

**ScottishPower Renewables**

# **Earraghail Renewable Energy Development: Groundwater Dependent Terrestrial Ecosystems Assessment**

Technical Appendix 10.4

**FEBRUARY 2022**





## RSK GENERAL NOTES

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# 1 INTRODUCTION

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- 1.1 This report provides a Groundwater-Dependent Terrestrial Ecosystem (GWDTE) Assessment for Earraghail Renewable Energy Development (‘the proposed Development’) and associated infrastructure.
- 1.2 The report forms a Technical Appendix to the Environmental Impact Assessment (EIA) Report for the proposed Development and should be read in conjunction with this document. It has been produced in response to concerns over development in areas with, or that have potential to affect, sensitive groundwater-dependent habitats raised by NatureScot and the Scottish Environment Protection Agency (SEPA).
- 1.3 GWDTE are protected under the Water Framework Directive and are potentially sensitive receptors to the impacts of development. This report describes the potentially groundwater-dependent habitats present at the Site and identifies and assesses the potential effects that may be caused to these habitats by the proposed Development. Design and mitigation methods to avoid or minimise these risks are set out, along with a number of good construction practices that would be employed during all site works.

## **Location**

- 1.4 The Site is between the village of Tarbert, to the north east, and the village of Skipness, to the south, situated within the northern part of Kintyre Peninsula in Argyll & Bute council and administrative area – centred on National Grid Reference (NGR) NR 88732 63637. The Site is owned by Forestry and Land Scotland (FLS). The Site lies primarily within the Corranbuie and Skipness coniferous woodland plantations and is located within an area of carbon-rich soils. The Site area is 1,455 hectares (ha) in total and the current land use is classified as primarily forestry with some moorland.
- 1.5 The topography of the Site is variable and undulating and is dictated by seven small hills within the forested areas. Between the hills, the land is generally less than 14 % slope, with the exception of some land in the north Corranbuie forest area and throughout the south west of the Skipness forest area.

## **Development proposals**

- 1.6 The proposed Development includes the following key elements:
- 13 wind turbines, up to 180 m to blade tip, including foundations and aviation lighting;
  - ground mounted solar arrays;
  - BESS units;
  - crane hardstandings for wind turbine installation;
  - transformer/switchgear housings located adjacent to turbines & solar arrays;
  - new (10.4 km) and upgraded (12.9 km) access tracks including watercourse crossings where necessary, passing places and turning heads;
  - underground electrical cabling;
  - compound containing substation, control building and BESS;

- one main site construction and maintenance compound and a security compound;
- a permanent lattice construction meteorological mast, up to 105 m high;
- health & safety and other directional site signage;
- search areas for three new borrow pit areas; and
- additional development components to improve the overall ecological, environmental and social benefits accruing from the proposed Development, as follows:
  - ecological and environmental: peatland restoration; habitat improvement; native woodland planting
  - social: proposed new walking bothy on the Kintyre Way; circular walking route and viewpoint near Tarbert.

1.7 Full details of the project design are provided in **Chapter 3** of the EIA Report.

### **Aims**

1.8 This report aims to undertake a review of available relevant site information, including all habitat and vegetation data and hydrogeological details, in order to provide an assessment of the risk to groundwater-dependent habitats. Recommendations will be made for mitigation measures and specific construction methods that should be implemented in order to minimise the risk of disturbance or damage to sensitive habitats during construction works and ongoing site operations.

### **Assessment method**

1.9 The assessment has involved the following stages:

- Desk study;
- Vegetation mapping;
- Hydrogeological assessment;
- Detailed assessment of sensitive habitats; and
- Identification of protection and mitigation measures.

## 2 DESK STUDY

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### Information sources

- 2.1 The desk study involved a review of available relevant information sources on the ground conditions at the Site. Information sources included:
- Ordnance Survey mapping at 1:50,000, 1:25,000 and VectorMap Local raster mapping, Terrain 50 digital terrain model contours and OpenData mapping;
  - Ordnance Survey MasterMap high-resolution orthorectified aerial imagery;
  - British Geological Survey online geological mapping, 1:50,000 scale;
  - Scotland's Soils digital soil mapping, 1:250,000 scale;
  - Flood Estimation Handbook Web Service;
  - Data provided by the client, including turbine foundation and track design specifications; and
  - Archive and extensive site data held by RSK Group.

### Climate and topography

- 2.2 The proposed Development is located on the Kintyre peninsula on the west coast of Scotland, within the UK Meteorological (Met.) Office's Western Scotland regional climatic area. Much of Western Scotland is exposed to the rain-bearing westerly winds, particularly areas along the west coast. Although in the more western part of the region, proposed Development lies to the east of the islands of Islay and Jura, affording it some ground-level protection from the westerly winds.
- 2.3 Average annual rainfall for the Site catchments varies between 1,707 mm and 2,015 mm (CEH, 2021), reflecting the elevation and slope aspect of the catchments. Average annual rainfall for the climate monitoring station at Campbeltown Airport, Machrihanish, is 1,226.2 mm, and for the monitoring station at Rothesay, Isle of Bute, is 1,455.2 mm.
- 2.4 Local topography is variable and undulating, with cliffs along the north-east coast of the Kintyre peninsula. The study area is located across a dissected plateau surrounded by sloping ground to lower areas and the coast. The main plateau area is characterised by a series of notable hills with summits between 237 and 377 m AOD, and a large number of smaller rocky hills, with a distinctive north-east to south-west lineation visible in aerial imagery. Between the hills, the land is generally less than 14 % slope, with the exception of some land in the north of the Corranbuie forest area and throughout the south west of the Skipness forest area.
- 2.5 The north eastern margin of the plateau area falls off steeply to the coastline. The slope is relatively smooth with numerous small watercourses providing drainage to this section. Slopes in the north-western and southern margins are comparatively steep. The south-western margin of the study area is less clearly defined, as the plateau area continues beyond this area. Part of the south-western margin, in the southern part of the study area, contains steep slopes in the section around the Skipness River valley.

## Geology

- 2.6 Geological information is derived from the BGS GeoIndex online geological mapping (BGS, 2021a) and BGS map sheets Sound of Gigha (Sheet 20 and part of 21W) and Kilfinan (Sheet 29W and part of 21W) (BGS, 1996; 2000).

### *Bedrock geology*

- 2.7 The Site is underlain by bedrock from the Beinn Bheula Schist Formation, part of the Southern Highland Group of the Dalradian Supergroup, of Pre-Cambrian age. This formation is described as 'psammite, quartzose to micaceous, locally gritty, with phyllitic semipelite'.
- 2.8 Two sets of dykes are mapped within the Site. One set cuts roughly east-west and forms part of the Central Scotland Late Carboniferous Tholeiitic Dyke Swarm and is characterised by quartz dolerite or quartz microgabbro. A younger set cuts roughly north west to south east and forms part of the Mull Dyke Swarm from the North Britain Palaeogene Dyke Suite, consisting of olivine microgabbro.
- 2.9 The Site lies across the Cowal Antiform, a major regional up-fold structure. The fold axis crosses the Site with a north-east to south-west orientation. A number of minor inferred faults and slides are indicated on the geological mapping. These form two sets, oriented north-east to south west and north west to south east. The area is largely without significant fault displacement.

### *Superficial geology*

- 2.10 Significant superficial deposits are not shown to be present across the majority of the Site.
- 2.11 The Skipness River valley is indicated to have deposits of diamicton till. This is a highly variable glacial sediment consisting of unsorted material ranging in size from clay to boulders, usually with a matrix of clay to sand.
- 2.12 Some coastal sections are indicated to have raised marine beach deposits formed from sand and gravel. These are confined to isolated very narrow strips along the eastern coastline.

## Soils and peat

- 2.13 The Soil Survey of Scotland digital soils mapping (James Hutton Institute, 1981) shows four soil types within the Site. Extensive blanket peat is not identified within the Site, although almost all the Site is overlain by peaty gleys with peat and peaty podzols as secondary soils. Brown forest soils are present along the eastern coastal section.
- 2.14 Several phases of peat depth surveying have been undertaken by RSK in March 2020, May 2020, August 2020, and April 2021. Details are provided in Technical Appendix 10.1.

## Hydrogeology

- 2.15 The Dalradian schists, psammites and semi-pelites present in the area are generally classed as a very low productivity aquifer. This means that natural groundwater flow within the site bedrock is limited. Groundwater flow is concentrated principally within the near-surface weathered zone, which typically extends to around 1-2 m below ground



surface. Groundwater storage and flow at deeper levels requires the presence of a network of fractures within the bedrock, which are infrequent and often isolated in these strata.

- 2.16 Regional groundwater flow will tend to mimic the natural topography, flowing north and east in the northern part of the Site and south and east in the southern part. It is likely that natural groundwater discharges will be partly via small flows to springs and streams on the hill slope, but principally to the sea.
- 2.17 Peat bodies will also hold some groundwater, although peaty gleys are known to have poor and impeded drainage. Flow within peat is extremely slow, although it can contribute some limited baseflow to local burns.

### **Hydrology**

- 2.18 The Site is located across the catchment areas for three main watercourses, plus approximately 20 smaller watercourses which provide drainage along the eastern side of the study area.
- 2.19 The three main watercourses that provide drainage to the study area are the Skipness River, the Bardaravine River and the Allt Achachoish. The minor watercourses all drain east directly to sea.
- 2.20 The Skipness River drains the southern part of the study area and the vast majority of the Site, flowing broadly south-south west into the Kilbrannan Sound at Skipness.
- 2.21 The Bardaravine River drains the central part of the study area and flows mainly west into West Loch Tarbert. The Abhainn Achachoish drains the north westernmost part of the study area broadly south west, also into West Loch Tarbert.
- 2.22 The Catchment Wetness Index, PROPWET, for the three main study area catchments are all 0.660, indicating the soils within the study area are wet for 66 % of the time. The area has a relatively low Baseflow Index, indicating that groundwater contribution is of limited importance to study area watercourses. The Standard Percentage Runoff is relatively high, indicating that 50-55 % of study area rainfall is converted into surface runoff from rainfall events. Catchment statistics are derived from the Flood Estimation Handbook Web Service (CEH, 2021).

### **Groundwater abstractions**

- 2.23 Six private water supplies located within 2 km of the application boundary are identified as having a groundwater source, either springs or boreholes. There are no confirmed groundwater abstractions within the application boundary.

### 3 VEGETATION AND GROUNDWATER DEPENDENCY

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3.1 Groundwater-dependent terrestrial ecosystems (GWDTE) are defined by the UKTAG (2004) as:

*“A terrestrial ecosystem of importance at Member State level that is directly dependent on the water level in or flow of water from a groundwater body (that is, in or from the saturated zone). Such an ecosystem may also be dependent on the concentrations of substances (and potential pollutants) within that groundwater body, but there must be a direct hydraulic connection with the groundwater body.”*

3.2 In line with the guidance provided in UKTAG (2004), a dual approach to identifying GWDTE has been used. This involves detailed study of vegetation communities in order to determine the potential level of groundwater dependency, combined with detailed hydrogeological study in order to identify locations where groundwater reaches the surface and is able therefore to provide a source of water to associated habitats.

3.3 Determination of complete groundwater dependency is complicated by the ability of many vegetation communities to use whatever source of water is available. In some topographical and hydrogeological conditions, a particular community can be groundwater-dependent whereas in others the same community is surface water-dependent. Seasonal patterns of water use provide an additional level of complexity, with groundwater reliance typically being greater in the summer when rainfall and surface water are less available (Isherwood, 2013).

#### Vegetation mapping

3.4 The site vegetation has been surveyed using the National Vegetation Classification (NVC) survey method and is reported in full in Chapter 6, with NVC mapping provided in **Figure 6.3**. The key elements relating to groundwater dependency are summarised below.

3.5 NVC communities identified by SEPA as potentially highly or moderately groundwater-dependent, depending on the hydrogeological setting, are listed in SEPA’s publications *“Planning advice on on-shore windfarm developments”* (SEPA, 2017a) and *“Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems”* (SEPA, 2017b). Within the Site the potentially groundwater-dependent NVC communities identified are:

- M23 – *Juncus effusus/acutiflorus* – *Galium palustre* rush-pasture;
- M25 – *Molinia caerulea* – *Potentilla erecta* mire.

3.6 The list of NVC communities provided in the updated annex to UKTAG (2004) (UKTAG, 2009) indicates that M23 has a moderate groundwater dependency, and M25 has a low groundwater dependency, in Scottish situations.

## 4 DETAILED ASSESSMENT

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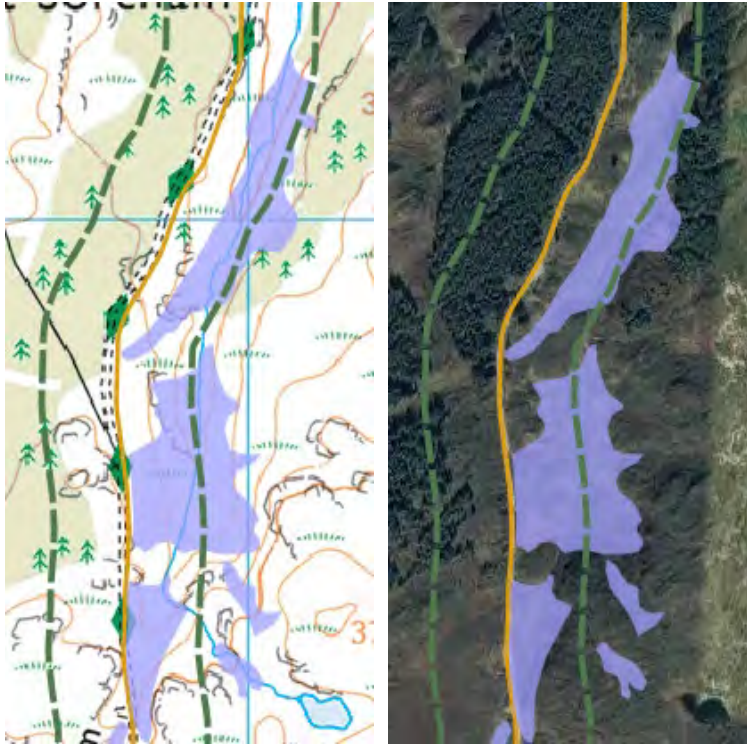
- 4.1 The study area, which comprises the application boundary plus a 250 m buffer zone around this, has been inspected to identify areas of M23 and M25 habitat that require assessment.
- 4.2 Detailed consideration is required for sensitive habitats that lie within 100 m of access tracks or within 250 m of excavations such as turbine foundations and borrow pits (SEPA, 2017). The combined infrastructure buffer is provided as a green dashed line in the figures below, for reference purposes. An overview map of the study area is provided in **Figure 10.4.1**.

### Conceptual Site Model

- 4.3 SEPA (2017) identifies M25 as a community “... likely to be ... moderately groundwater dependent ... depending on the hydrogeological setting”. The updated UKTAG Annex 1 table (UKTAG, 2009) identified M25 as class 3 (low), where class 1 is highly groundwater-dependent and class 3 is low groundwater-dependency.
- 4.4 SEPA (2017) identifies M23 as “... likely to be ... highly groundwater dependent ... depending on the hydrogeological setting”. The updated UKTAG Annex 1 table (UKTAG, 2009) identified M23 as class 2 (moderate) in Scottish settings.
- 4.5 M23 is considered to be potentially more sensitive than M25.

### Area 1

- 4.6 Area 1 is situated at the northern end of the open area between Skipness and Corranbuie forest areas, to the east of the access track. Three separate areas of M25 mire have been identified within 100 m of the access track, associated with a small valley with a minor unnamed watercourse which flows north, then north east, discharging into Loch Fyne. (**Figure 10.4.A**). Areas of M25 mire within the 100 m buffer around the access road cover an area of approximately 47,600 m<sup>2</sup>, extending north from NGR NR 8786 6430 to NGR NR 8805 6522. An overview of the area is provided in **Figure 10.4.B**.



**Figure 10.4.A: Area 1. M25 mire is shown in purple.**

- 4.7 At the closest point, the mire areas are directly adjacent to the current access track.
- 4.8 The bedrock in this part of the Site is predominantly gritty psammite and pelite of the Beinn Bheula Schist Formation. Superficial deposits are not recorded in the area. The bedrock is a low productivity aquifer with small amounts of groundwater in the near-surface weathered zone and secondary fractures
- 4.9 The proximity of the area of M25 mire to the watercourse channel and access track in this area indicates that the mire is reliant either directly on the watercourse, or on surface drainage from the access track which currently discharges in a number of locations at the top of the slope above the watercourse.
- 4.10 No superficial deposits are shown on geological mapping of the area. The watercourse channel appears to be cut into peat or peaty soils, and peat depth surveys confirmed the variable thicknesses of peat up to 1.2 m. Areas of peat are likely to contain significant amounts of water; however, water flow is generally very slow through peat bodies. Blanket peat is considered to be ombrotrophic (i.e. dependent on rainwater) as the peat itself is usually considered to form a barrier to flow except in areas with significant peat cracking or piping.





**Figure 10.4.B: Photo northwards across Area 1 from NGR NR 8790 6440 showing existing access track and watercourse.**

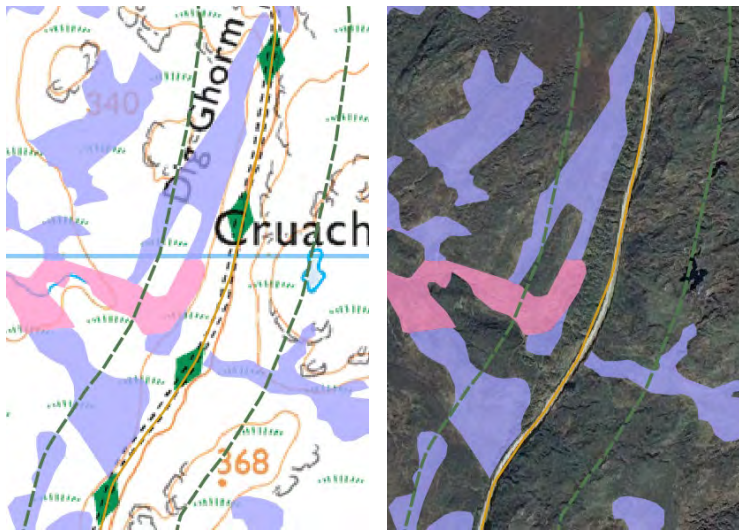
- 4.11 The M25 mire in Area 1 is determined not to be groundwater-dependent as the low productivity bedrock is unlikely to contain significant groundwater, and water flow within peat is likely to be slow. It is likely that the dominant water source is rainwater with through-flow within the uppermost vegetated layer, with contributory flow from discharges from the existing access track and track cross-drainage.
- 4.12 Development within this area would be limited to widening of the existing access track. Drainage from the access road has potential to affect water quality in the areas of M25 mire. Trackside drainage would be kept to a practical minimum to ensure a dry running surface and runoff would not be directed into the area of rush-pasture, to avoid nutrient flushing.
- 4.13 Protection measures relating to surface water and drainage runoff are provided in **Section 5**.

#### *Area 2*

- 4.14 Area 2 is located within the central section of the open area between Skipness and Corranbuie forest areas, south of Area 1 (**Figure 10.4.C**).
- 4.15 A total of five areas of M25 mire, and one area of M23 rush-pasture, have been identified wholly or partially within the 100 m buffer around the access track.
- 4.16 To the west of the existing access track the areas of M25 mire and M23 rush pasture are closely associated with existing surface water drainage running approximately parallel to the access track, which discharge towards the upper reaches of the Allt Chapull-cloiche watercourse. An overview of this area is provided in **Figure 10.4.D**.
- 4.17 To the east of the access track the identified area of M25 mire is present within a steeply sloping area extending from between two raised peaks at the eastern boundary of the buffer, down to the existing trackside drainage.



- 4.18 The existing access track drainage on the east side of the track in this area passes beneath the access track in a small culvert, and discharges on the west side.



**Figure 10.4.C: Area 2.**  
M23 rush-pasture is shown in pink; M25 mire is shown in purple.

***East of existing access track***

- 4.19 The area of M25 mire to the east of the access track covers an area of approximately 2,000 m<sup>2</sup>. The nearest part of the area to the access road is located at NGR NR 8775 6386.
- 4.20 The bedrock in this part of the Site is predominantly gritty psammite and pelite of the Beinn Bheula Schist Formation, a low productivity aquifer with small amounts of groundwater in the near-surface weathered zone and secondary fractures. Superficial deposits are not recorded in the area. The area has been confirmed to be underlain by peat between 0.5 m and 1.0 m deep. As discussed above peat is likely to hold significant amounts of water; however, flow is likely to be very slow.
- 4.21 The area of M25 mire east of the existing access track in Area 2 is determined not to be groundwater dependent as the low productivity bedrock, present at a depth of at least 0.5 m below ground level, is unlikely to contain significant groundwater and any groundwater present is unlikely to be accessible by surface habitats. Water present within the underlying peat is likely to be slow-moving and effectively inaccessible to surface habitats. The underlying peat is unlikely to provide a significant water source; it is likely that the dominant water source is rainwater with through-flow within the uppermost vegetated layer and focused runoff from nearby higher ground.
- 4.22 Development within this area is limited to widening of the existing access track. The position of the area of M25 mire on higher ground above the access track means that works as part of the development will not physically affect the mire, or change surface water drainage in the area.

***West of existing access track***

- 4.23 The areas of M23 rush-pasture and M25 mire identified within the 100 m buffer to the west of the access track cover areas of approximately 4,800 m<sup>2</sup> and 26,400 m<sup>2</sup>, respectively.

- 4.24 Within this area a drainage ditch runs approximately north-south parallel to, but separate from, the existing access track, in addition to drainage along the edge of the access track. Both of these ditches discharge into the upper reaches of the Allt Chapull-cloiche, initially flowing to the west beyond the 100 m buffer, then to the north.
- 4.25 The association of both the M23 rush-pasture and M25 mire area with drainage ditches and watercourses indicates that these are likely to provide the majority of water to these communities.



**Figure 10.4.D: Overview of Area 2 west of the existing access track from NGR NR 8776 6390 looking west showing discharge from access track drainage, area of M23 rush-pasture and upper reaches of watercourse.**

- 4.26 The bedrock in this part of the Site is predominantly gritty psammite and pelite of the Beinn Bheula Schist Formation. The bedrock is a low productivity aquifer with small amounts of groundwater in the near-surface weathered zone and secondary fractures. Superficial deposits are not recorded in the area. Peat depths in this area are confirmed to be between 0.6 m and 2.6 m.
- 4.27 The low productivity bedrock present at significant depth is unlikely to provide significant water to habitats at the surface. Whilst the underlying peat is likely to contain some water,

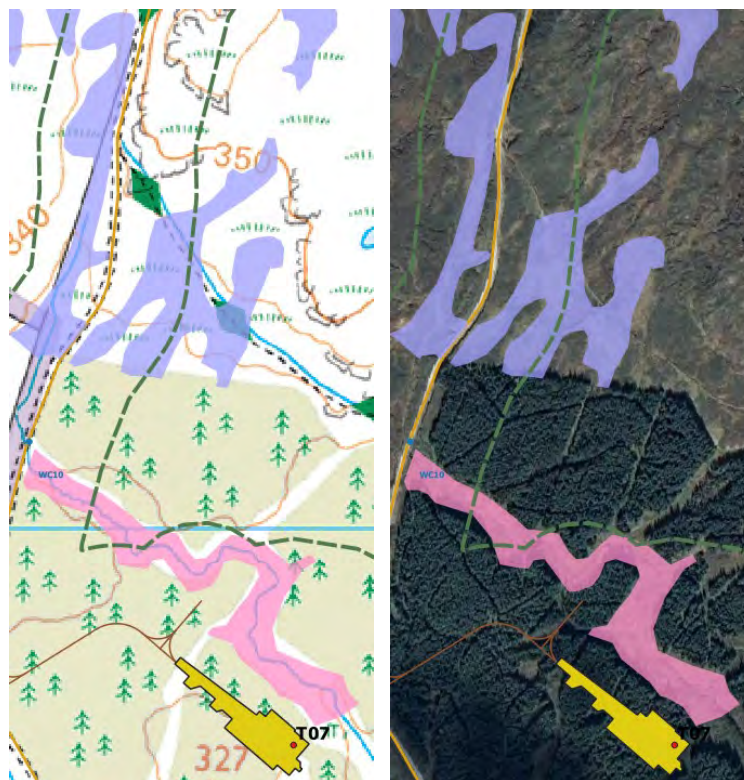


which may have some importance during dry summer periods when surface water levels are reduced, it is unlikely to provide significant flow.

- 4.28 The M23 rush-pasture and M25 mire communities in Area 2 are determined not to be groundwater-dependent.
- 4.29 Development within this area would be limited to widening of the existing access track. There is the potential for water quality to be impacted by surface water runoff and drainage discharge. Protection measures relating to surface water and drainage runoff are provided in **Section 5**.

*Area 3*

- 4.30 Area 3 is located at the southern end of the open area between Skipness and Corranbuie forest areas, and within the north-east corner of Skipness forest, north of T07. Two areas of M25 mire have been identified within the 100 m buffer around the access track. One area of M23 rush-pasture has been identified within the 100 m buffer around the access track and 250 m buffer around the T07 foundation (**Figure 10.4.E**).



**Figure 10.4.E: Area 3. M23 rush-pasture is shown in pink; M25 mire is shown in purple.**

***M25 mire***

- 4.31 The two areas of M25 mire in Area 3 are located on either side of the existing access track. The area of M25 mire to the east of the existing access track covers approximately 12,900 m<sup>2</sup> within the buffer and is located higher than the existing access track. Development works in the area would be limited to widening of the existing access track and would not affect groundwater or surface water in this area.

- 4.32 The area of M25 mire to the west of the access track covers approximately 18,300 m<sup>2</sup> and is entirely within the buffer zone. It runs approximately parallel to the access track from NGR NR 8759 6366 to NGR NR 8747 6322 and is closely associated with an existing drainage ditch in this area, and the start of a tributary to the Garbh Allt watercourse. At its closest point, the mire area is directly adjacent to the current access track.
- 4.33 The bedrock in this part of the Site is low productivity gritty psammite and pelite of the Beinn Bheula Schist Formation, with small amounts of groundwater in the near-surface weathered zone and secondary fractures. Superficial deposits are not recorded in the area, and recorded peat depths are >1 m.
- 4.34 The low productivity bedrock present at significant depth is unlikely to provide significant water to habitats at the surface. Whilst the underlying peat is likely to contain some water, which may have some importance during dry summer periods when surface water levels are reduced, it is unlikely to provide significant flow.
- 4.35 The M25 mire in Area 3 is determined not to be groundwater-dependent although limited amounts of groundwater may be supplied by the underlying peat, which may have some importance during dry summer periods when surface water levels are reduced.
- 4.36 A surface water linkage via overland flow and track drainage discharge has a strong potential to affect water quality in the area to the west of the access track. Protection measures relating to surface water and drainage runoff are provided in Section 5.

#### ***M23 Rush-Pasture***

- 4.37 The identified M23 rush-pasture in Area 3 covers an area of approximately 27,300 m<sup>2</sup> and is closely related to the watercourse channel of a tributary to Garbh Allt which runs along a clearing with the forestry.
- 4.38 It is directly adjacent to the east of the existing access track at NGR NR 8746 6309 and runs generally to the south east to NGR NR 8788 6276. At its closest point it is 25 m north east and down-gradient of the T07 crane pad. An overview of this area is provided in **Figure 10.4.F**.



**Figure 10.4.F: Area 3 view south-west downstream along watercourse from NGR NR 8746 6309 showing M23 area adjacent to access track.**

- 4.39 The bedrock in this part of the Site is low productivity gritty psammite and pelite of the Beinn Bheula Schist Formation, with small amounts of groundwater in the near-surface weathered zone and secondary fractures. Superficial deposits are not recorded in the area, peat depths have been found to be variable but are generally >0.5 m in the area of the watercourse.
- 4.40 The low productivity bedrock present at significant depth is unlikely to provide significant water to habitats at the surface. Whilst the underlying peat is likely to contain some water, which may have some importance during dry summer periods when surface water levels are reduced, it is unlikely to provide significant flow.
- 4.41 The M25 mire in Area 3 is determined not to be groundwater-dependent, although limited amounts of groundwater may be supplied by the underlying peat, which may have some importance during dry summer periods when surface water levels are reduced.
- 4.42 A surface water linkage via overland flow and track drainage discharge has a strong potential to affect water quality downstream of the access track in the north-west and close to the T07 crane pad. Protection measures relating to surface water and drainage runoff are provided in Section 5.

#### *Area 4*

- 4.43 Area 4 contains an area of M23 rush-pasture, located north of the access road and west of the T12 crane pad, and entirely within the development buffers of each (Figure 10.4.G).
- 4.44 The rush-pasture covers an area of approximately 7,100 m<sup>2</sup>, and is directly north, upstream, of the access track. At its closest point it is 45 m west of the T12 crane pad. It is closely associated with the Allt Càrn Chaluim watercourse and is confined to the area between two smaller channels.



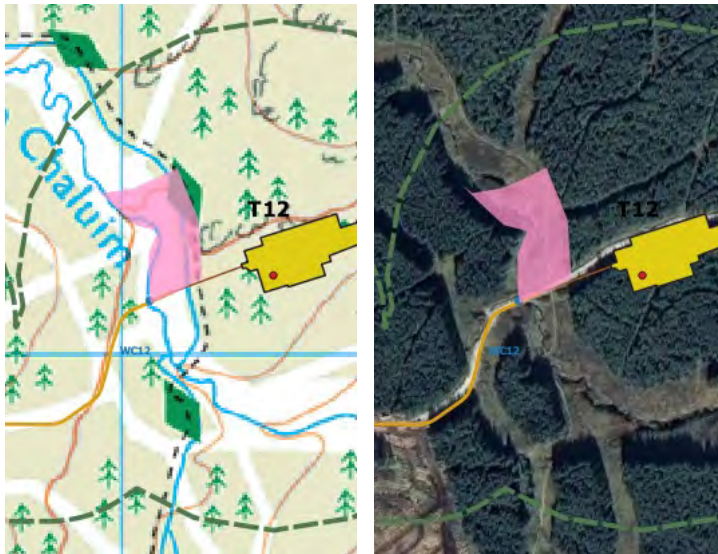


Figure 10.4.G: Area 4. M23 rush-pasture is shown in pink; M25 mire is shown in purple.

- 4.45 The bedrock in this part of the Site is low productivity gritty psammite and pelite of the Beinn Bheula Schist Formation, with small amounts of groundwater in the near-surface weathered zone and secondary fractures.
- 4.46 Superficial deposits are not recorded in the area; however, small localised areas of alluvium may be present in the direct vicinity of the watercourse. Peat depths have been found to be variable in the wider area but appear to be limited in the direct vicinity of the watercourse with the base appearing to be flowing over bedrock.
- 4.47 The close association of the M23 rush-pasture with the watercourse, and low productivity underlying bedrock, indicates that the mire is reliant upon surface water within the Allt Càrn Chaluim. The underlying bedrock may provide limited amounts of groundwater, which is likely to have some importance during dry summer periods when surface water levels are reduced.
- 4.48 Development in the area would include widening of the existing access track, and excavation works and placement of hardstanding for the T12 crane pad. The M23 rush-pasture is upstream of the access track and is not down-gradient of the T12 crane pad. Development works in this area would be unlikely to affect surface water or groundwater in the vicinity of the rush-pasture provided surface drainage does not discharge directly into the area. Protection measures relating to surface water and drainage runoff are provided in **Section 5**. Track widening would focus on the southern side of the existing track if possible, to avoid loss of the M23 habitat in this area.

## 5 PROTECTION AND MITIGATION

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5.1 Wetland habitats are known to be sensitive to changes in their water supply, whether this is from groundwater, surface water or rainwater. With this in mind, the following good practice construction methods would be used for all development on or adjacent to wetland or bog areas:

- Where track sections cross wetland or bog areas, cross-drainage would be provided within the track construction to ensure continuity of flow. This may take the form of a drainage layer within the track, suitably closely-spaced drainage pipes, or both as appropriate. These would be determined on a case-by-case basis to suit each individual area;
- Earthworks would be kept to a practical minimum within these areas, to reduce the area of wetland affected by the construction works;
- Trackside drainage would be kept to a practical minimum, and would only be installed where required to protect the track from erosion;
- All works through and adjacent to wetland areas would be supervised by the Environmental Clerk of Works; and
- Site-specific mitigation, including track drainage segregation to avoid 'flushing' from excavation works, and micrositing to avoid specific higher sensitivity areas, would be identified and established where appropriate.

5.2 Specific mitigation relating to the areas of M23 rush-pasture and M25 mire identified with the potential to be impacted by changes in water supply are detailed below. Area 4 is not included as it is considered unlikely that this will be affected.

### Area 1

5.3 The existing drainage system in Area 1 discharges surface water drainage from the access track into Area 1 at a number of points, and areas of M23 mire appear to be associated with some of the discharge points. Surface water would continue to be discharged into these areas to maintain existing conditions.

5.4 Water would not be discharged directly from the trackside drainage during the construction phase in order to avoid nutrient flushing; discharge locations would be subject to additional protection with sediment traps, in the form of silt fencing, straw bales, or suitable alternative, in place. Installation of all protection measures would be overseen by the Environmental Clerk of Works. An indicative drainage strategy is included in **Figure 10.4.H**.

5.5 Re-establishment of current drainage would be undertaken once construction works have settled and vegetation is becoming re-established on newly exposed ground.

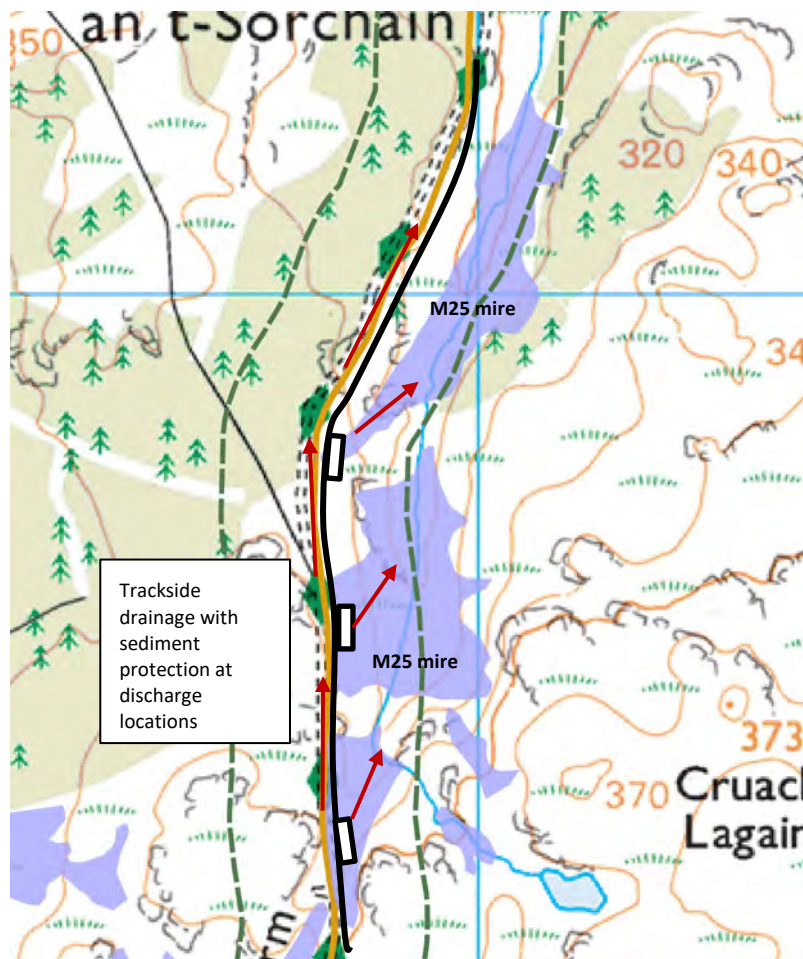


Figure 10.4.H:  
Area 1 indicative  
drainage strategy.

## Area 2

- 5.6 The existing drainage system in Area 2 currently discharges surface water directly from the track drainage towards areas of M23 rush-pasture and M25 mire. Surface water drainage into these areas would be maintained at comparable levels to the current drainage.
- 5.7 Water would not be discharged directly from the trackside drainage during the construction phase in order to avoid nutrient flushing; discharge locations would be subject to additional protection with sediment traps, in the form of silt fencing, straw bales, or suitable alternative, in place. Installation of all protection measures would be overseen by the Environmental Clerk of Works. An indicative drainage strategy is included in **Figure 10.4.I**.
- 5.8 Re-establishment of current drainage would be undertaken once construction works have settled and vegetation is becoming re-established on newly exposed ground.

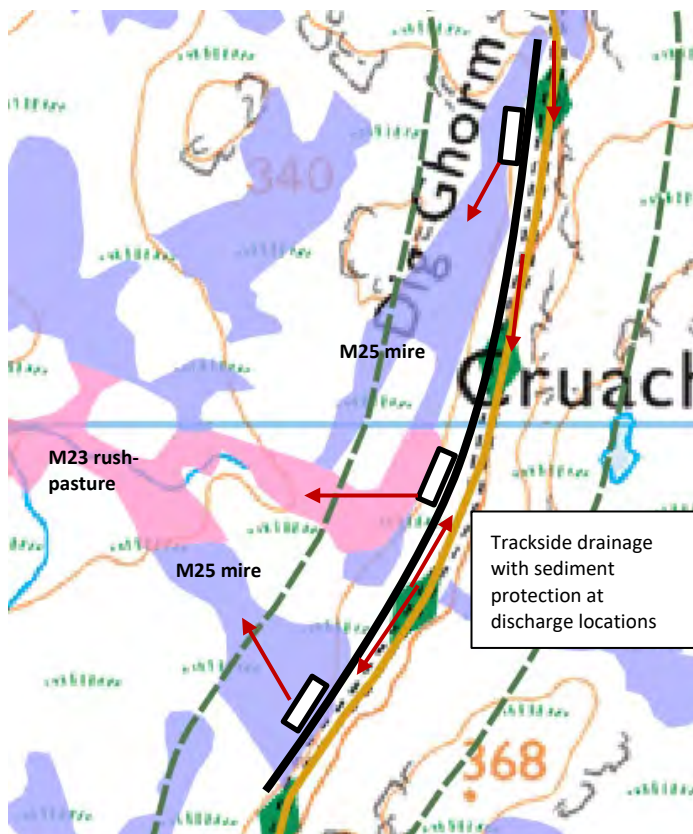
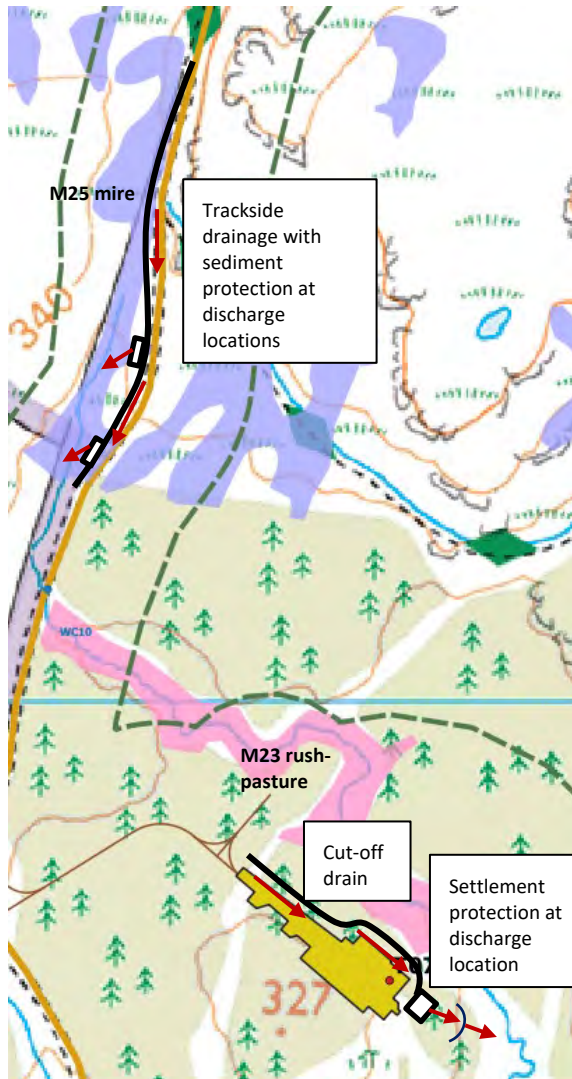


Figure 10.4.I: Area 2 indicative drainage strategy.

### Area 3

- 5.9 M25 Mire within Area 3 currently receives surface water discharge directly from the trackside drainage. M23 rush-pasture within Area 3 has the potential to be impacted by surface water drainage from the access track and the T07 crane pad.
- 5.10 Water would not be discharged directly from the trackside drainage during the construction phase in order to avoid nutrient flushing; discharge locations would be subject to additional protection with sediment traps, in the form of silt fencing, straw bales, or suitable alternative, in place.
- 5.11 The north east side of the T07 crane pad would have cut-off drainage installed along the perimeter to prevent surface water impacting the down-gradient area of M23 rush-pasture. Discharge would be directed downstream of the area of rush-pasture with sediment protection measures such as sediment traps using silt fencing, straw bales or suitable alternative, installed. Installation of all protection measures would be supervised by the Environmental Clerk of Works. An indicative drainage strategy is included in **Figure 10.4.J**.
- 5.12 Tree felling in this area would be required as part of the works but would be kept to a practical minimum in order to minimise mobilisation of sediment, and would only be undertaken once sediment protection has been established.
- 5.13 Re-establishment of current drainage would be undertaken once construction works have settled and vegetation is becoming re-established on newly exposed ground.





**Figure 10.4.J: Area 3 indicative drainage strategy.**



## 6 CONCLUSIONS

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- 6.1 A detailed assessment of the interaction between the proposed works for the proposed Development and potentially groundwater-dependent terrestrial ecosystems has been undertaken.
- 6.2 Two potentially groundwater-dependent NVC communities have been identified within the Site: M23 rush-pasture and M25 mire. M23 mire has potential moderate groundwater dependency and M23 rush-pasture has potential high groundwater dependency.
- 6.3 Ten areas of potentially groundwater-dependent M25 mire wetland habitat have been identified within the open area between Skipness and Corranbuie forest areas, wholly or partially inside the 100 m buffer around the access track.
- 6.4 Three areas of potentially groundwater-dependent M23 rush-pasture wetland habitat have been identified within the 100m buffer around the access track or 250 m buffer around the turbine foundations.
- 6.5 The potentially groundwater-dependent habitats have been assessed specifically within the context of the proposed Development, taking into account the local geology, hydrogeology, peat distribution and site observations. Mapped superficial deposits were absent within the vicinity of the identified communities; however, significant thicknesses of peat were generally present in areas around the watercourse channels. The underlying bedrock is a low productivity aquifer, and the small amounts of groundwater are likely to be insulated from the surface by the peat present. The peat itself is likely to contain some water; however, flow will be slow, limiting the amount of water available and likely only to form a partial source of water during prolonged dry periods.
- 6.6 All of the identified areas of M23 rush-pasture are closely associated with watercourses and are restricted to the immediate area of the channel or associated surface drainage.
- 6.7 It is determined as a result that neither of the two potentially groundwater-dependent communities within the study area are actually groundwater-dependent in this area but rely on a mix of surface water, shallow throughflow in surface vegetation and rainwater.
- 6.8 Specific mitigation measures, to avoid changes to the watercourse hydrochemistry through 'flushing' of excavated soil in surface runoff, have been set out and would be adhered to during all site works. Careful construction to ensure suitable continuity of flow across site tracks would help to minimise any potential impacts to the wetland habitats present within the Site.

## 7 REFERENCES

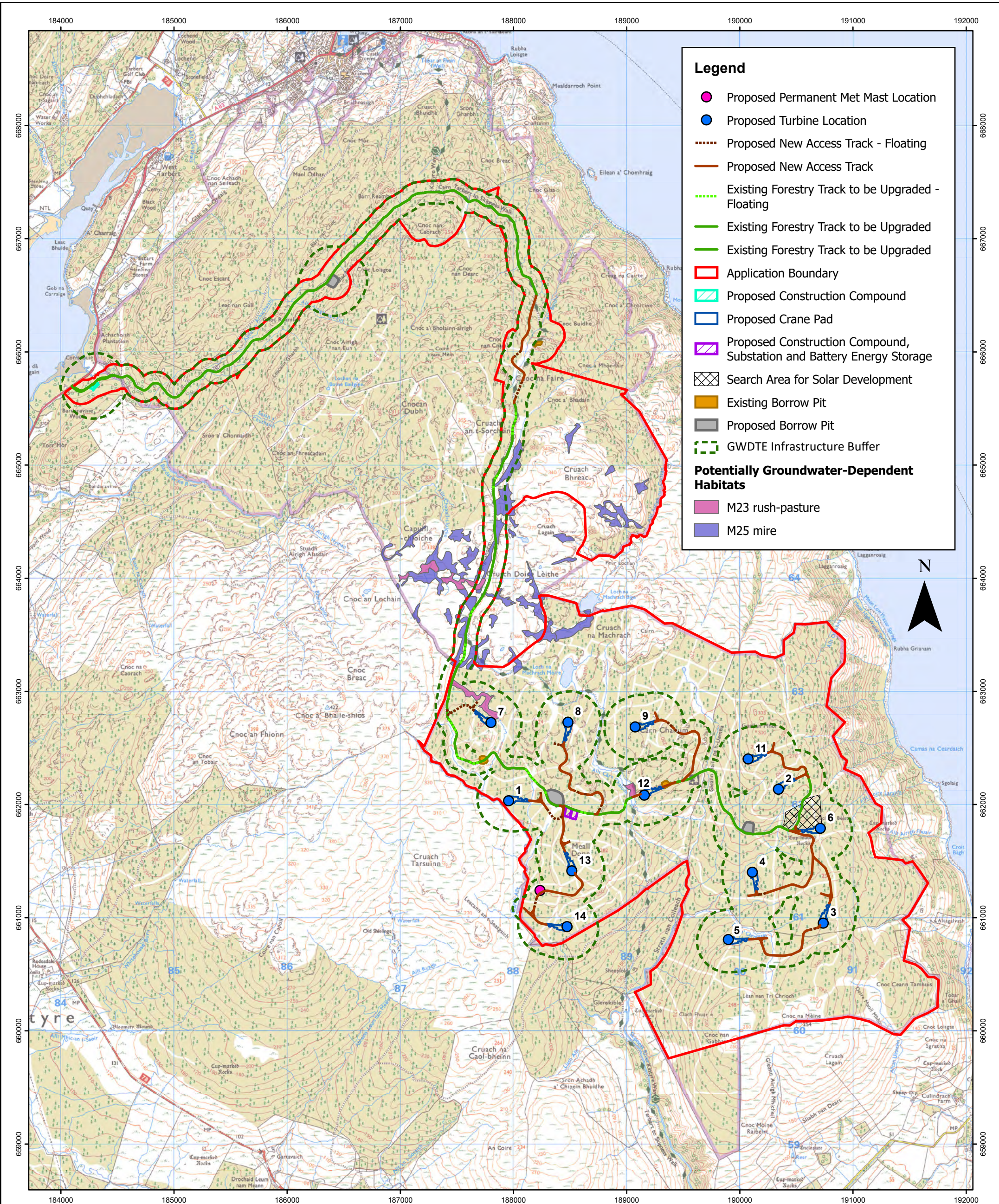
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## 8 FIGURES

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## Earraghail Renewable Energy Development

### Groundwater Dependent Terrestrial Ecosystems Assessment

#### Potentially Groundwater-Dependent Habitats

Rev	Date	By	Comment
E	01/12/21	CM	Revised track and logo
F	06/12/21	CM	Updated RLB
G	21/01/22	CM	Updated turbine locations

1:31,000 Scale @ A3				
Figure	Date	Rev	Dwg No.	Datum: OSGB36
10.4.1	21/01/22	G	EHAIL-RSK-I-063	Projection: TM