE

1: 3,000 @ A3

FIGURE 1

Hydrological Setting

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Drawn by: JM Date: 10/10/2024

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Key:

- Site Layout
- Site Boundary

Hydrology

- Watercourse
- Drainage ditch (UKHab survey)
- Surface water body

Superficial Geology

- Alluvium - clay, silt, sand and gravel
- Glacial deposits - diamicton, gravel, sand and silt
- Peat

Potential GWDTE

- Potential GWDTE
- Target note, potentially GWD

0 50 100 150 200 m

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SCALE

1: 3,000 @ A3

FIGURE 2

Potential GWDTEs

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Drawn by: JM Date: 10/10/2024