ScottishPower Renewables

Hollandmey Renewable Energy Development: Drainage Impact & Watercourse Crossing Assessment

Technical Appendix 10.5

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RSK GENERAL NOTES

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1 INTRODUCTION

1.1 This report provides a Drainage Impact and Watercourse Crossing Assessment for Hollandmey Renewable Energy Development (RED) and associated infrastructure, hereafter the 'proposed Development'.

1.2 The report forms a Technical Appendix to the Environmental Impact Assessment Report (EIA Report) for Hollandmey RED and should be read in conjunction with this document. It has been produced to address the requirement for new drainage infrastructure, including new watercourse crossing structures, for the proposed development.

1.3 This document covers site drainage and watercourse crossings. These topics are interlinked and important to understand, as each has the potential to have significant environmental effects if not adequately addressed.

1.4 For the purposes of this technical appendix, the study area is considered to include the planning application boundary (the 'Site') and an area up to 2 km from this boundary. For hydrological concerns, areas downstream of the planning application boundary are considered at distances greater than 2 km as it is possible for effects to be transmitted downstream for greater distances.

Drainage impact assessment

1.5 This document will assess how the proposed development may affect the existing drainage system within the Site, from both a water quality and a water quantity perspective. This assessment will identify any drainage issues, as well as appropriate mitigation measures to address these issues. This will ensure that Site drainage is suitable for the proposed Development and keep changes to the natural drainage to a practical minimum.

Watercourse crossing assessment

1.6 Watercourse crossings will be required on the proposed access track layout for the Development. This document will provide background descriptions of the watercourse crossing locations and the process of layout design that has resulted in these crossings being proposed; it will also provide sufficient background information to support future applications for authorisation under the *Water Environment (Controlled Activities) (Scotland) Regulations 2011* as amended, known as CAR.

Regulatory background

1.7 Under the terms of CAR, it is an offence to undertake the following activities without an appropriate authorisation in place:

- Discharge to any wetland, surface water or groundwater;
- Disposal to land;
- Abstraction from any wetland, surface water or groundwater;
- Impoundment (dam or weir) of any river, loch, wetland or transitional water; and
- Engineering works in any inland water or wetland.

1.8 With respect to drainage infrastructure, any formal discharge to water or to land may require authorisation. The developer has a duty to manage water within the Site and discharging from the Site in a compliant manner. The drainage strategy provided here will establish the design requirements in order to manage post-construction water flows within and deriving from the Site.

1.9 With respect to watercourse crossings, any engineering works in inland water or wetlands may require authorisation. The Scottish Environment Protection Agency's (SEPA) document "The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended): A Practical Guide" specifies that authorisations are not normally required for engineering works on minor watercourses, where a minor watercourse is defined as one not shown on the 1:50,000 scale Ordnance Survey maps (Landranger series) (SEPA, 2019).

1.10 On this basis, some watercourse crossings required to provide access to the proposed Development would require authorisation. Additional crossing of minor watercourses would also be necessary but would not require authorisation.

1.11 This report is produced in compliance with the requirements of the Highland Council (THC) and SEPA and is in line with current best practice.

Development proposals

1.12 The proposed Development includes the following key elements:

- ten wind turbines of up to 5 MW capacity and maximum tip height of 149.9 m;
- hardstanding areas and crane pads at the base of each turbine, with a maximum combined area of 3,146 m^2;
- 15 MW ground mounted solar arrays;
- 15 MW battery energy storage system (BESS);
- transformer/switchgear housings located adjacent to turbines & solar panels;
- 12.01 km of access tracks (8.93 km of which is new (6.18 km normal track and 2.75 km floating track), 2.71 is upgraded existing track and 0.37 km is existing access track), including passing places and turning heads;
- watercourse crossings (upgrade of existing or new as required);
- underground electrical cabling;
- permanent met mast and LIDAR compound;
- up to two temporary Power Performance Masts (PPM);
- a temporary windfarm construction compound area and a temporary solar construction compound area;
- a control compound comprising a permanent control building, substation and BESS;
- closed-circuit television mast(s);
- communication mast(s);
- permanent control building;
- up to three borrow pit search areas; and
- health & safety and other directional site signage.

1.13 In addition, felling of approximately 24 ha of commercial tree planting would be required to accommodate access for the turbines.

1.14 Full details of the proposed Development design are provided in **Chapter 2: Site Description and Design Evolution** of the EIA Report.

2 DRAINAGE CHARACTERISTICS

2.1 This section of the document outlines the existing drainage characteristics of the Site in order to determine a baseline against which to assess changes to the drainage regime. Natural drainage characteristics are determined by the site topography, existing drainage features and natural catchment areas, site rainfall characteristics, current land use and any existing drainage infrastructure.

Site topography

2.2 The Site is primarily undulating lowlands with gentle slopes, with most of the Site having an elevation between 45 and 55 m above Ordnance Datum (AOD). The highest ground in the Site is located on isolated low hills in the north-east, south-east and south-west of the Site. The Hill of Rigifa' forms a high point just north of the application boundary, reaching an elevation of 80 m AOD. In the southern part of the Site the Hill of Slickly reaches an elevation of 75 m AOD.

2.3 The lowest elevations within the Site are in the western part around the Link Burn and the Burn of Ormigill (40 m AOD), and in the north-west around the Burn of Horsegrow (35 m AOD). The west and south-western part of the Site is characterised by a shallow valley which slopes westwards around the Link Burn. The north-western part of the Site slopes north-west towards the Loch of Mey, with a shallow valley around the Burn of Horsegrow.

2.4 Following topography, the majority of the Site drains roughly west to join the Burn of Rattar. Outwith the Site, topography generally slopes towards the coast.

2.5 The application boundary covers 1,195 ha. Proposed infrastructure and borrow pits have a total land-take of 9.31 ha, of which 1.49 ha would be temporary working areas during the construction phase and 7.82 ha would be long-term. The long-term land-take includes all impermeable or reduced permeability surfaces including turbine foundations, buildings, hardstanding areas, borrow pits and access tracks.

Existing drainage and natural catchments

2.6 The Site lies across five surface water catchments:

- the Burn of Rattar;
- the Burn of Horsegrow;
- the West Burn of Gills;
- the Gill Burn; and
- the Burn of Lyth catchments.

2.7 Nearly 70% of the proposed Development is located within the Burn of Rattar catchment. The Burn of Horsegrow catchment drains the north-western Site. The West Burn of Gills catchment encompasses the north-eastern Site. The Gill Burn and the Burn of Lyth catchments provide drainage for the south and south-eastern Site.

2.8 The Burn of Hollandmey, Link Burn and Burn of Ormigill are all tributaries to the Burn of Rattar and provide the main drainage to the Site, draining broadly north-west and north into the Pentland Firth. An overview of watercourse catchment areas and infrastructure is provided in **Table 10.5.1**. Catchment areas are shown on **Figure 10.5.1**.

Table 10.5.1: Overview of watercourse catchment areas and infrastructure

Catchment	Total area (km^2)	% of Site within catchment	% of catchment within Site	Comments
Burn of Rattar (BoR)	20	67.9%	40.6%	Turbines 1, 2, 3, 5, 6, 7, 8, 9 and 10, all borrow pits, compound area, laydown area, and associated access tracks and crane pads lie in this catchment.
Burn of Horsegrow (BoH)	3.4	11.5%	40.5%	The solar array, additional solar compound area, proposed battery energy storage system, substation and associated access track lie within the catchment.
West Burn of Gills (WBG)	3.1	9.9%	38.2%	No infrastructure lies within the catchment.
Gill Burn (GB)	9.8	5.5%	6.7%	No infrastructure lies within this catchment.
Burn of Lyth (BoL)	36.2	5.1%	1.7%	Turbine 4 lies within this catchment.

Rainfall characteristics

2.9 A review of the watercourse catchment and rainfall characteristics was undertaken using data from the FEH web service (CEH, 2020). Catchment statistics have been provided for the three main catchments within the Site.

2.10 Standard average annual rainfall (SAAR) for the main Site catchments are as follows:

- BoR: 894 mm
- BoH: 891 mm
- WBG: 888 mm

2.11 The calculations in **Section 3** below make use of the figures for Burn of Rattar, as this covers the vast majority of the Site and is considered to be the most representative.

Catchment land use

2.12 The Site consists primarily of commercial forestry and peatland with some areas of agricultural land (mainly grazing with some arable land) and native woodland. In total, almost two thirds of the application area is under planted or native woodland. Watercourses within all of the catchments show extensive modification by straightening and excavation of drainage channels, for commercial forestry and agricultural purposes.

2.13 Within the application boundary, the Burn of Rattar catchment consists of commercial forestry (including an area of recent clearfell) and peatland with some agricultural land. To the north-east, the Philips Mains Mire SSSI lies across the watershed between the Burn of Rattar and West Burn of Gills catchments. The north-east of the application boundary, within the West Burn of Gills catchment, consists of commercial forestry (including an area of recent clearfell) and peatland. The north-west of the application boundary, within the Burn of Horsegrow catchment, the land use consists of commercial

and native forestry and peatland. The Burn of Lyth catchment encompasses commercial forestry and agricultural land uses. The Gill Burn catchment includes peatland and commercial forestry land uses.

Existing drainage infrastructure

Waste water

2.14 There is no existing waste water infrastructure, either foul drainage or surface water drainage, present within the Site.

Surface water

2.15 Surface water drainage within the Site varies, depending on the dominant land use.

2.16 The Site currently drains primarily naturally via infiltration and overland flow to the existing watercourse network. However, drainage has been significantly modified in agricultural and commercial forestry land use areas. Within the agricultural land, many of the natural watercourse channels have been modified and straightened to improve the drainage. Additional drainage ditches have been excavated mainly around the field margins. Trackside ditches are common, typically on both sides of the tracks. Culverts are present in some locations to permit under-track drainage. These sometimes take the form of pipes, but older culverts are stone-built cundies (e.g. crossing at X01).

2.17 Some, fairly limited, artificial surface drainage infrastructure (i.e. culverts, field drains) is associated with the access track and other field drainage. The infrastructure is largely in poor condition. There is a large cundy at minor watercourse location X01 (see **Table 10.5.3**).

2.18 The plantation area has an extensive drainage network, installed to improve conditions for conifer growth. This has had variable success and tree growth in some areas is notably stunted as a result of waterlogging. Notably, there were new ditches dug recently (between the Phase 1 peat survey in June 2020 and the site walkover in August 2020) in the south-west part of the Site. These have affected a tributary to the Link Burn at the location of crossing WC05.

Private water supply

2.19 There are no known PWS within the Site or within 5 km of the application boundary.

2.20 The Environmental Health Department of The Highland Council confirmed on 18 September 2020 that their records do not indicate any PWS within the application boundary. The owners of Philips Mains Farm confirmed that their property is on a mains supply.

2.21 A number of wells are indicated on Ordnance Survey mapping within 2 km of the Site. These wells are mainly located near isolated houses or farms but may now be disused. It is possible that some remain in active use as water supplies for livestock. Details of wells identified within 2 km of the application boundary are provided in **Chapter 10: Hydrology, Hydrogeology, Geology and Soils.**

2.22 It remains possible that some local properties rely on a PWS, although none have been identified within the study area.

3 OUTLINE DRAINAGE STRATEGY

Introduction

3.1 This section provides an outline drainage strategy for the Site. The proposal is to maintain site runoff within the natural catchment areas, and to maintain drainage to the Site watercourses following treatment and attenuation in order to mimic natural flow as closely as possible.

Waste water drainage

3.2 It is anticipated that waste water drainage for construction and operation will be provided by use of a septic tank or a dedicated waste treatment plant. A reedbed may be included as part of the water treatment system if site conditions are found to need this. Determination of the requirement for a reedbed would be undertaken as part of detailed design.

3.3 Should ground conditions prevent use of a soakaway facility, controlled discharge to surface water would be considered. Any necessary authorisations for waste treatment and water discharge would be put in place ahead of works beginning.

3.4 The septic tank or waste treatment plant would be suitably sized to control any discharge to ground or to surface water such that there would be no increase to downstream flood risk arising from the discharge.

Surface water drainage

3.5 The surface water drainage network for the Site would be designed taking into account THC's Supplementary Guidance: Flood Risk and Drainage Impact Assessment (THC, 2013) and CIRIA Publication C753 – the SuDS Manual (CIRIA, 2015).

3.6 The following sections describe the requirements that lead to determination of the proposed drainage strategy and which inform SuDS provision recommendations.

Allowable discharge

3.7 Surface water flows from the site would be directed, following appropriate treatment and attenuation, to the existing Site watercourses in order to maintain pre-development water quality characteristics and flow rate. In line with THC's guidelines for development, it is anticipated that the allowable discharge from the Site would match that of the existing 1-in-2 year Greenfield runoff rate.

Post-development discharge criteria

3.8 Post-development surface water flows would be restricted to the discharge levels set out in THC's supplementary guidance document (THC, 2013). The development proposals recognise THC's requirements, within which three key design principles are noted:

- The post-development runoff rate and volume do not exceed the Greenfield runoff rate for previously undeveloped sites;

- Formal on-site storage should be provided up to the 1-in-30 year return period event and attenuation measures should be designed such that SuDS features would not surcharge during a 1-in-30 year return period rainfall event; and
- The 1-in-200 year event should be contained on site (unless it can be demonstrated that the 1-in-200 year event could be managed appropriately without causing a flood risk elsewhere).

Greenfield runoff assessment

3.9 A review of the catchment characteristics relating to the Site was undertaken using the FEH Web Service (CEH, 2020). This identified the following criteria:

- Standard average annual rainfall (SAAR) of 894 mm for the site area; and
- Standard percentage runoff (SPR) of 50.06%.

3.10 This information has been used to determine the Greenfield Runoff Rate that corresponds to the Site's existing characteristics. This has been calculated using the online Greenfield Runoff Estimation for Sites tool (HR Wallingford, 2020), which gives the IH124 model results for the Site.

3.11 The 1-in-2 year Greenfield Runoff Rate has been calculated to be 7,349.31 l/s (7.35 m^3/s) based on a total drained area of 1,157 ha.

Attenuation

3.12 THC's current guidance document requires that formal on-site storage is provided up to the 1-in-30 year return period event and attenuation measures should be designed such that SuDS features will not surcharge during a storm of this magnitude.

3.13 The drainage strategy for the Site aims to promote attenuation within the SuDS proposals to mitigate any additional surface water runoff generated as a result of the development. Attenuation volumes would be reviewed at the detailed design stage in order to ensure compliance with the 1-in-30 year and 1-in-200 year requirements as specified within THC's documents.

3.14 Approximate attenuation and storage volumes have been calculated as follows, using guidance provided in the SuDS Manual (CIRIA, 2015):

- For a 1-in-30 year return period event plus climate change allowance, storage of approximately 1,000 m^3 is required; and
- For a 1-in-200 year return period event plus climate change allowance, storage of approximately 1,500 m^3 is required.

4 SUSTAINABLE DRAINAGE SYSTEMS

4.1 The Site drainage strategy seeks to implement a design that would match the pre-development site characteristics. Site drainage is intended therefore to provide an appropriate degree of treatment and attenuation such that runoff discharge is no greater than pre-development greenfield runoff for the area and that runoff quality would not risk any reduction in the water quality of the receiving waterbody.

Quality of receiving waterbodies

4.2 SEPA's Water Classification (SEPA, 2020a) and Water Environment Hubs (SEPA, 2020b) have been consulted to determine the existing baseline water quality for the main watercourses and waterbodies within the study area.

4.3 The Link Burn, which provides the main drainage to the Site, has been classified by SEPA in 2018 as having 'good' overall ecological status with respect to its condition resulting from diffuse and point source pollution, modification to its bed, banks and shores, alterations to water levels and flows, and the presence of invasive non-native species (SEPA, 2020a). It was also designated by SEPA in 2014 as having 'good' overall condition and 'good' physical condition with a 'high' status for fish migration access, water flows and levels, freedom from invasive species, and water quality (SEPA, 2020b).

4.4 The Gill Burn, which drains the very south-eastern portion of the Site, has been classified by SEPA in 2018 as having 'good' overall ecological status with respect to its condition resulting from diffuse and point source pollution, modification to its bed, banks and shores, alterations to water levels and flows, and the presence of invasive non-native species (SEPA, 2020a). It was designated by SEPA in 2014 as having a 'good' overall condition and a 'high' physical condition. It was also characterised as having 'good' water quality with a 'high' status for fish migration access, water flows and levels, and freedom from invasive species (SEPA, 2020b).

4.5 The other watercourses providing Site drainage are not classified and assessed directly as their catchment sizes are too small and fall below the size limit. Based on the water quality of adjacent watercourses, it is assumed that the Site watercourses all have 'good' status.

4.6 The main watercourses in the Site (including the Burn of Hollandmey, the Link Burn, the Burn of Ormigill and the Burn of Horsegrow) eventually feed north into the sea, into the Dunnet Head to Duncansby Head coastal waterbody. This waterbody has been classified by SEPA as having 'good' overall ecological status (SEPA, 2020a) and 'good' overall condition and water quality (SEPA, 2020b).

4.7 The Gill Burn drains east into the sea, into the Duncansby Head to Noss Head coastal waterbody. This waterbody has been classified by SEPA as having 'good' overall ecological status (SEPA, 2020a) and 'good' overall condition and water quality (SEPA, 2020b).

Treatment

4.8 Surface water treatment systems should be based on catchment characteristics and the sensitivity of the receiving watercourse (CIRIA, 2015). Treatment would be required

during the entire lifetime of the development, from construction through to decommissioning. Much of the construction phase surface water treatment would provide suitable water treatment for the operational phase.

4.9 It is assumed that all site operations would require at least two levels of treatment prior to discharge, as a result of the high sensitivity of the receiving waterbodies. Areas of the Site with a higher pollution risk, notably concrete batching (if used) and any areas used for plant maintenance and refuelling, would require three levels of treatment.

SuDS components

4.10 The following SuDS features have been considered for inclusion within certain sections of the proposed development's drainage network in order to control, manage and treat surface water runoff during construction, operation and decommissioning of the proposed Development.

Swales and filter strips

4.11 Swales are shallow, broad and linear vegetated drainage features that can be designed to store and/or convey surface runoff as well as providing water treatment. Where soil and groundwater conditions allow, swales can also promote infiltration. Vegetation within swales varies but typically comprises grass or dense vegetation that can act to slow down flow rates and trap particulate pollutants in the water.

4.12 Filter strips are gently sloping vegetated strips of land that provide off-the-edge diffuse drainage. They provide some flow attenuation and treatment, but little or no water storage.

Filter drains

4.13 Filter drains are also linear drainage features, but rather than incorporating vegetation they include coarse graded rock which provides good drain stability whilst also providing water storage and conveyance. Filter drains have a narrower footprint than swales and can be used in areas where space constraints prevent wider swales from being used. Filter drains provide some limited water treatment.

Check dams

4.14 For either swales or filter drains that cross slopes, check dams provide a valuable means of attenuating water flow. These are typically placed across the swale or drain at intervals of 10-20 m. The design is such that the toe of the upstream dam is level with the crest of the next downstream dam. A small opening or pipe is placed at or near the base of each dam to allow limited flow to pass through rather than over the dam, in order to maintain low flow conveyance.

4.15 Check dams should be built into the sides of the swale or filter drain, to ensure that water flow cannot bypass the dam.

4.16 When made of soil (as opposed to stone or rock), check dams are often called bunds or berms.

Silt fences and straw bales

4.17 Silt fences, constructed from a closely woven synthetic geotextile material, and straw bales both provide flow attenuation and excellent particulate filtration treatment for surface water runoff. These are particularly valuable for sediment management in runoff during construction works, as silt fences and pegged straw bales can be positioned along the main runoff routes to capture, slow and treat runoff. They can also provide temporary check dams if required in short-term drainage infrastructure.

Settlement ponds

4.18 Settlement ponds provide storage for site runoff and are a highly effective method of treatment and attenuation of surface water. They are particularly useful for developments where bulk earthworks form a significant part of the works.

Drainage strategy

4.19 Settlement ponds would be used at the three borrow pit sites, the solar array, the construction compounds, laydown area and substation for storage, attenuation and treatment of surface water. The ponds would be established during construction to provide water management for the construction phase works. The solar array pond would be retained during operation to provide ongoing water management for this area. The pond for the main borrow pit is likely also to be retained for use during the operational phase although the ponds for the other two borrow pits would be reinstated at the end of the construction period. The other ponds may be retained if water storage is required at these locations during the operational phase.

4.20 Swales and filter strips would provide attenuation, storage and treatment for access tracks and turbine hardstandings. Swales would form the preferred option, given the topography of the Site. During construction, small sumps with silt fencing would be established periodically along track routes in order to manage entrained sediment within the surface water. The sumps and silt fencing would be removed at the end of the construction phase, once vegetation on the filter strips and swales has become established.

4.21 Temporary cut-off drains and bunds would be required around excavation areas including turbine bases and borrow pits, to capture clean runoff and divert it around construction areas. These may be converted into swales at the end of the construction phase if long-term drainage is required.

Authorisation

4.22 Where proposals have potential to affect the water environment, the design of any works required to mitigate these effects must take into account the site's characteristics and existing drainage conditions. Treatment and discharge of surface water to the water environment is regulated under CAR (*Water Environment (Controlled Activities) (Scotland) Regulations 2011* as amended) and forms an additional requirement to planning consent. Any formal authorisations under CAR that are needed for the drainage strategy would be put in place prior to work beginning on the Site.

5 WATERCOURSE CROSSING ASSESSMENT

Route Selection

5.1 Prior to consideration of watercourse crossings in detail, SEPA would wish to satisfy themselves that 'good practice' has been followed, which in their terms means avoidance or minimisation of the number of crossings. The number of crossings is a function of the access route, to connect the turbines and other essential infrastructure for construction and operational purposes. Route selection takes into consideration a number of key factors including:

- Maximum track gradient suitable for the required traffic and loads for construction purposes;
- Track geometry including bend radii, junction layouts, passing infrastructure and turning circles;
- Stability and bearing capacity of the ground and adjacent slopes;
- The volumes of 'cut' and 'fill' required to ensure a suitable horizontal and vertical track alignment;
- Land-take, determined by route length and other aspects of track geometry;
- The type and nature of bridging structures;
- Sensitivity of environmental receptors including areas of deep peat, habitats and potential receptors downstream of crossing structures; and
- Whole-life costs for construction and maintenance.

5.2 With these factors in mind, a preferred track geometry has been determined to connect the turbines and other essential development infrastructure. Compromise is always required between competing constraints and concerns. The desire to locate turbines and associated hardstanding areas on areas of shallow peatland, plus a series of environmental and engineering constraints requiring avoidance of sensitive areas and potentially unstable or waterlogged ground, means that the track geometry is constrained by ecological and hydrological features.

5.3 There is no direct link between 'optimum', in terms of a balance between environmental and engineering constraints, and 'best practice' in the WFD context, which is oriented towards the water environment. However, there should not be obvious redundant crossings or crossings that are readily avoidable.

Access track design

5.4 The water environment and associated concerns formed an integral part of the track design process, which developed in an iterative manner in parallel with the turbine layout and associated infrastructure. As part of this process, the proposed track route has fewer crossings than the initial design submitted for consideration at design meetings.

Access route

5.5 As discussed in **Chapter 2: Site Description and Design Evolution** and **Chapter 12: Access, Traffic and Transport** of the EIA Report, the preferred access to the proposed

Development is expected to leave the minor road to the north of the Site at ND 2888 7223 to follow the existing access track south-east. At ND 2926 7162 a short section of proposed new track would diverge south-south-west to allow for suitable bend radii for turbine infrastructure transport. This would re-join the existing access track at ND 2923 7134. At this point, an access link to the solar array separates from the main access track.

5.6 The solar array access follows the existing access track south-west for 0.2 km. Some minor modifications to bends would be required to ensure the track is suitable for vehicle and plant access.

5.7 The main access route continues south-east and then south along the existing track to the track end at Crackersfield. Borrow pits 1 and 2 are located on the north-east and east sides of this section of track, and the main construction compound and laydown area are located on the western side. A link immediately north of BP2 would give access to Turbines 7 and 10.

5.8 From the existing track end, the main track route continues south and then south-east before turning west near Turbine 9 and then turning north and north-east after Turbine 3 to reach Turbines 1 and 2 at the track end. Small approach links would be required to give access to Turbines 5, 8, 9, 4, 3 and 2 for engineering reasons, principally to allow sensible positioning of the associated crane pad hardstanding areas for these turbines and to take account of the straight access requirement for construction. Turbine 6 is located directly on the main track route.

5.9 One watercourse crossing would be required on the main existing access north of the construction compound and laydown area. Three further watercourse crossings would be required on the main access track to Turbine 9. A crossing would be required immediately after Turbine 6 and another required between Turbines 3 and 2.

5.10 The new track required for the proposed Development would be a total of 8.93 km. Of this, 6.18 km is proposed new cut-and-fill track and 2.75 km is proposed floating track. In addition, 2.71 km of existing track would require upgrading.

Removal or modification of existing structures

5.11 Where a proposed new crossing is located adjacent to an existing crossing, it is considered best practice to remove the redundant structure. There are no planned crossings adjacent to existing crossings.

5.12 Two existing minor watercourse crossings on the existing track would require upgrading as part of the track upgrading process. It is proposed to lengthen the crossings rather than replace the existing structures.

Cable crossing locations

5.13 As cables would generally be laid alongside access tracks, cable crossings would normally be incorporated as part of track crossing structures. There are no plans for additional crossings of watercourses shown on Ordnance Survey 1:50,000 mapping.

Crossing descriptions

5.14 The crossings have been assessed using a catchment-based approach, involving a desk study and walkover survey.

Desk study

5.15 The desk study consisted of a review of the information regarding the proposed Development, principally involving an examination of the proposed track layout and the identification of watercourses marked on the OS 1:50,000 scale maps which would require crossings.

5.16 Following issue of the initial track layout, discussions were held with the design team in order to revise the layout to reduce the number of watercourse crossings required for the development.

Walkover survey

5.17 Subsequent to the issue of the revised track layout, a walkover survey of the Site was undertaken, during which the identified crossings were visited to obtain specific information about each crossing location. This work was undertaken in August 2020, in dry weather but following a comparatively wet period. Information regarding previous high-water activity including flooding was recorded in order to allow an informed decision-making process with regard to crossing structures and sizing.

5.18 During the walkover survey and the peat surveys, photographs and detailed field notes were taken to record dimensions of the watercourse channel and flood channel, where apparent, the type of substrate and any other local information required to inform the proposed crossing type. Locations were recorded using a hand-held GPS unit, with better than 5 m accuracy.

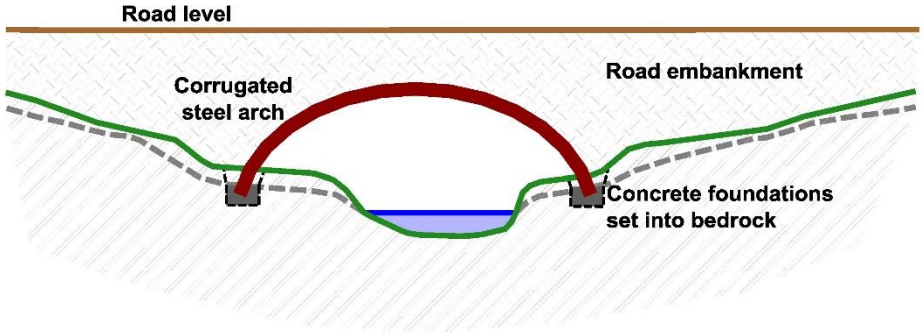
Ecological provision

5.19 **Technical Appendix 8.4: Fish Habitat Survey** indicates that functional fish habitat is relatively restricted within the Site and is considered to be of low sensitivity. However, some fish species are likely to be present, notably brown trout, eels and possibly lamprey. In addition, the watercourses are likely to be used by mammal species such as otter and water vole.

Crossing details

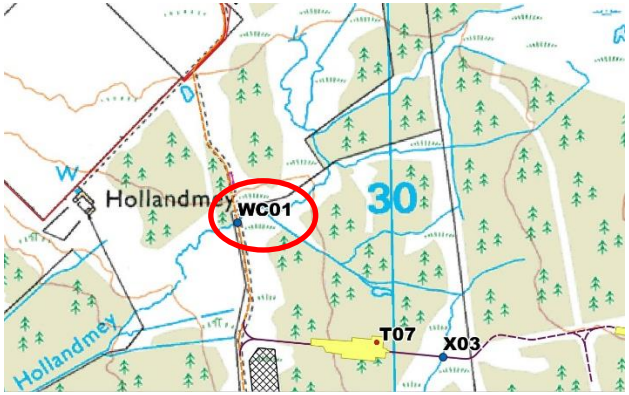
5.20 **Table 10.5.2** includes details of all the crossings which require authorisation, together with photographs of the watercourse and a recommendation of the crossing type to be used. All crossings are shown on **Figure 10.5.2**.

Table 10.5.2: Watercourse crossing details

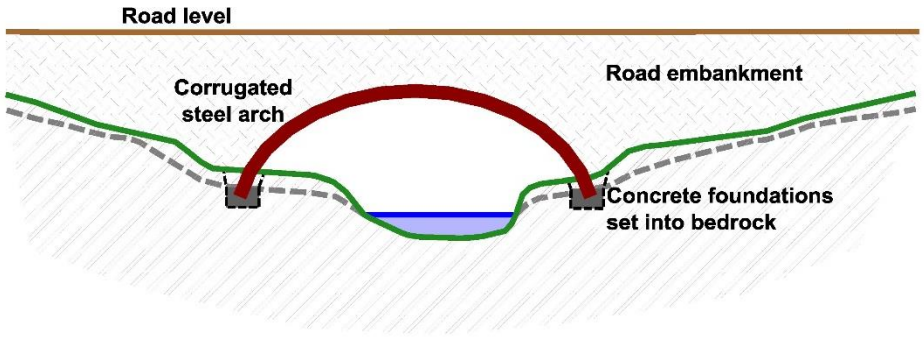
Watercourse Crossing Details		
Crossing:	WC01	 Indicative cross-section, not to scale
Location:	Along existing access track from public road	
Watercourse:	Burn of Hollandmey (Link Burn)	
NGR:	ND 2968 7045	
Description:	Small meandering watercourse with relatively well-defined narrow channel within wider flood channel. Wide and shallow where it forms a ford on the existing access track. Bedrock is exposed within shallow water in area of the ford. Banks low and well vegetated with grass and shrub vegetation.	
Catchment Area:	1.1 km^2	
Crossing Type:	Bottomless arch or box culvert	

View upstream (north east) from ND 2968 7045 showing variable channel width and shallow area across track.

View downstream (west) from ND 2968 7045 showing narrow channel in wider floodplain.



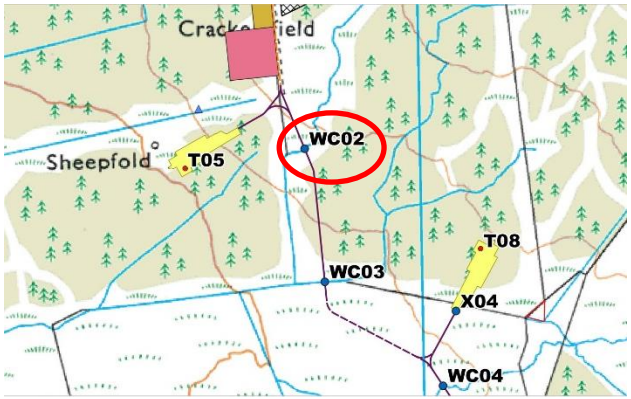
Watercourse Crossing Details	
Crossing:	WC02
Location:	Between T05 and T08
Watercourse:	Tributary to Link Burn
NGR:	ND 2976 6966
Description:	Boggy area in heavily vegetated wide flood channel without a well-defined flow channel. Channel 1.5-2 m wide. Banks around flood channel 0.75-1.0 m in height. Peaty around and below watercourse (peat depth 0.5 m). Area is well-vegetated with rushes, sedges and grass.
Catchment Area:	0.3 km^2
Crossing Type:	Bottomless arch or box culvert



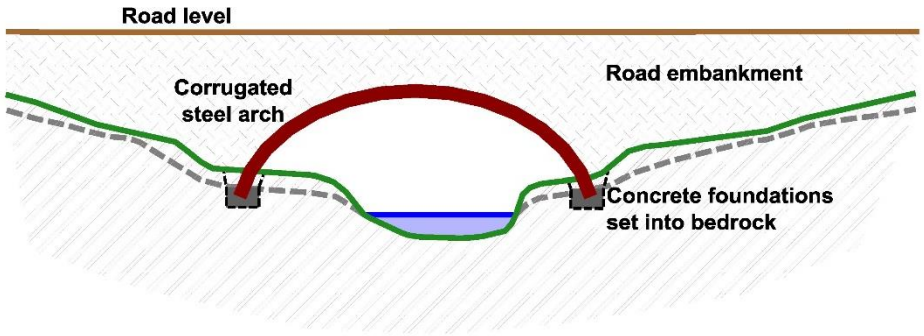
Indicative cross-section, not to scale

View upstream (ENE) from ND 2976 6966 showing boggy channel within wider flood channel.

View downstream (WSW) from ND 2976 6966 showing poorly-defined flow channel within wider flood channel.



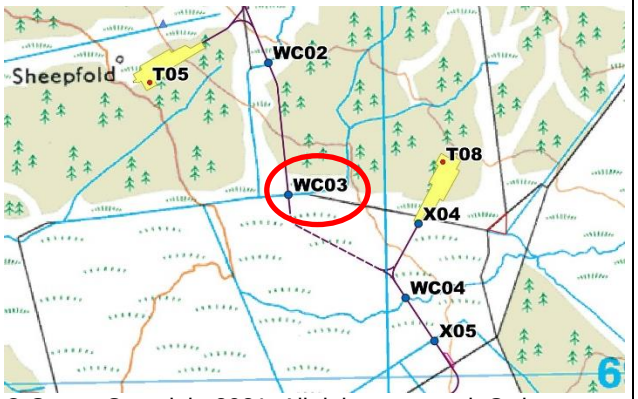
Watercourse Crossing Details		
Crossing:	WC03	
Location:	Between T08 and T09	
Watercourse:	Tributary to Link Burn	
NGR:	ND 2980 6938	
Description:	Small watercourse along field boundary with well-defined incised channel that has been heavily modified and straightened. Channel width is 3 m and has a peaty base. Banks heavily vegetated. Bank height 1-1.5 m.	
Catchment Area:	0.6 km^2	
Crossing Type:	Bottomless arch or bridge	



Indicative cross-section, not to scale

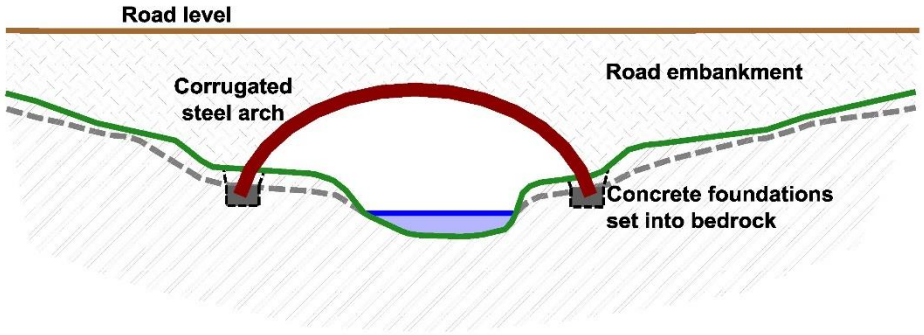
View upstream (east) from ND 2980 6938 showing channel and vegetated banks in wider floodplain.

View downstream (west) from ND 2980 6938 showing channel and vegetated banks in wider floodplain.



Watercourse Crossing Details

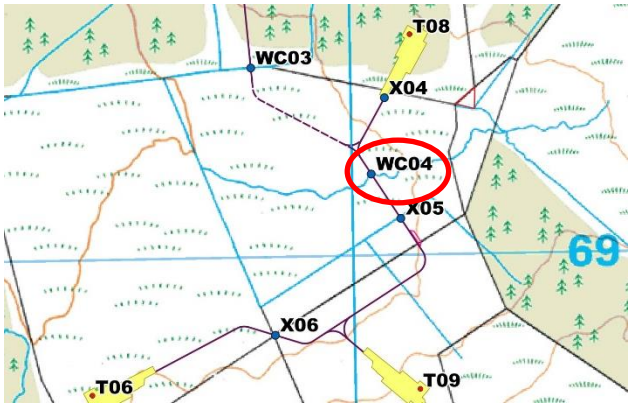
Crossing:	WC04
Location:	Between T08 and T09
Watercourse:	Tributary to Link Burn
NGR:	ND 3004 6916
Description:	Small meandering watercourse within an area of boggy rough ground. Very variable in width from 0.5-3 m with banks typically around 0.5-1 m high. Bedrock is exposed in the channel in some areas, with other sections cut into the peat. Clear signs of flooding under high water conditions, with signs of 'flood pools' adjacent to the main channel in places.
Catchment Area:	0.8 km^2
Crossing Type:	Bottomless arch culvert or bridge



Indicative cross-section, not to scale

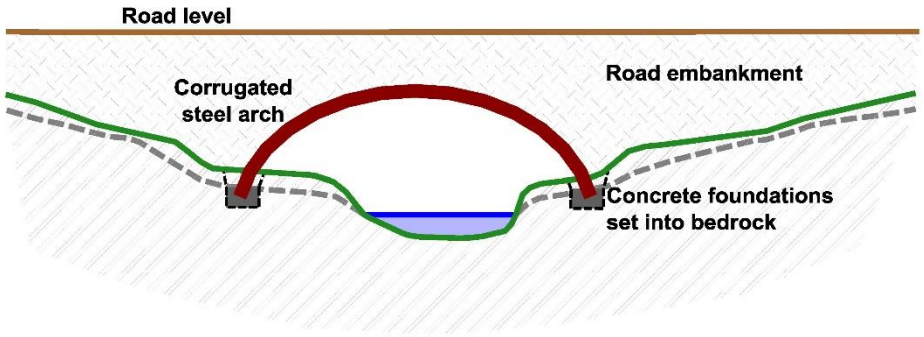
View upstream (east) from ND 3004 6916 showing channel and vegetated banks in wider valley.

View downstream (west) from ND 3004 6916 showing channel and vegetated banks.



Watercourse Crossing Details

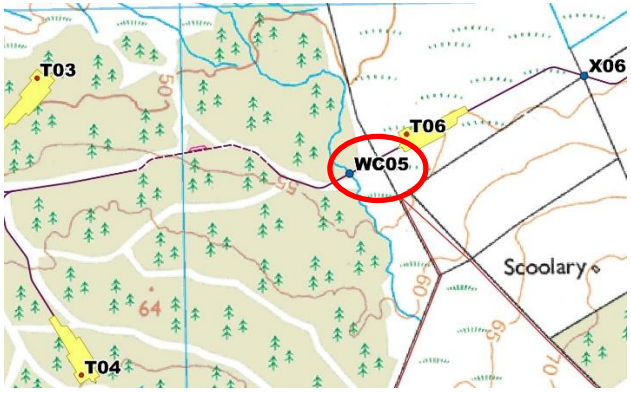
Crossing:	WC05
Location:	Between T03 and T06
Watercourse:	Tributary to the Link Burn
NGR:	ND 2935 6865
Description:	This watercourse has been heavily modified, with evidence of recent excavation forming a new ditch-like channel. The new channel is 0.9 m wide with bank heights of 0.8 m, and has been cut through the peat into the underlying glacial sediments. The channel shows signs of overtopping during high water conditions. The new channel diverts the flow from its former natural channel along the forestry margin in this location.
Catchment Area:	0.4 km^2
Crossing Type:	Bottomless arch or box culvert



Indicative cross-section, not to scale

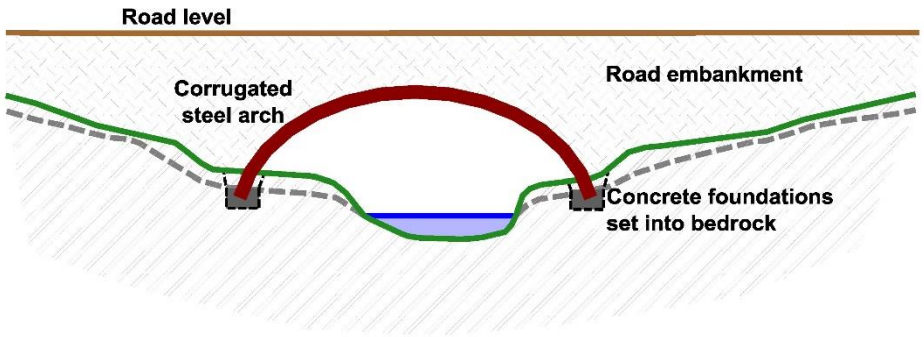
View upstream (SSE) from ND 2935 6865 showing excavated channel.

View downstream (NNW) from ND 2935 6865 showing excavated channel.



Watercourse Crossing Details

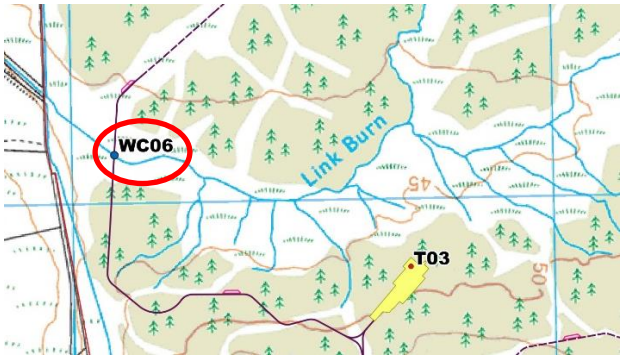
Crossing:	WC06
Location:	Between T02 and T03
Watercourse:	Link Burn
NGR:	ND 2809 6910
Description:	Moderate watercourse with well-defined incised channel that has been straightened. Relatively uniform width, 3.8 m wide. Banks relatively stable and well-vegetated. Bank height 1.3 m. In some sections, banks expose sections of peat.
Catchment Area:	6.2 km^2
Crossing Type:	Bottomless arch or box culvert



Indicative cross-section, not to scale

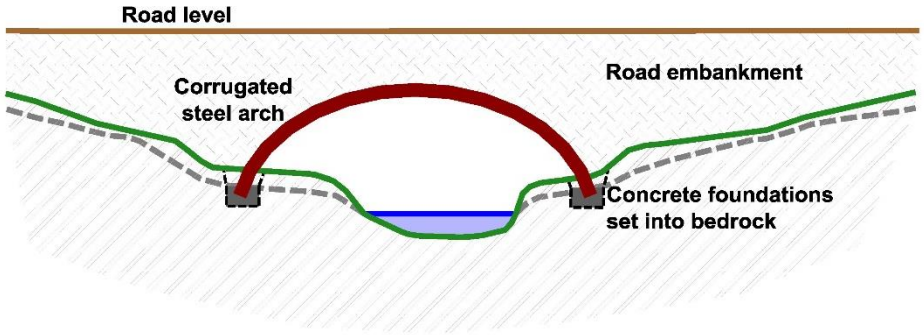
View upstream (ESE) from ND 3004 6916 showing well-defined channel with stable, vegetated banks.

View downstream (NNW) from ND 3004 6916 showing well-defined channel with stable, vegetated banks.



Watercourse Crossing Details

Crossing:	WC07
Location:	Existing access track north-west of study area
Watercourse:	Burn of Rattar
NGR:	ND 2703 7139
Description:	Moderate watercourse with well-defined incised channel that has been straightened. Relatively uniform width, 3.8 m wide. Banks relatively stable and well-vegetated. Bank height 1.3 m. In some sections, banks expose sections of peat.
Catchment Area:	13.8 km^2
Crossing Type:	Existing stone bridge crossing needing upgrade. Bottomless arch or box culvert



Indicative cross-section, not to scale

View upstream (SSW) from ND 2703 7139 showing well-defined channel with stable, vegetated banks.

View downstream (NNE) from ND 2703 7139 showing well-defined channel with stable, vegetated banks.

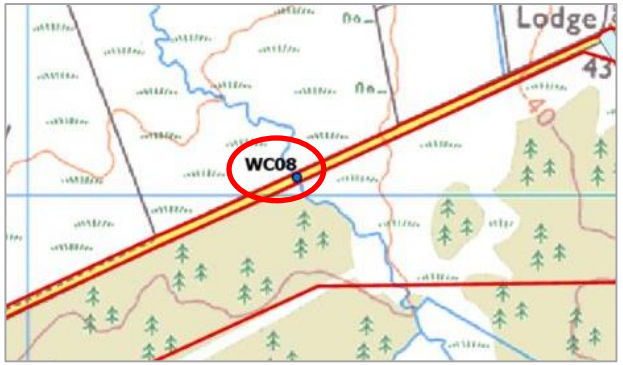
Watercourse Crossing Details

Crossing:	WC08
Location:	Existing access track north-west of study area
Watercourse:	Burn of Horsegrow
NGR:	ND 2841 7203
Description:	Moderate watercourse with well-defined incised channel that has been straightened. Relatively uniform width, 3.8 m wide. Banks relatively stable and well-vegetated. Bank height 1.3 m. In some sections, banks expose sections of peat.
Catchment Area:	1.72 km^2
Crossing Type:	Existing stone bridge crossing needing upgrade. Bottomless arch or box culvert

Photos of existing bridge

View upstream (SE) from ND 2841 7203 showing well-defined channel with stable, vegetated banks.

View downstream (NW) from ND 2841 7203 showing well-defined channel with stable, vegetated banks.



Additional watercourse crossings

5.21 In addition to the eight watercourse crossings detailed above, six crossings of minor watercourses would be required. Locations and details are provided in **Table 10.5.3.**

Table 10.5.3: Overview of minor watercourse crossings

Name	NGR	Comments
X01	ND 2910 7189	Existing stone-built cundy under the track, requiring upgrade. Field and trackside drainage along boundary of agricultural field and area of forestry, discharging into tributary of Burn of Horsegrow.
X02	ND 2922 7135	New crossing. Field and trackside drainage discharging into tributary of Burn of Horsegrow.
X03	ND 3009 7017	New crossing. Watercourse between forestry blocks forming tributary to Link Burn.
X04	ND 3006 6931	New crossing. Modified watercourse between forestry blocks forming tributary to Link Burn. Upstream of modified/straightened section along field boundary
X05	ND 3009 6908	New crossing. Drainage ditch near field boundary. Tributary to Link Burn.
X06	ND 2984 6884	Existing culvert under track, requiring upgrade. Drainage ditch along field boundary. Tributary to Link Burn.

5.22 Small scale drainage features are common across the Site, particularly in areas of forestry. There would be further drainage requirements along the access track route to maintain existing drainage capacity in these areas, particularly during periods of wetter weather.

6 CONCLUSIONS

6.1 This report has assessed the relevant aspects of drainage associated with the proposed Hollandmey Renewable Energy Development. It sets out a drainage strategy on which to base detailed design plans, recognising the requirements of THC and SEPA and taking current best practice guidance into account.

6.2 The Site currently drains naturally via overland flow and drainage ditches to the existing watercourses in and around the Site. The proposed drainage strategy promotes maintenance of natural runoff characteristics where possible, and drainage infrastructure to mimic these characteristics where required. Runoff attenuation and treatment proposals are designed to prevent any detrimental effects to the water quality or quantity of existing waterbodies. The proposed strategy makes use of SuDS features within the detailed engineering design to mimic the existing runoff characteristics.

6.3 Proposed SuDS include use of settlement ponds, swales, filter strips, check dams and silt fences/straw bales at different stages of the development.

6.4 Watercourse crossing locations have been identified and assessed, and appropriate conceptual crossing designs have been suggested to ensure that the watercourses retain their natural hydromorphology and ecological characteristics. Crossing design would take account of flood water conveyance. Details would be provided within the detailed design specifications.

6.5 All necessary authorisations under CAR would be put in place prior to any site works taking place.

7 REFERENCES

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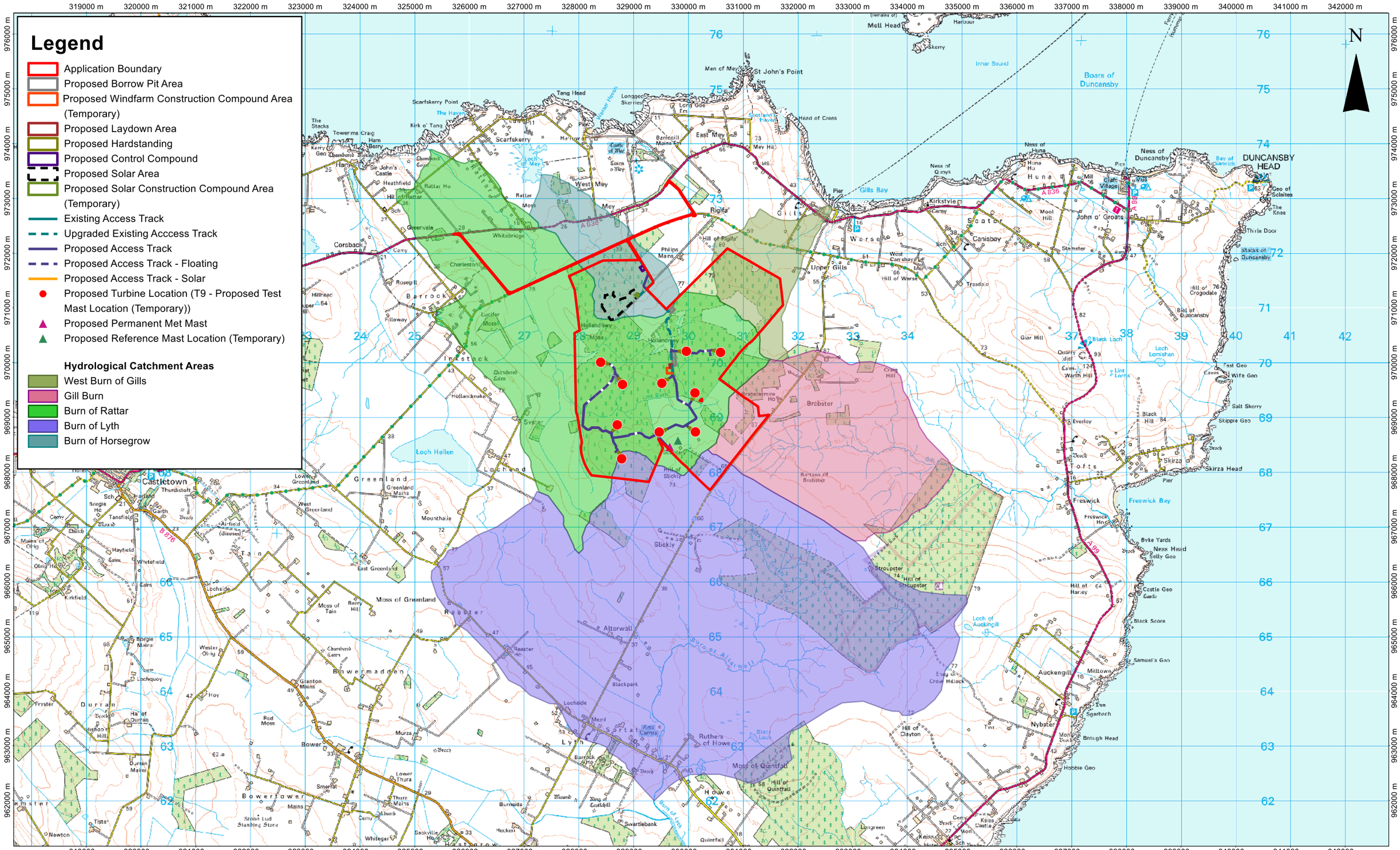

SCOTTISHPOWER RENEWABLES	E	10/11/2021	CI	Layout change	1:65,000 Scale @ A3	0 2 km	**Hollandmey Renewable Energy Development**
	D	28/10/2021	CI	Infrastructure & boundary update			Figure 10.5.1: Hydrological Catchment Areas
	C	19/08/2021	CI	Infrastructure update			
	Rev	**Date**	**By**	**Comment**			

Drg No	**HMY_Geo_CI**
Rev	**E**
Date	**10/11/2021**
Figure	**10.5.1**

Datum: OSGB36
Projection: TM

Legend

- Application Boundary
- Proposed Borrow Pit Area
- Proposed Windfarm Construction Compound Area (Temporary)
- Proposed Laydown Area
- Proposed Hardstanding
- Proposed Control Compound
- Proposed Solar Area
- Proposed Solar Construction Compound Area (Temporary)
- Existing Access Track
- Upgraded Existing Acccess Track
- Proposed Access Track
- Proposed Access Track - Floating
- Proposed Turbine Location (T9 - Proposed Test Mast Location (Temporary))
- Proposed Permanent Met Mast
- Proposed Reference Mast Location (Temporary)
- Watercourse
- Major Ditch
- Watercourse Crossing
- Minor Watercourse Crossing

Rev	Date	By	Comment
E	11/11/2021	CI	Layout change
D	03/11/2021	CI	Infrastructure & boundary update
C	20/08/2021	CI	Infrastructure update

1:25,000 Scale @ A3

0 1 km

Hollandmey Renewable Energy Development

Figure 10.5.2: Watercourse Crossing Locations

Drg No	HMY_Geo_CI	Datum: OSGB36 Projection: TM	
Rev	E		
Date	11/11/2021		
Figure	10.5.2		