voltalia

CRUACH CLENAMACRIE WIND FARM

APPENDIX 9.4 DRAINAGE IMPACT AND WATERCOURSE CROSSING ASSESSMENT

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Cruach Clenamacrie Wind Farm: Drainage Impact and Watercourse Crossing Assessment

Technical Appendix 9.4

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CONTENTS

1 INTRODUCTION 1
Drainage Impact Assessment 1
Watercourse Crossing Assessment 1
Regulatory Background 2
Development Proposals 2
2 DRAINAGE CHARACTERISTICS 4
Site Topography 4
Existing Drainage and Natural Catchments 4
Rainfall Characteristics 5
Catchment Land Use 5
Existing Drainage Infrastructure 5
Wastewater 5
Surface Water 6
Private Water Supplies 6
3 OUTLINE DRAINAGE STRATEGY 7
Introduction 7
Wastewater Drainage 7
Surface Water Drainage 7
Allowable discharge 7
Attenuation 8
Sustainable Drainage Systems 9
Quality of receiving waterbodies 9
Levels of treatment 10
SuDS components 10
Outline drainage strategy 12
Authorisation 12
4 WATERCOURSE CROSSING ASSESSMENT 13
Route Selection 13
Access track design 13
Access route 14
Crossing Descriptions 14
Desk study 14
Walkover survey 15
Ecological provision 15
Crossing details 15
5 CONCLUSIONS 23
6 REFERENCES 24
7 ANNEX A 25

TABLES

Table 9.4.1: Overview of Watercourse Catchment Areas and Infrastructure 4
Table 9.4.2: Details of crossings requiring authorisation 16

FIGURES

Figure 9.6 Hydrological catchments & Watercourses
Figure 9.7 Private Water Supplies
Figure 9.4.1: Watercourse crossing locations

1 INTRODUCTION

1.1 This report provides a Drainage Impact and Watercourse Crossing Assessment for Cruach Clenamacrie Wind Farm and associated infrastructure and ancillary features (hereafter referred to as the Proposed Development).

1.2 The report forms a Technical Appendix to the Environmental Impact Assessment Report (EIA Report) for the Proposed Development and should be read in conjunction with this document. It has been produced to address the requirement for new drainage infrastructure, including new and upgraded 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 Within this Technical Appendix, the following definitions will be used:

- the 'Proposed Development' refers to Cruach Clenamacrie Wind Farm and all associated infrastructure and ancillary features;
- the 'Application Boundary' refers to the extent of the area relating to the application for which consent will be sought;
- the 'Site' refers to the area within the Application Boundary within which the Proposed Development lies;
- the 'Study Area' refers to the Application Boundary plus a buffer zone of 2kilometres (km). Areas downstream, to a distance of 5km from the Application Boundary, are also considered, as effects can be transmitted downstream for greater distances than 2km.

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 drainage infrastructure 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 track layout for the Proposed 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 of waste water or effluent 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 water or wetland.

1.8 With respect to drainage infrastructure, any formal discharge to water or to land may require authorisation. The Applicant has a duty to manage water within the Site and discharge 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 Proposed Development.

1.9 With respect to watercourse crossings, any engineering works in inland waters or wetlands may require authorisation. The Scottish Environment Protection Agency (SEPA)'s 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 (OS) maps (Landranger series) (SEPA, 2024a).

1.10 On this basis, up to seven watercourse crossings required for access to the Proposed Development would require authorisation.

1.11 This report is produced in compliance with the requirements of SEPA and is in line with current best practice.

Development Proposals

1.12 The Proposed Development infrastructure would include:

- New Access tracks, passing places, and turning heads;
- Site entrance from the A85;
- Access route through Fearnoch Forest;
- Turbine foundations;
- Hardstanding areas for cranes at each turbine location;
- Blade laydown areas;
- Temporary construction compound, including parking, and welfare facilities;
- Watercourse crossings;
- Drainage works;
- Power cables, linking the wind turbines, laid in trenches underground, including cable markers;
- An on-site electrical substation, parking, and a small storage compound;
-

- Borrow Pits; and

1.13 Aviation obstacle lighting fitted to turbines. Full details of the Proposed Development design are provided in **EIA Report Chapter 5: Project Description**.

2 DRAINAGE CHARACTERISTICS

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

Site Topography

2.2 The Site is characterised by upland moor with irregular and undulating landforms. The highest point within the Site is the summit of Cruach Clenamacrie at 273m above Ordnance Datum (AOD). The wider area is characterised by similarly undulating areas of relatively high ground, notably Deadh Choimhead to the south at 383m AOD.

2.3 While most of the hill slopes within the Site are relatively gentle, steeper areas are present, notably along the south and south east of the Application Boundary. Generally, the main Site area slopes northwards from higher ground in the west and south-east. The Site is located in the headwaters areas of the River Lonan, Allt Nathais and Lusragan Burn, meaning that there are a number of small watercourses scattered throughout the Proposed Development.

2.4 The Site access runs through an area of commercial forestry managed by Forestry and Land Scotland. The Site access drops from approximately 190m AOD in the west to 30m AOD at the Site entrance, which is the lowest area within the Application Boundary.

Existing Drainage and Natural Catchments

2.5 The Proposed Development is located across three main catchment areas: the Lusragan Burn, the River Lonan and the Allt Nathais. Catchments are shown in **Figure 9.6**.

2.6 The Allt Nathais catchment drains the majority of Application Boundary, especially in the north and east. The River Lonan catchment drains the south, and the Lusragan Burn catchment drains the west.

2.7 Details are provided in **Table 9.4.1**.

Table 9.4.1: Overview of Watercourse Catchment Areas and Infrastructure

Catchment	Total area (km^2)	% of site within catchment	% of catchment within site	Comments
Allt Nathais 733350	18.45	64.63	10.89	Turbines 3, 4, 5, & 6 and associated hardstandings; BESS; substation; construction compound; access tracks; and internal wind farm tracks.
Lusragan Burn 734100	21.79	16.12	2.30	Internal wind farm tracks.

Catchment	Total area (km^2)	% of site within catchment	% of catchment within site	Comments
River Lonan 728500	20.65	19.23	2.89	Turbines 1 & 2 and associated hardstandings; and internal wind farm tracks.

Rainfall Characteristics

2.8 A review of the watercourse catchment and rainfall characteristics was undertaken using data from the Flood Estimation Handbook web service (CEH, 2024). Catchment statistics were provided for the main catchments in the Site.

2.9 Standard average annual rainfall (SAAR) for the catchment areas are as follows:

- Lusragan Burn: 1,796 mm
- River Lonan: 2,188 mm
- Allt Nathais: 1,979 mm

2.10 The calculations in **Section 3** below make use of the figures for River Lonan catchment, as this has the highest SAAR and provides the most conservative estimate for the Proposed Development.

Catchment Land Use

2.11 Within the Application Boundary the land use consists of rough grazing and upland moorland, mires and mosaics of blanket bog. The access track to the Site runs through an area of commercial forestry. Much of the proposed access track make use of existing forestry tracks and includes existing watercourse crossing structures. Watercourses within the Proposed Development are mainly in their natural or near-natural condition, with generally high levels of sinuosity. There is some evidence of channel modification in places, including straightening and artificial drainage.

2.12 There are a number of small settlements within close proximity to the proposed access track, including Fearnoch and Dailmanac. The land at the site entrance from the A85 is used for agricultural purposes. Although managed for commercial purposes, Fearnoch Forest is also used for recreational activities including walking and biking and incorporates a car park which is accessed via a small track south off the A85, near the proposed access route.

Existing Drainage Infrastructure

Wastewater

2.13 There is no existing wastewater infrastructure, either foul drainage or surface water drainage, present within the Proposed Development.

Surface Water

2.14 The Study Area primarily drains naturally via filtration and overland flow to the existing watercourse network. There is evidence of drainage modification in areas associated with existing tracks and forestry. Alongside the existing forestry tracks, trackside drainage is present along one or both sides of the track in most areas. In areas of forestry there are drainage ditches which are in place to improve ground conditions for forestry growth.

2.15 Watercourses and waterbodies within the catchments appear mostly to be in near-natural condition. There is some evidence of modification and straightening of channels within the Study Area, particularly along the existing forestry track.

Private Water Supplies

2.16 Data obtained from Argyll and Bute Council regarding PWS indicates that there are no PWS present within the Application Boundary; however, 19 have been identified within 2km of the Application Boundary. Details of PWS identified are provided in **Table 9.11** of the **EIA Report Chapter 9: Geology, Hydrogeology, Hydrology and Soils** and are shown in **Figure 9.7**.

2.17 No wells or springs are identified on OS mapping within the Site or within 2km of the Application Boundary. BGS GeoIndex (BGS, 2024) identifies two boreholes to the north of the A85.

3 OUTLINE DRAINAGE STRATEGY

Introduction

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

Wastewater Drainage

3.2 There is not currently a foul drainage network within the Site; this may be implemented as part of the development and would be confirmed post-consent.

3.3 Welfare facilities for use during construction would have suitably sized holding tanks and wastewater would be removed by tanker for disposal at a licensed disposal facility.

3.4 It is unlikely that ground conditions within the Site would be suitable for a soakaway. Therefore, operational phase welfare facilities would utilise one of the following:

- A suitably sized holding tank with wastewater removed from the Site by a tanker for disposal at a licensed disposal facility in line with construction phase proposals;
- A waste treatment package plant with associated discharge as a longer-term alternative; or
- Waterless composting toilet facilities with bottled water provided for washing and drinking.

Surface Water Drainage

3.5 The surface water drainage network for the Site would be designed taking into account the Sustainable Urban Drainage Scottish Working Party's (SUDSWP) Water Assessment and Drainage Assessment Guide (2016) and CIRIA Publication C735 – the SuDS Manual (2015).

3.6 The following sections describe the requirements that lead to determination of the proposed outline drainage strategy and which inform sustainable drainage systems (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.

3.8 In line with current best practice guidelines for development, runoff rates and volumes post-development should not exceed the pre-development greenfield runoff rate. It is anticipated that the allowable discharge from the Site would match that of the existing 1-in-2 year greenfield runoff rate. This is discussed in the following sections.

Post-development discharge criteria

3.9 Post-development surface water flows would be restricted to the discharge levels set out in the SUDS Working Party's Water Assessment and Drainage Assessment Guide (SUDSWP, 2016) and would be in line with best practice. The development proposals recognise SEPA'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. However, if infiltration to ground is not feasible, the additional runoff generated should be discharged from the site at flow rates below 2 l/s/ha.
- Formal on-site storage should be provided up to the 1-in-30 year return periods event (3.33% annual exceedance probability) and attenuation measures should be designed such that SuDS features would not surcharge during a 1-in-30 year return period rainfall event.
- The 1-in-200 year event (0.5% annual exceedance probability) should be contained on Site, unless it can be demonstrated that the 1-in-200 year event could be managed appropriately without causing increased flood risk elsewhere.

Greenfield runoff assessment

3.10 A review of the catchment characteristics relating to the Proposed Development was undertaken using the FEH Web Service (CEH, 2024). Catchment statistics for the River Lonan are considered to give a worst-case scenario for the Site as it has the highest SAAR of the three catchments and a similar SPR to the other two. The following catchment statistics have been used to determine the Greenfield Runoff Rate that corresponds to the existing characteristics within the Study Area:

- Standard average annual rainfall (SAAR) of 2,188 mm for the Study Area;
- Standard percentage runoff (SPR) of 53 %.

3.11 The Greenfield Runoff Rate has been calculated using the online Greenfield Runoff Estimation for Sites tool (UK SuDS, 2024), which gives the IH124 model results for the Study Area.

3.12 The construction phase land take is considered to be double the infrastructure footprint. This is to ensure that the value incorporates the edges of tracks and hardstandings, as well as any drainage that is required for the proposed infrastructure. Therefore, 36 ha is considered to represent the total area requiring drainage for the purposes of Greenfield Runoff calculations.

3.13 The 1-in-2 year Greenfield Runoff Rate has been calculated to be **855.8 l/s** based on a total drained area of **36 ha**.

3.14 The output from the Greenfield Runoff Estimation for Sites tool is provided in **Annex A**.

Attenuation

3.15 SEPA'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.

3.16 The drainage strategy for the Proposed Development aims to promote attenuation within the SuDS proposals to mitigate any additional surface water runoff generated as a result of the Proposed 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 SEPA's guidance.

3.17 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 3,200 m^3 is required.
- For a 1-in-200 year return period event plus climate change allowance, storage of approximately 4,200 m^3 is required.

3.18 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 SEPA's guidance documents.

Sustainable Drainage Systems

3.19 The outline 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 Site and that runoff quality would not risk any reduction in the water quality of the receiving waterbodies.

Quality of receiving waterbodies

3.20 SEPA's Water Classification (SEPA, 2024b) and Water Environment Hubs (SEPA, 2024c) have been consulted to determine the existing baseline water quality for the main watercourses and waterbodies within the Application Boundary.

Surface waterbodies

3.21 A number of minor headwater tributaries drain the south of the Proposed Development, via the Allt Fròga ch and unnamed tributaries, into the River Lonan. The River Lonan was classified by SEPA in 2022 as having a 'Moderate' overall and hydromorphology condition, and a 'Good' biology condition. In 2020, SEPA designated the River Lonan as having a 'Moderate' overall and water flows & levels conditions, largely due to water abstraction for hydroelectricity.

3.22 A few headwater tributaries drain into the Lursragan Burn/Black Lochs via the Allt an t-Sean-achaidh and unnamed systems. In 2022 SEPA designated these as having a 'High' overall, biology (fish) and hydromorphology condition. The river system was also classified having a 'High' condition in 2020.

3.23 Much of the Site in the north is drained by the River Luachragan and Allt na Seabhaig into the Allt Nathais. In 2020 SEPA designated this system as having a 'Moderate' overall, and physical condition, relating to modifications from farming, although the water flows and levels, and water quality were both assessed as 'High'. The classification in 2022 returned 'Moderate' ratings for overall status and hydromophology and 'High' rating for biology (fish).

Receiving waterbodies

3.24 The River Lonan drains west into Loch Nell. The Lusragan Burn and Allt Nathais drain north into Loch Etive.

3.25 Loch Nell was designated by SEPA in 2020 as having 'Good' overall condition and water quality, with 'High' status for water flows and levels and physical condition. In 2022 the waterbody was classed as having a 'Good' overall condition, with a 'High' biology (fish) and hydromorphology condition.

3.26 Loch Etive was designated by SEPA in 2020 having 'Good' overall condition, with 'High' ratings for physical condition and water quality. In 2022 the waterbody was classed as having a 'Good' overall and biology (fish) condition, and a 'High' hydromorphology condition.

Levels of treatment

3.27 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 a development, from construction through to decommissioning. Much of the construction phase surface water treatment could provide suitable water treatment for the operational phase.

3.28 SEPA's planning guidance on SuDS (2010) states that *'Each individual type of SuDS feature, such as a filter drain, detention basin, permeable paving or swale, provides one level of treatment.'*

3.29 All operations on the Proposed Development during construction and decommissioning would require at least two levels of treatment prior to discharge, as a result of the high sensitivity of the receiving waterbodies and the high potential for generating loose sediment associated with construction and excavation works. Areas of the Proposed Development with a higher pollution risk, notably concrete batching (if used), any areas used for plant maintenance and refuelling, and any groundworks within 50m of the Loch Etive Woods SAC boundary would require three levels of treatment.

3.30 During operation, one level of treatment, such as swales or filter drains, should be sufficient for most of the Proposed Development apart from any areas where potentially polluting materials such as fuel, oils and lubricants, are used or stored. These areas would require at least two levels of treatment as a result of their higher pollution risk.

SuDS components

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

Swales and filter strips

3.32 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.

3.33 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

3.34 Filter drains are also linear features, but rather than incorporating vegetation they include coarse graded rock which provides good drain stability while 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

3.35 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 10-20m. 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.

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

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

Silt fences

3.38 Silt fences, constructed from a closely woven synthetic geotextile material, provide temporary 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 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

3.39 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.

Sumps

3.40 Sumps are essentially small settlement ponds, located in areas where there are space restrictions preventing use of a larger pond, or where large volumes of water or sediment are not anticipated. Water can either discharge naturally from a sump or can be pumped out to an alternative location for discharge or further treatment.

Outline drainage strategy

3.41 The surface of access tracks would have a cross-fall in order to encourage runoff to drain into trackside ditches along the side of the track where necessary, and lateral and cross-drains would also be installed where required. Drainage outlets would be carefully located with erosion protection if required.

3.42 Settlement ponds would be used at borrow pit sites, construction compounds, BESS and substations for storage, attenuation and treatment of surface water. Settlement ponds may also be required at turbine and hardstanding locations, depending on the ground conditions present. The ponds would be established during construction to provide water management for the construction phase works.

3.43 Swales, filter strips and filter drains would provide attenuation, storage and treatment for access tracks and turbine hardstanding areas. Swales would form the preferred option where space and ground slopes are suitable, although it is likely that filter strips and filter drains would have to be used in some areas as a result of slope and space constraints. When providing drainage across slopes, check dams and berms would be used across the flow path of swales and filter strips to promote settling and infiltration. 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.

3.44 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 or filter drains at the end of the construction phase if long-term drainage is required.

Authorisation

3.45 Where proposals have potential to affect the water environment, the design of any works required to mitigate these effects must take into account the Proposed Development'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-site. It is anticipated that a Construction Runoff Permit would be required for the Proposed Development.

4 WATERCOURSE CROSSING ASSESSMENT

Route Selection

4.1 Prior to consideration of watercourse crossings in detail, SEPA would wish to ensure 'good practice' has been followed, including avoidance or minimisation of the number of crossings. The number of crossings is a function of the proposed access route, to connect the proposed 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 such as areas of deep peat or sensitive habitats; and
- Whole-life costs for construction and maintenance.

4.2 With these factors in mind, a preferred track geometry has been determined to connect the proposed turbines and other essential development infrastructure. Compromise is always required between competing constraints and concerns. The desire to site turbines and associated hardstanding areas on areas of shallow or no peat, plus a series of environmental and engineering constraints requiring avoidance of sensitive areas and potentially unstable or waterlogged ground, means that track geometry is constrained by ecological and hydrological features.

4.3 There is no link between 'optimum', in terms of a balance between environmental and engineering constraints, and 'best practice' in the Water Framework Directive 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

4.4 The water environment and associated concerns formed an integral part of the track design process for the Proposed Development, which developed in an iterative manner in parallel with the proposed turbine and associated infrastructure layout. Options for limiting watercourse crossings on tracks have been restricted owing to other site constraints; however, the number of entirely new watercourse crossings has been kept to a practical minimum through careful design.

Access route

4.5 As discussed in the **EIA Report Chapter 5: Project Description**, access to the Proposed Development would be from the A85 to the north of the Site. The proposed access route to the Site takes advantage of the network of existing forestry tracks, with only limited sections of new track where engineering constraints require. Both crossings on this section of track would be upgraded existing or replacement crossings. Please refer to **Figure 9.4.1** for locations of all watercourse crossings.

4.6 Within the Site, there is one main spine track that runs roughly north-east to south-west through the Site to turbine T1. Small spur tracks depart from this spine to give access to the other turbines.

4.7 Owing to the Site topography, there are five new crossings required within the area of the Site where the turbines are located. WC1 is located near turbine T4 on an unnamed tributary to the Eas nam Meirleach. WC2 is located on the main spine track, also on an unnamed tributary to the Eas nam Meirleach, and WC3 is located on the access track to turbine T3 on the same tributary.

4.8 WC4 is located on the access track to turbine T5, on an unnamed tributary to the Eas nam Meirleach, and WC5 is located on the access track to Turbine T6 on the same tributary.

Removal or modification of existing structures

4.9 Where a proposed new crossing is located adjacent to an existing crossing, it is considered best practice to remove the redundant structure.

4.10 Two watercourse crossings. WC6 and WC7 **(Figure 9.4.1),** along the existing forestry track of the proposed access route, are likely to require upgrading or replacement as part of the track upgrading process. Depending on agreement with FLS, it is proposed to remove the existing culverts and replace them with new bottomless arch or box culverts.

Cable crossing locations

4.11 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 cable crossings of watercourses shown on OS 1:50,000 mapping.

Crossing Descriptions

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

Desk study

4.13 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.

Walkover survey

4.14 Walkover surveys were undertaken by RSK in tandem with the Phase 1 and 2 peat surveys in February 2022, November 2023, May 2024 and June 2024. The identified crossings were visited as part of these surveys to obtain specific information about each crossing location. The walkover surveys were undertaken in varied conditions, mainly clear and dry but at widely variable times of year. 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.

4.15 During the walkover surveys photographs and detailed field notes were taken to record dimensions of the watercourse channels and flood channels, 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 5m accuracy.

Ecological provision

4.16 The minor watercourses draining the Site are likely to include habitats of conservation importance in a local context, supporting populations of salmonid fish, otter and other aquatic species. Connectivity via these minor tributaries to larger watercourses in the wider catchment increases their sensitivity. As most of the watercourses within the main Site drain into the Loch Etive Woods SAC they are all considered to have high sensitivity and high ecological value. Impacts to the Loch Etive SAC are discussed in more detail in **Appendix 10.7**.

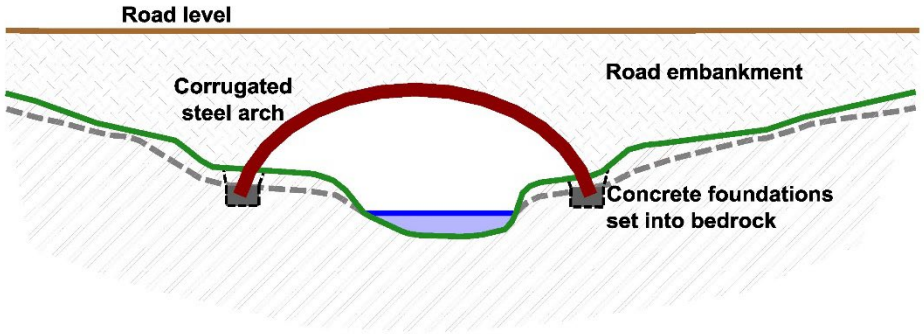
4.17 It is advisable, as a result, that ecological considerations are included in crossing designs. New or replacement crossings would make use of open-bottomed arch or box culverts or bridge structures in order to minimise disturbance of watercourse channels and banks. Where opportunities exist, existing crossings would be modified to make them more suitable for freshwater species.

Crossing details

4.18 The following table (**Table 9.4.2**) 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 9.4.1.**

Table 9.4.2: Details of crossings requiring authorisation

Watercourse Crossing Details	
Crossing:	WC1
Location:	North-west of T4
Watercourse:	Tributary of Eas nam Meirleach
NGR:	NM 94247 30201
Description:	Relatively minor vegetated (grass and bracken communities) watercourse in a well-defined narrow channel. Gently sloping low banks, with a broad floodplain area to either side. The channel is roughly 0.3m by 0.5m, largely cut into peat and mineral soils. There is no evidence of ponding within the vicinity of the proposed crossing.
Catchment Area:	14.5ha
Crossing Type:	Bottomless arch or box culvert



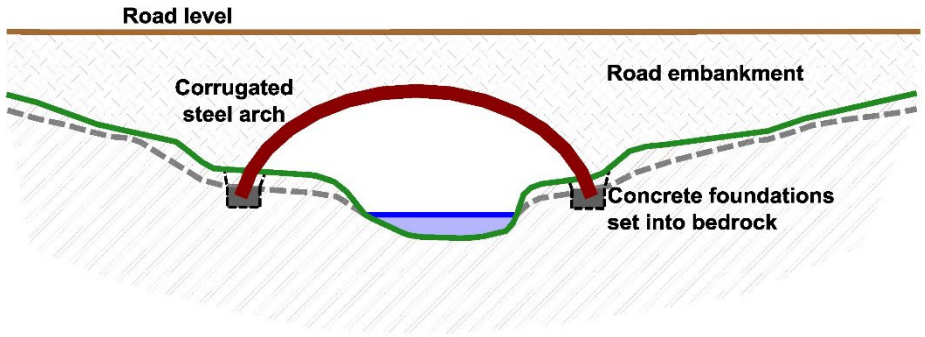
Indicative cross-section, not to scale

View upstream (SW) from NM 94247 30201 showing channel and vegetated banks.

View downstream (E) from NM 94247 30201 showing channel and vegetated banks.

Watercourse Crossing Details

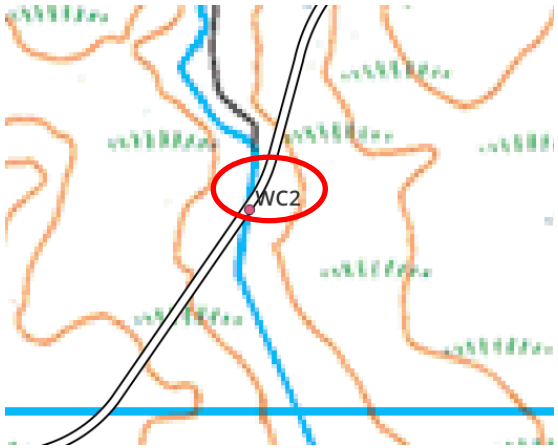
Crossing:	WC2
Location:	On the access track between T3 and T4
Watercourse:	Tributary of Eas nam Meirleach
NGR:	NM 94399 30117
Description:	Relatively minor vegetated (grass and rush communities) watercourse in a well-defined narrow channel. Gently sloping and low banks, where the watercourse could spill out onto the floodplain. The channel is roughly 0.5m by 0.5-1m. There is evidence of small pockets of pooling water within the vicinity of the proposed crossing.
Catchment Area:	48.5ha
Crossing Type:	Bottomless arch or box culvert



Indicative cross section, not to scale

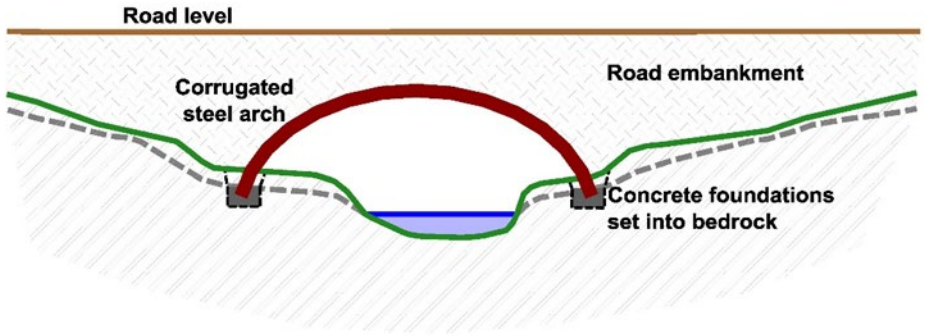
Upstream (S) from NM 94528 30476 showing channel and vegetated banks.

Downstream (N) from NM 94528 30476 showing channel and vegetated banks.



Watercourse Crossing Details

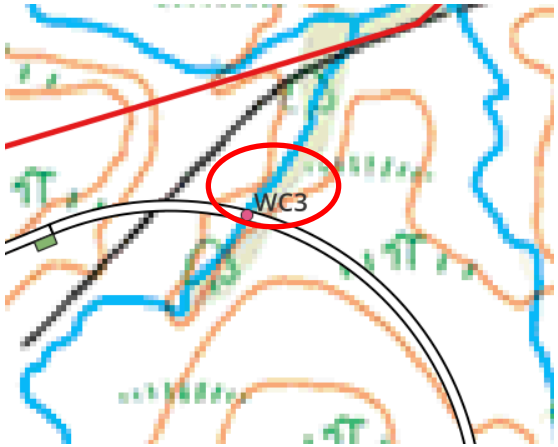
Crossing:	WC03
Location:	West of T3
Watercourse:	Tributary of Eas nam Meirleach
NGR:	NM 94528 30476
Description:	Moderately large and well-defined channel is shallow and approximately 1.5m wide, and 0.5-1m deep. Rocky bed with exposed bedrock and fluvial deposits (cobbles and pebbles). Both banks are well-vegetated with grass, shrubs and small trees.
Catchment Area:	70.8ha
Crossing Type:	Bottomless arch or box culvert



Indicative cross-section, not to scale

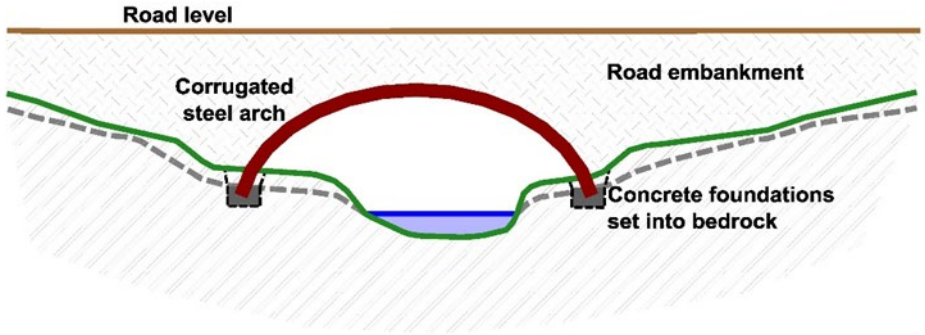
View upstream (SW) from NM 94528 30476 showing well-defined channel and vegetation.

View downstream (NE) from NM 94528 30476 showing well-defined channel.



Watercourse Crossing Details

Crossing:	WC4
Location:	Along access track towards T5
Watercourse:	Tributary of Eas nam Meirleach
NGR:	NM 95068 30374
Description:	Boggy area with upstream channel being heavily vegetated wide flood channel, and becoming narrow and well-defined downstream. Channel 0.2-1m wide and up to 0.5m deep. Low poorly defined banks with a wide floodplain area. Area is well-vegetated with rushes, sedges and grasses.
Catchment Area:	10.1 ha
Crossing Type:	Bottomless arch or box culvert



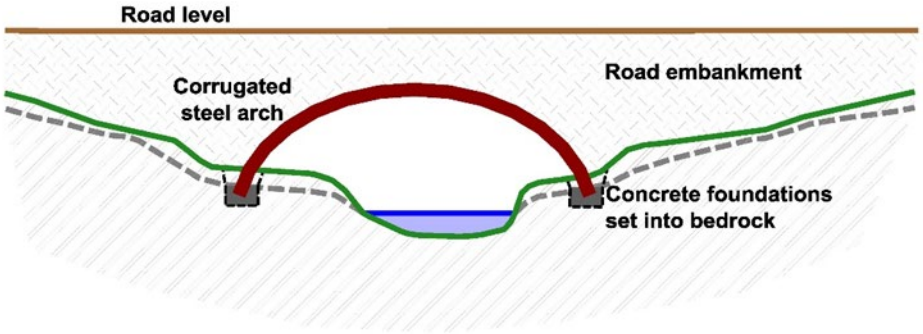
Indicative cross-section, not to scale

Upstream (S) from NM 95068 30374 showing not well-defined and vegetated channel.

View downstream (N) from NM 95068 30374 showing narrow, well-defined channel.

Watercourse Crossing Details

Crossing:	WC5
Location:	Access track to Turbine 6
Watercourse:	Tributary of Eas nam Meirleach
NGR:	NM 95064 30243
Description:	The channel is narrow but well-defined with a pebble and cobble bed. moderately large with a well-defined waterfall. Bedrock is exposed with fluvial substrate (cobbles and boulders). The channel is approximately 1 m wide and 1 m deep. Both banks are well-vegetated with grass, shrubs and small trees.
Catchment Area:	9.4 ha
Crossing Type:	Bottomless arch or box culvert

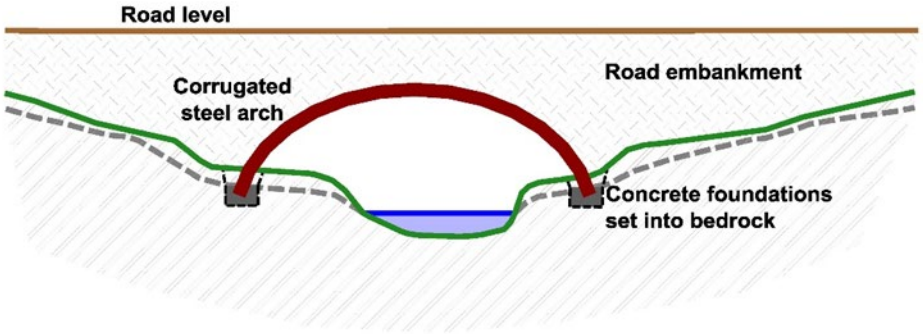


Indicative cross-section, not to scale

Upstream (S) from NM 95064 30243 showing the narrow channel but well-defined channel.

Downstream (S) from NM 95064 30243 showing the pebble and cobble channel bed.

Watercourse Crossing Details	
Crossing:	WC6
Location:	Along the proposed access track
Watercourse:	Allt an Taillir
NGR:	NM 97211 30314
Description:	The Allt an Taillir is a minor watercourse feeding the Allt Nathais. The existing forestry track and culvert cross the Allt an Taillir, which has roughly 1m by 1m dimensions. The previously existing crossing will need upgrading to current best practice guidelines.
Catchment Area:	5.2 ha
Crossing Type:	Replacement crossing: bottomless culvert.



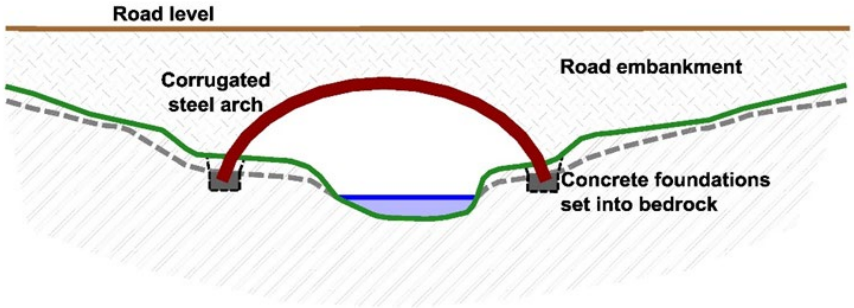
Indicative cross-section, not to scale

Upstream (W) from NM 97211 30314 showing the pebble and cobble channel bed and vegetation along banks.

Downstream (NE) from NM 97211 30314 showing the existing culvert at the proposed crossing.

Watercourse Crossing Details

Crossing:	WC7
Location:	Along the Proposed Access Track
Watercourse:	Eas na Làraiche Mòire
NGR:	NM 97238 31328
Description:	The Eas na Làraiche Mòire is a minor watercourse feeding the Allt Nathais. The existing forestry track and large culvert cross the watercourse, which has roughly 2m by 1m dimensions. The previously existing crossing will need upgrading to current best practice guidelines.
Catchment Area:	6.7 ha
Crossing Type:	Replacement crossing: bottomless culvert



Indicative cross-section, not to scale

Downstream (NE) from NM 97238 31328 showing the existing culvert at the proposed crossing.

Upstream (W) from NM 97238 31328 showing the cobble channel bed and vegetation along banks.

5 CONCLUSIONS

5.1 This report has assessed the relevant aspects of drainage associated with the Proposed Development. It sets out an outline drainage strategy on which to base detailed design plans, recognising the requirements of SEPA, and taking current best practice guidance into account.

5.2 The Proposed Development currently drains semi-naturally via overland flow, drainage ditches and natural channels to the existing watercourses in and around the area. The outline 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 to be designed to prevent any detrimental effects to the water quality or quantity of existing waterbodies. The outline drainage strategy makes use of SuDS features within the detailed engineering design to mimic the existing runoff characteristics.

5.3 Proposed SuDS to be incorporated in the detailed drainage strategy include use of swales and filter strips, filter drains, check dams, silt fences and straw bales, settlements ponds and sumps at different stages of the Proposed Development. During construction, small sumps with silt fencing would be established periodically along track routes.

5.4 Watercourse crossing locations have been identified and assessed, and appropriate conceptual crossing designs have been suggested for new crossings to ensure that the watercourses retain their natural hydromorphology and ecological characteristics. A total of five new regulated crossings and two crossings requiring upgrading have been identified. Crossing design would take account of flood water conveyance. Details would be provided post-consent within the detailed design specifications, including any proposals for replacement of existing structures that may be in poor condition or under-sized in terms of their conveyance capacity.

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

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7 ANNEX A

hr wallingford

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Samuel Jarvis
Site name:	Cruach Clenamacrie
Site location:	Oban

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	56.41994° N
Longitude:	5.33119° W
Reference:	1293496556
Date:	Aug 29 2024 16:29

Runoff estimation approach

IH124

Site characteristics

Total site area (ha): 36

Methodology

Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Specify SPR manually

Soil characteristics

	Default	Edited
SOIL type:	5	5
HOST class:	N/A	N/A
SPR/SPRHOST:	0.53	0.53

Hydrological characteristics

	Default	Edited
SAAR (mm):	1996	2188
Hydrological region:	1	1
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	1.95	1.95
Growth curve factor 100 years:	2.48	2.48
Growth curve factor 200 years:	2.84	2.84

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited

Q_{BAR} (l/s):	768.61	855.8
1 in 1 year (l/s):	653.32	727.43
1 in 30 years (l/s):	1498.79	1668.81
1 in 100 year (l/s):	1906.15	2122.39
1 in 200 years (l/s):	2182.85	2430.48

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement , which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.