Hare Hill Windfarm Repowering and Extension

Environmental Impact Assessment Report

Volume 1

Chapter 9: Hydrology, Hydrogeology and Geology

November 2025

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Glossary

Term	Definition
Above Ordnance Datum	The mean sea level at Newlyn (UK) used as a base measurement on Ordnance Survey Maps for contours.
Aquifer	A rock formation that is sufficiently porous and permeable to yield a significant quantity of water to a borehole, well or spring. The aquifer may be unconfined beneath a standing water table or confined by an impermeable or weakly permeable horizon.
Catchment	A catchment boundary defines the area of land which drains to a given point (the catchment outlet).
Confluence	The point at which two watercourses meet.
EIA Regulations	The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017.
Environmental Impact Assessment	Environmental Impact Assessment (EIA) is a means of drawing together by the developer, in a systematic way, a description of the development and information relating to of the likely significant environmental effects arising from a proposed Development.
Environmental Impact Assessment Report	A document reporting the findings of the EIA and produced in accordance with the EIA Regulations.
Geographic Information System	Computerised data base of geographical information that can easily be updated and manipulated.
Groundwater Dependent Terrestrial Ecosystems	Terrestrial wetland ecosystem dependent upon a groundwater supply for their existence.
Natural Power	The lead consultant EIA co-ordinator is Natural Power Consultants Limited.
Peat	An organic surface horizon over 0.5 m deep of partially decomposed remains of plants and organic matter that is formed in wet anaerobic ground.
Permeability	The ability of a fluid, like water or oil, to pass from one pore space to another.
Private Water Supply	Water not supplied by a statutory water undertaker such as a water company.
proposed Development	The proposed Hare Hill Windfarm Repowering and Extension as described in **Chapter 5** of this EIA Report.
Site	The project development area within the site boundary as shown in **Figure 5.1** of this EIA Report.

Term	Definition
Superficial Deposits (geology)	These are the youngest form of geological deposit formed during the most recent period of geological time. These directly overlie the solid bedrock and can often be unconsolidated and highly permeable.
Sustainable Drainage Systems	A sequence of management practices and control structures designed to drain system's surface water (SuDS) in a more sustainable fashion than some conventional techniques.
Sub-catchment	A division of a catchment, to allow runoff to be managed as near to the source as is reasonable.
Tributary	An adjoining stream which flows into the main river.

Abbreviations

Abbreviation	Description
AOD	Above Ordnance Datum
AST	Above Ground Storage Tank
BFI	Base Flow Index
BGS	British Geological Survey
BP3	Borrow Pit 3
CAR	Water Environment (Controlled Activities) (Scotland) Regulations 2011
CC	Climate Change
CIRIA	Construction Industry Research and Information Association
CO	Conservation objective
CRL	Construction Run-off Licence
DCEMP	Decommissioning and Construction Environmental Management Plan
DGC	Dumfries and Galloway Council
EAC	East Ayrshire Council
EASR	Environmental Authorisations (Scotland) Regulations 2025
ECoW	Environmental Clerk of Works
EIA	Environmental Impact Assessment
EIA Regulations	Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017
EU	European Union
FEH	Flood Estimation Handbook
FRA	Flood Risk Assessment
GBR	General Binding Rule
GCR	Geological Conservation Review
GPP	Guidance for Pollution Prevention

Abbreviation	Description
GW	Ground water
GWDTE	Ground Water Dependant Terrestrial Ecosystems
HH	Hare Hill
HHE	Hare Hill Extension
HOST	Hydrology Of Soil Types
LUPS	Land Use Planning System
NNR	National Nature Reserve
NPF4	National Planning Framework 4
NVC	National Vegetation Classification
PAN	Planning Advice Notes
PIRP	Pollution Incident Response Plan
PMP	Peat Management Plan
PPP	Pollution Prevention Plan
PWS	Private Water Supply
RBMP	River Basin Management Plan
RR	Residual Receptor
SAC	Special Area of Conservation
SEPA	Scottish Environment Protection Agency
SGt	Scottish Government
SNH	Scottish Natural Heritage (now NatureScot)
SPA	Special Protection Area
SPR	Standard Percentage Runoff
SSSI	Site of Special Scientific Interest
SuDS	Sustainable urban Drainage Systems
WFD	Water Framework Directive (2000/60/EC)
WQMP	Water Quality Monitoring Programme

9. Hydrology, Hydrogeology and Geology

9.1. Statement of Competence

1. The assessment and associated Technical Appendices were undertaken by Natural Power Consultants Ltd (Natural Power). Natural Power has an established reputation in providing assessment of hydrological, geological, hydrogeological and soil environment considerations discussed in this Chapter.

2. This document has been approved by Paul McSorley whose qualifications include a BSc (Hons) in Environmental Science and is a fellow of the Geological Society. Paul has over 15 years' experience in the technical input and report writing and review of numerous hydrological Environmental Impact Assessment (EIA) Chapters for windfarms, solar and Battery Energy Storage Systems projects across the UK.

3. He has experience of offering advice and solutions to protect the water environment, hydrogeology, peat and soils during construction, operation and decommissioning of windfarm developments. Work carried out involves regular liaison with statutory consultees as well as collaborating with ecologists, geotechnical engineers and project managers to allow all work to be carried out in line with industry good practice, agreed consenting strategies and up-to-date legislation.

9.2. Introduction

4. This Chapter of the EIA Report assesses the potential effects of the proposed Development with respect to Hydrology (including flood risk), Geology (including peat) and Hydrogeology (including ground conditions). The Chapter should be read in conjunction with the site design commentary provided in **Chapter 2: Legal and Policy Context**, **Chapter 4: Site Selection and Design Evolution** and **Chapter 5: Development Description**. It should also be read with respect to the relevant parts of **Chapter 7: Ecology and Biodiversity**, where common receptors have been considered and where there is an overlap or relationship between the assessment of effects.

5. The Chapter is supported by the following technical appendices:

    - **Technical Appendix 5.1: Outline Decommissioning and Construction Environmental Management Plan;**
    - **Technical Appendix 9.1: Watercourse Crossing Assessment;**
    - **Technical Appendix 9.2: Private Water Supply Risk Assessment;**
    - **Technical Appendix 9.3: Groundwater Dependant Terrestrial Ecosystems Assessment;**
    - **Technical Appendix 9.4: Outline Peat Management Plan;**
    - **Technical Appendix 9.5: Borrow Pit Appraisal Report; and**

- Technical Appendix 9.6: Peat Slide Risk Assessment Stage 2.

6. The Chapter is supported by the following figures which are referenced in the text, where relevant:

   - Figure 9.1: Hydrology Overview;
   - Figure 9.2: Carbon and Peatland;
   - Figure 9.3: Peatland Condition Assessment
   - Figure 9.4: Interpolated Peat Depth;
   - Figure 9.5: Predominant Soils;
   - Figure 9.6: Superficial Geology;
   - Figure 9.7: Bedrock Geology;
   - Figure 9.8: Hydrological Constraints;
   - Figure A9.1: Potential Groundwater Dependent Terrestrial Ecosystems overlain on Topography;
   - Figure A9.2: Potential Groundwater Dependent Terrestrial Ecosystems overlain on Superficial Geology; and
   - Figure A9.3: Potential Groundwater Dependent Terrestrial Ecosystems overlain on Bedrock Geology.

9.3. Legislation, Policy and Guidance

9.3.1. Policy Context

7. The assessment takes into account the requirements of the Water Framework Directive (2000/60/EC) (WFD). The WFD aims to protect and enhance the quality of surface freshwater (including lakes, rivers and streams), groundwater, groundwater dependant terrestrial ecosystems (GWDTE), estuaries and coastal waters. The key objectives of the WFD relevant to this assessment are:

- to prevent deterioration and enhance aquatic ecosystems; and
- to establish a framework of protection of surface freshwater and groundwater.

8. The WFD was transposed into Scottish law by the Water Environment and Water Services (Scotland) Act 2003, which gave Scottish Ministers powers to introduce regulatory controls over water activities in order to protect, improve and promote sustainable use of Scotland's water environment. These regulatory controls, in the form of the Environmental Authorisations (Scotland) Amendment Regulations 2025 (EASR) which are applied out with the Electricity Act 1989 and Town and Country Planning Act 1997 consenting regime, make it an offence to undertake the following activities without a regulatory authorisation:

   - discharges to all wetlands, surface waters and groundwaters (replacing the Control of Pollution Act 1974);

- disposal to land (replacing the Groundwater Regulations 1998);
- abstractions from all wetlands, surface waters and groundwaters;
- impoundments (dams and weirs) of rivers, lochs, wetlands and transitional waters; and
- engineering works in inland waters and wetlands.

9.3.2. National Legislation and Policy

9. In preparing this section of the EIA Report, consideration has been given to the relevant legislation and policy. This includes but is not limited to, the following (in chronological order):

- Control of Pollution Act 1974 (as amended);
- Agriculture Act (1986);
- Part IIa of the Environmental Protection Act 1990;
- Land Drainage Act 1991 and 1994;
- Water Resources Act 1991;
- Water Environment Act 1995;
- Pollution Prevention and Control Act 1999;
- Control of Substances Hazardous to Health Regulations 2002;
- The Water Environment and Water Services (Scotland) Act 2003, as amended by the Environment (EU Exit) (Scotland) (Amendment etc.) Regulations 2019 and the Environment (EU Exit) (Scotland) (Amendment etc.) (No.2) Regulations 2019;
- Landfill (Scotland) Regulations 2003;
- European Liability Directive (2004/35/EC);
- Nature Conservation (Scotland) Act 2004;
- Water Environment (Register of Protected Areas) (Scotland) Regulations 2004;
- Groundwater Daughter Directive (2006/118/EC);
- Private Water Supplies (Scotland) Regulations 2006;
- Flood Risk Regulations 2009 (S.I. 2009/3042);
- Environmental Liability (Scotland) Regulations 2009, as amended by the Environment (EU Exit) (Scotland) (Amendment etc.) Regulations 2019 and the Environment (EU Exit) (Scotland) (Amendment etc.) (No.2) Regulations 2019;
- Flood Risk Management (Scotland) Act 2009;
- Flood and Water Management Act 2010;
- The Water Quality (Scotland) Regulations 2010;

- The Environmental Authorisations (Scotland) Regulations 2018;
- Waste Management Licensing (Scotland) Regulations 2011;
- Pollution Prevention and Control Regulations (Scotland) Regulations 2012;
- Water Environment (Drinking Water Protected Areas) (Scotland) Order 2013;
- Water Act 2014;
- Construction Design and Management Regulations 2015;
- The Water Environment (Miscellaneous) (Scotland) Regulations 2017;
- The Water Intended for Human Consumption (Private Supplies) (Scotland) Regulations 2017;
- Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017, as amended (EIA Regulations);
- Environment Act 2021;
- Scottish Governments National Planning Framework 4 (NPF4) 2023 (updated 2024); and
- Scottish Environment Protection Agency (SEPA) Policies:
  - No. 19 Groundwater Protection Policy for Scotland;
  - No. 22 Flood Risk Assessment Strategy;
  - No. 41 Development at Risk of Flooding: Advice and Consultation;
  - No. 54 Land Protection Policy; and
  - No. 61 Control of Priority & Dangerous Substances & Specific Pollutants in the Water Environment.

10. The requirements of various EU Directives such as the WFD (2000/60/EC), the European Liability Directive (2004/35/EC) and the Groundwater Daughter Directive (2006/118/EC) have been transposed into domestic legislation by the Environment (EU Exit) (Scotland) (Amendment etc.) Regulations 2019. Previously the WFD and now the Environmental Regulations 2019 and supporting domestic legislation establish a legal framework for the protection, improvement and sustainable use of surface waters, transitional waters, coastal waters and groundwater resources.

11. The regulation of activities relating to the water environment is implemented through EASR. This covers activities including abstraction, discharges, impoundments and engineering works that could impact on a watercourse. Depending on the size and nature of the activity, General Binding Rules (GBRs) need to be followed, the activity registered or a full licence obtained.

9.3.3. Regional & Local Policy

12. This assessment takes account for the following local development policy which is addressed in **Chapter 2**:

- The East Ayrshire Council Adopted Local Development Plan 2 (2024). Policies of particular relevance:
  - Policy SS1: Climate Change;
  - Policy NE1: Protecting and Enhancing Landscape and Features;
  - Policy NE11: Soils;
  - Policy NE12: Water, air, light and noise pollution;
  - Policy MIN7: Borrow pits; and
  - Policy CR1: Flood Risk Management.
- The Dumfries and Galloway Council Local Development Plan 2 (2019). Policies (of particular relevance:
  - Policy NE11: Supporting the Water Environment;
  - Policy NE12: Protection of Water Margins;
  - Policy NE14: Carbon Rich Soil;
  - Policy NE15: Protection and Restoration of Peat Deposits as Carbon Sinks;
  - Policy IN1: Renewable Energy;
  - Policy IN2: Wind Energy;
  - Policy IN7: Flooding and Development; and
  - Policy IN8: Surface Water Drainage and Sustainable Drainage Systems (SuDS).

9.3.4. Other Guidance and Good Practice

13. Table 9.1 lists other key guidance and good practice documentation considered as part of this assessment.

Table 9.1: Guidance and Best Practice

Topic	Source of Information
Scottish Government Planning Advice Notes (PANs)	PAN 50 (1996), Controlling the Environmental Effects of Surface Mineral Workings PAN 51 (2006), Planning, Environmental Protection and Regulation PAN 1/2013 (2013), Environmental Impact Assessment PAN 61 (2001), Sustainable Urban Drainage Systems Flood Risk (2015), Planning Advice PAN 79 (2006), Water and Drainage
SEPA Guidance for	GPP1 (2020), Understanding your environmental responsibilities – good environmental practices

Topic	Source of Information
Pollution Prevention (GPPs)	GPP2 (2018), Above Ground Oil Storage GPP4 (2017), Treatment and Disposal of Wastewater Where there is no Connection to the Public Foul Sewer GPP5 (2018), Works and maintenance in or near water GPP6 (2023), Working at Construction and Demolition Sites GPP 8 (2017), Safe Storage and Disposal of Used Oils GPP 13 (2017), Vehicle Washing and Cleaning GPP 21 (2021), Pollution Incident Response Planning GPP 22 (2018), Dealing with Spills GPP 26 (2019), Safe Storage - Drums and Intermediate Bulk Containers
SEPA Position Statements (Published)	WAT-PS-06-02: SEPA (2015), Culverting of Watercourses, Version 2 WAT-PS-07-02: SEPA (2012), Engineering in artificial inland surface waters, Version 2 WAT-SG- 78: SEPA (2012), Sediment Management Authorisation, Version 1 WAT-SG-23: SEPA (2008), Engineering in the Water Environment, Good Practice Guide - Bank Protection Rivers and Lochs, Version 1 WAT-SG-25: SEPA (2010), Engineering in the Water Environment, Good Practice Guide, Construction of River Crossings, Version 2 WAT-SG-26: SEPA (2010), Engineering in the Water Environment, Good Practice Guide, Sediment Management, Version 1 WAT-SG-29: SEPA (2009), Engineering in the Water Environment, Good Practice Guide, Temporary Construction Methods, First edition WAT-SG-31: SEPA, (2006), Special Requirements for Civil Engineering Contracts for the Prevention of Pollution, Version 2 WAT-SG-75: SEPA (2018) Sector Specific Guidance: Construction Sites
Construction Industry Research and Information Association (CIRIA)	CIRIA C532 (2001), Control of Water Pollution from Construction Sites CIRIA C648 (2006), Control of Water Pollution from Linear Construction Projects CIRIA C624 (2004), Development and Flood Risk - guidance for the construction industry CIRIA C741 (2023), Environmental Good Practice on Site Guide (fifth edition) CIRIA C753 (2015), The SuDS Manual CIRIA C786 (2019), Culvert, Screen and Outfall Manual
Other Guidelines	British Standards, (2009), BS 6031: 2009 Code of Practice for Earth Works Fisheries Management Scotland (2017), Advice to Boards/Trusts on engaging with the planning process for terrestrial windfarms

Topic	Source of Information
	Forestry Commission Scotland (FCS) and Scottish Natural Heritage (SNH) (2010), Floating Roads on Peat; NatureScot and Scottish Renewables Joint Publication (2024): Good Practice During Wind Farm Construction; SEPA and SGt (2010), Engineering in the Water Environment: Good Practice Guide – Sediment Management; SEPA and SGt (2010), Engineering in the Water Environment: Good Practice Guide – River Crossings; SEPA, The Water Environment (Controlled Activities) (Scotland);Regulations 2011 (as amended). A Practical Guide, Version 9.4, July 2024; SEPA Environmental Authorisations (Scotland) Regulations 2018 No. 219; SEPA Land Use Planning Guidance CC1 (LUPS-CC1) (2019). Climate change allowances for flood risk assessment in land use planning. Issue 1 SEPA (2024a). Guidance on Assessing the Impacts of Development on Groundwater Abstractions SEPA (2024b). Guidance on Assessing the Impacts of Developments on Groundwater Dependent Terrestrial Ecosystems SEPA Land Use Planning Guidance Note 24 (2024). Flood Risk and Land Use Vulnerability Guidance Scottish Government (SGt), SNH, SEPA (2017). Peatland Survey - Guidance on Developments on Peatland, on-line version only SNIFFER (2009). WFD95 A Functional Typology for Scotland Marine Scotland Science advice on freshwater and diadromous fish and fisheries in relation to onshore windfarm developments (2022)

9.4. Method of Assessment

9.4.1. Initial Scope of Assessment

Effects Scoped out of the Assessment

14. As part of the Hare Hill Repower (March 2023) Scoping Report (**Technical Appendix 3.1**), Designated Sites and Geology were scoped out of the EIA Report for further assessment. This was confirmed by NatureScot in their Scoping Opinion (See **Technical Appendix 3.2,** and **Section 9.5** below).

15. Fountainhead Site of Special Scientific Interest (SSSI) and Geological Conservation Review (GCR) site is sited within the study area, however it is located at a significant distance (>300 m) from proposed infrastructure and is geological in nature. Polhote and Polneul Burns SSSI and GCR is also sited within the study area, but is also located at a significant distance (> 850 m) from proposed infrastructure and is geological in nature.

Therefore, the integrity of the geological features would not be compromised and as such both designated sites have been scoped out.

16. Given that no further protected geological designations were noted on site, and the superficial and bedrock geology is typical of regional ground conditions, geology has been scoped out for further assessment. Review of the local geological information has been considered for the GWDTE assessment.

9.4.2. Effects Scoped into the Assessment

17. As outlined in the Hare Hill Windfarm Repowering and Extension Scoping Report (**Technical Appendix 3.1**), the following topics have been scoped in for further assessment:

- site hydrology;
- water resources;
- flood risk;
- soils and peat; and
- hydrogeology.

18. The following matters are considered and an assessment of impacts in respect of these are provided in this Chapter. The greatest risk of the proposed Development affecting the hydrological, hydrogeological, geological and soil environment would occur during the construction phase, with effects reduced during the operational and decommissioning phase. Taking this into account the following issues will be addressed during all phases of the proposed Development:

- changes to existing drainage patterns;
- effects on baseflow;
- effects on run-off rates;
- effects on erosion and sedimentation;
- effects on groundwater and surface water quality (including GWDTEs);
- effects on groundwater levels; effects on water resources;
- effects of impediments to flow;
- on-site and downstream flood risk;
- pollution risk; and
- effects on local soils (including peat), superficial deposits and solid geology.

9.4.3. Overview

19. The assessment has involved the following:

- detailed desk studies and site investigation to establish baseline conditions of the study area;
- evaluation of the environmental impacts of the proposed Development and the likely significant effects that these could have on the current site conditions;
- identification of embedded good practice measures to avoid and mitigate against any identified adverse effects resulting from the proposed Development;
- evaluation of the likely significant environmental effects with consideration of the potential embedded mitigation measures, taking account of the sensitivity of the baseline features, the potential magnitude of these effects and the probability of these effects occurring; and
- the residual significance of the environmental effects following the consideration of additional mitigation measures.

9.4.4. Baseline Assessment

20. A desktop survey to establish the baseline conditions was undertaken in order to:
    - describe surface water hydrology, including watercourses, springs and waterbodies;
    - identify existing catchment pressures (e.g. point source and diffuse pollution issues);
    - identify all private drinking water abstractions and public water supplies within 3 km of the Site;
    - identify all flooding risks;
    - describe the hydromorphological conditions of watercourses;
    - collate hydrological flow and flooding data for the immediate area and main downstream watercourses;
    - collect soil, geological and hydrogeological information; and
    - confirm surface water catchment areas and watersheds.

9.4.5. Study area

21. Both desk study and survey data for this Chapter of the EIA Report have been gathered with respect to a defined study area. The study area includes the Site and a 3 km buffer area immediately beyond the Site (**Figure 9.1**). The study area sits within East Ayrshire Council (EAC) and Dumfries and Galloway Council (DGC) local authority areas.

9.4.6. Desk Study and Site Investigations

22. Published information sources used to characterise the baseline conditions within the Site and in the surrounding area is outlined in **Table 9.2** below.

Table 9.2 Baseline Information Sources

Topic	Sources of Information
Topography	1:10,000 OS Raster Data 1:25,000 OS Raster Data 1:50,000 OS Raster Data
Designated Nature and Conservation Sites	In-house Designated Site Database. NatureScot: https://sitelink.nature.scot/home, https://www.nature.scot/professional-advice/protected-areas-and-species/protected-areas
Bedrock and Superficial Geology	BGS Geology of Britain Viewer, https://geologyviewer.bgs.ac.uk/
Soils and Peat	James Hutton Institute, Soil Information For Scottish Soils, http://sifss.hutton.ac.uk/ Scotland's Soils Interactive Map, Carbon and Peatland 2016 and National Soil Map of Scotland, http://soils.environment.gov.scot/
Climate	Met Office, https://www.metoffice.gov.uk/public/weather/climate/gcv3mcrf9 Flood Estimation Handbook (FEH): FEH Web Service, https://fehweb.ceh.ac.uk/ Flood Modeller Suite, https://www.floodmodeller.com/
Surface Water Hydrology	1:10,000 OS Raster Data 1:25,000 OS Raster Data 1:50,000 OS Raster Data Flood Estimation Handbook (FEH): FEH Web Service, https://fehweb.ceh.ac.uk/
Flooding	Flood Risk Management Map (SEPA) https://map.sepa.org.uk/floodmaps
Water Quality	SEPA, Water Classification Hub, https://www.sepa.org.uk/data-visualisation/water-classification-hub SEPA, Water Environment Hub, https://www.sepa.org.uk/data-visualisation/water-environment-hub/
Water Resources	Private Water Supply (PWS) information provided by EAC and DGC Scottish Water SEPA
Hydrogeology	Scotland's Environment Web Interactive Map, https://map.environment.gov.scot/sewebmap/

Topic	Sources of Information
	BGS Hydrogeology Map of the UK, https://mapapps2.bgs.ac.uk/geoindex/home.html?layer=BGSHydroMap BGS Geoindex Onshore https://mapapps2.bgs.ac.uk/geoindex/home.html SEPA, Water Classification Hub, https://www.sepa.org.uk/data-visualisation/water-classification-hub/

9.4.7. Effects Evaluation

23. The likely significant environmental effects of the proposed Development have been defined by taking account of the two main factors: the sensitivity of the receiving environment and the potential magnitude should that impact occur. The sensitivity of the receiving environment i.e. its baseline quality as well as its ability to absorb the effect without perceptible change is defined in Table 9.3.

Table 9.3 Definition of Sensitivity of the Receiving Environment

Sensitivity	Criteria	Receptor Type*	Context
High	Features with a high yield, quality or rarity with little potential for substitution.	Aquatic and geological environment	Conditions supporting a site with an international conservation designation (Special Area of Conservation (SAC), Special Protection Area (SPA), Ramsar), where the designation is based specifically on aquatic and geological (including peat) features. WFD surface water body (or part thereof) with overall High status, also any associated upstream non-reportable WFD surface water body or non-WFD surface water body. WFD surface water body (or part thereof) with High status for morphology. Unmodified/near natural peatland with depths recorded as greater than 0.5 m.
	Water use supporting human health and economic activity at a regional scale.	Water use	EASR-licensed public surface water or groundwater supply (and associated catchment) or permitted discharge.

Sensitivity	Criteria	Receptor Type*	Context
	Features with a high vulnerability to flooding.	Flood risk	Land use type defined as Essential Infrastructure (i.e. critical national infrastructure, such as essential transport and utility infrastructure) and Most Vulnerable Use' (e.g. police / ambulance stations that are required to operate during flooding, mobile homes intended for permanent residential use) in SEPA (2018) flood risk land use vulnerability classification.
Medium	Features with a medium yield, quality or rarity, with a limited potential for substitution.	Aquatic and geological environment	Conditions supporting a site with a national conservation designation (e.g. SSSI, National Nature Reserve (NNR)), where the designation is based specifically on aquatic and geological (including peat) features. WFD surface water body (or part thereof) with overall Good status / potential, also any associated upstream non-reportable WFD surface water body or non-WFD surface water body. WFD groundwater body (or part thereof) with overall Good status. Modified/degraded peatland with depths recorded as greater than 0.5 m (Class 1 – 2 peat soil classification in absence of peatland condition data).
	Water use supporting human health and economic activity at a local scale.	Water use	EASR-licensed non-public surface water and groundwater supply abstraction (and associated groundwater catchment) e.g. industrial process water or permitted discharge. Unlicensed potable surface water and groundwater abstraction (and associated catchment) e.g. private domestic water supply, well, spring or permitted discharge.
	Features with a medium	Flood risk	Land use type defined as 'Highly Vulnerable Use' in SEPA (2018) flood risk

Sensitivity	Criteria	Receptor Type*	Context
	vulnerability to flooding.		land use vulnerability classification e.g. most types of residential development, hostels and hotels, landfill and waste management facilities.
Low	Features with a low yield, quality or rarity, with some potential for substitution.	Aquatic and geological environment	Conditions supporting a site with a local conservation designation i.e. GCR site, where the designation is based specifically on aquatic and geological (including peat) features, or an undesignated but highly / moderately water-dependent ecosystem, including a GWDTE. WFD surface water body (or part thereof) with overall Moderate or lower status / potential, also any associated upstream non-reportable WFD surface water body or non-WFD surface water body. Groundwater body (or part thereof) with overall Poor status. Modified, degraded or actively eroding peatland with depths recorded predominantly <0.5 m (Class 3 peat soil classification in absence of peatland condition data).
	Water use supporting human health and economic activity at household / individual business scale.	Water use	Unlicensed non-potable surface water and groundwater abstraction (and associated catchment) e.g. livestock supply.
	Features with a low vulnerability to flooding.	Flood risk	Land use type defined as 'Least Vulnerable' in SEPA (2018) flood risk land use vulnerability classification e.g. most types of business premises.
Negligible	Commonplace features with very low yield	Aquatic and geological environment	Conditions supporting an undesignated and low water-dependent ecosystem,

Sensitivity	Criteria	Receptor Type*	Context
	or quality with good potential for substitution.		including a GWDTE, ancient woodland and pond. Non-reportable WFD surface water body (or part thereof), or non-WFD surface water body, not associated with any downstream WFD surface water body. Non-reportable WFD groundwater body (or part thereof), or non-WFD groundwater body including non-abstraction springs. No peatland or peaty/organic soils, with depths recorded less than 0.5 m (Class -2, -1, 0, 4 or 5 peat soil classification in absence of peatland condition data)
	Water use does not support human health, and of only limited economic benefit.	Water use	Unlicensed well shown on OS mapping.
	Features that are resilient to flooding.	Flood risk	Land use type defined as 'Water-compatible use' in SEPA (2018) flood risk land use vulnerability classification and undeveloped land e.g. flood control infrastructure; water transmission infrastructure.

**Receptor types map onto the Table 3 receptor lists as follows:*

- aquatic and geological environment – refers to aquifers and WFD groundwater bodies, watercourses and WFD surface water bodies, conditions supporting designated conservation sites and GWDTEs, Geological Conservation Review (GCR) sites and Class 1 – 3 peat soils;

- water use – refers to springs, abstractions; and

- flood risk – refers to humans, properties and infrastructure.

24. The magnitude of change on the receptors is independent of the value of the receptor, and its assessment is semi-quantitative and again reliant, in part, on professional judgement. Table 9.4 provides examples of how various levels of change have been determined with respect to water features.

Table 9.4 Magnitude of Change

Magnitude	Criteria	Receptor Type	Context
High	Results in major change to feature, of sufficient magnitude to affect its use / integrity.	Aquatic and geological environment	Deterioration in river flow regime, morphology or water quality, leading to sustained, permanent or long-term breach of relevant conservation objectives (COs) or non-temporary downgrading (deterioration) of WFD surface water body status (including downgrading of individual WFD elements) or dependent receptors (including conservation sites), or resulting in the inability of the surface water body to attain Good status in line with the measures identified in the River Basin Management Plan (RBMP). Deterioration in groundwater levels, flows or water quality, leading to non-temporary downgrading of status of WFD groundwater body or dependent receptors (including conservation sites and GWDTEs), or the inability of the groundwater body to attain Good status in line with the measures identified in the RBMP. Disturbance of geology leading to non-temporary downgrading of status of GCR site or Class 1 – 3 peat soils.
		Water Use	Complete or severely reduced water availability and / or quality, compromising the ability of water users to abstract.
		Flood risk	Change in flood risk resulting in potential loss of life or major damage to the property or infrastructure.
Medium	Results in noticeable change to feature, of sufficient	Aquatic and geological environment	Deterioration in river flow regime, morphology or water quality, leading to periodic, short-term and reversible breaches of relevant COs, or potential temporary downgrading of surface

Magnitude	Criteria	Receptor Type	Context
	magnitude to affect its use / integrity in some circumstances.		water body status (including potential temporary downgrading of individual WFD elements), or dependent receptors (including conservation sites), although not affecting the ability of the surface water body to achieve future WFD objectives. Deterioration in groundwater levels, flows or water quality, leading to potential temporary downgrading of status of WFD groundwater body or dependent receptors (including conservation sites and GWDTEs), although not affecting the ability of the groundwater body to achieve future WFD objectives. Disturbance of geology leading to potential temporary downgrading of status of GCR site or Class 1 – 3 peat soils.
		Water use	Moderate reduction in water availability and / or quality, which may compromise the ability of the water user to abstract on a temporary basis or for limited periods, with no longer-term impact on the purpose for which the water is used.
		Flood risk	Change in flood risk resulting in potential for moderate damage to the property or infrastructure.
Low	Results in minor change to feature, with insufficient magnitude to affect its use / integrity in most circumstances.	Aquatic and geological environment	Slight change in river flow regime or water quality, but remaining generally within COs, and with no short-term or permanent change to WFD surface water body status (of overall status or element status) or dependent receptors (including conservation sites). Slight deterioration in groundwater levels, flows or water quality, but with no short-term or permanent

Magnitude	Criteria	Receptor Type	Context
			downgrading of status of WFD groundwater body or dependent receptors (including conservation sites and GWDTEs). Slight disturbance of geology but no consequences in terms of status of GCR site or Class 1 – 3 peat soils.
		Water use	Minor reduction in water availability and / or quality, but unlikely to affect the ability of a water user to abstract.
		Flood risk	Change in flood risk resulting in potential for minor damage to property or infrastructure.
Negligible	Results in little or no change to feature, with insufficient magnitude to affect its use / integrity	Aquatic and geological environment	None or very slight change in river flow regime or water quality, and no consequences in terms of COs or surface water body status or dependent receptors (including conservation sites). No or very slight change in groundwater levels or quality, and no consequences in terms of status of WFD groundwater body or dependent receptors (including conservation sites and GWDTEs). No or very slight disturbance of geology and no consequences in terms of status of GCR site or Class 1 – 3 peat soils.
		Water use	No or very slight change in water availability or quality and no change in ability of the water user to exercise licensed rights or continue with small private abstraction.
		Flood risk	Increased frequency of flood flows, but which does not pose an increased risk to property or infrastructure.

25. The EIA Regulations require that an overall judgement is made on the nature of the receptor (sensitivity) and the likely change (magnitude) resulting from the proposed Development. The criteria are semi-quantitative and therefore professional judgement is required in the assessment. This judgement is based on evaluations of the individual

aspects of value, susceptibility, size and scale, geographical extent, duration and reversibility. There are four main levels of hydrological effect that are used in this EIA Report; Major, Moderate, Minor and Negligible. The evaluation of potential effects makes allowance for the use of professional judgement and experience.

26. In this assessment, effects are **'Significant'** or '**Not Significant'** according to the matrix in **Table 9.5,** with those effects considered to be Major and some Major/Moderate effects by virtue of the more sensitive receptors and the greater magnitude of change, considered to be '**Significant'** in terms of EIA Regulations. Some Moderate, and all Minor and Negligible effects are considered to be **'Not Significant'**. Where a Moderate effect is deemed to be **'Not Significant'** this was decided based on there being High receptor sensitivity, but a Negligible magnitude of change, meaning changes to baseline conditions are deemed to be only Minor or Negligible.

Table 9.5 Significance of effect

Magnitude of Change					
Sensitivity		**High**	**Medium**	**Low**	**Negligible**
	High	Major (**Significant**)	Major/ Moderate (**Significant**)	Moderate (**Not Significant**)	Moderate/Minor (**Not Significant**)
	Medium	Major/ Moderate (**Significant**)	Moderate (**Not Significant**)	Moderate/ Minor (**Not Significant**)	Minor (**Not Significant**)
	Low	Moderate (**Not Significant**)	Moderate/ Minor (**Not Significant**)	Minor (**Not Significant**)	Minor/Negligible (**Not Significant**)
	Negligible	Minor (**Not Significant**)	Negligible (**Not Significant**)	Negligible (**Not Significant**)	Negligible (**Not Significant**)

27. It should be noted that Significant effects need not be unacceptable or necessarily adverse and may be reversible.

28. Furthermore, it is important to recognise that Significant effects on receptors in the aquatic environment do not necessarily mean that the same outcomes would occur in respect of the same receptors that may also be ecology receptors. Indeed, because of the different value and magnitude criteria used by the two assessments, it is possible that effects assessed as Not Significant in one environmental topic assessment, e.g. the water environment, can still sit alongside effects assessed as Significant in another environmental topic assessment, e.g. ecology, and vice-versa.

9.4.1. Spatial scope

29. The spatial scope of the assessment of Hydrology, Geology and Hydrogeology covers the study area (i.e. the Site including a 3 km buffer area), for which the baseline is described in Section 9.6, on the basis that the effects on the water environment due to the proposed Development are considered unlikely to extend beyond this area. The only potential receptors identified outside this study area are downgradient watercourses and conservation sites on the basis that any changes in the surface and groundwater environment arising as a result of the proposed Development could theoretically affect their flows / quality and water support, respectively.

9.4.2. Temporal scope

30. The temporal scope of the assessment of Hydrology, Geology and Hydrogeology is consistent with the construction and operational periods for the proposed Development (see **Chapter 5)**.

31. The proposed Development will be split across two distinct construction phases, relative to the differing life cycles between the current Hare Hill (HH) and the Hare Hill Extension (HHE) windfarms. Phase 1 would comprise 15 no. turbines (T1-T15) and Phase 2 would comprise eight turbines (T16-T23). Phase 1 of the proposed Development would include the decommissioning of HH and the installation of the first 15 no. new turbines. Phase 2 would include the decommissioning of HHE and the installation of the final eight turbines, thus completing the proposed Development.

32. The construction period for the proposed Development would be approximately 23 months for Phase 1 and 15 months for Phase 2, with decommissioning anticipated at the end of a 50-year operational period. There would be an approximate four-year break between the completion of the construction of the Phase 1 turbines and the commencement of construction of the Phase 2 turbines (see **Table 5.1** in **Chapter 5** for more details).

9.4.3. Assessment of Residual Effects of Significance

33. A statement of residual effects, following consideration of any further specific mitigation measures where identified, is then given.

9.5. Consultation

34. The scoping and consultation responses relating to the hydrological, geological and hydrogeological environment are summarised in **Table 9.6**.

Table 9.6 List of Consultee Responses

Consultee	Scoping Response	Addressed in EIA Report
Nature Scot (February 2024-CEA173523) SEPA – January 2024 - 11332	1.Protected Areas to be scoped in / out a. Ailsa Craig SPA & SSSI b. Muirkirk and Lowther Uplands SPA & SSSI c. Fountainhead, Polhote & Polneul Burns and Lagrae Burn Sites of Special Scientific Interest (SSSI) i. Fountainhead SSSI in RLB - the potential direct and indirect effects of construction, operation and decommissioning of the proposed development must be considered. Given the separation distance between any proposed infrastructure and the geological nature of the notified feature, we advise that this SSSI/GCR site can be scoped out of further assessment as the objectives of designation and the overall integrity of the area will not be compromised by the proposed development. ii. Polhote and Polneul Burns SSSI- is approximately 350m from the red line boundary but connected hydrologically to the proposal site. Given the separation distance and the geological nature of the SSSI we advise that this SSSI/GCR site can be scoped out of further assessment. iii. Lagrae Burn SSSI is approximately 3 km from the red line boundary. Given the separation distance and the geological nature of the SSSI we advise that this SSSI/GCR site can be scoped out of further assessment.	a. Ailsa Craig SPA & SSSI is out with the study area and not in hydrological connectivity with the proposed Development. b. Muirkirk and Lowther Uplands SPA & SSSI, C. Fountainhead, Polhote & Polneul Burns SSSI and Lagrae Burn SSSI baseline conditions described in **Section 9.6.4** and all designated sites are scoped out in **Section 9.4.1** and **Table 9.16**.
	2. Peatland a. Our detailed peatland advice for applicants is contained in our revised guidance on Advising on peatland, carbon-rich soils and priority peatland	a. Guidance used to inform peatland assessment, restoration and study design

Consultee	Scoping Response	Addressed in EIA Report
	habitats in development management (November 2023). Our onshore wind pre-application guidance (February 2024) also highlights key messages in relation to peatland assessment, recommendations on peatland restoration, and the level of information to be submitted with the application. (Advising on peatland, carbon-rich soils and priority peatland habitats in development management | NatureScot) b. Potential impacts on carbon-rich soil and priority peatland habitats.	(see **Section 9.3.4**) and referred to in **Table 9.1**. b. Potential impacts have been assessed in **Table 9.3, 9.8, 9.19** and **9.20**, and **Section 9.8.1**, as well as **Technical Appendix 9.4.**
	1. Site Layout 1.1 The EIA must contain a scaled plan of the sensitivities, including for example, peat, GWDTE, proximity to watercourses, overlain with the proposed development. Existing built infrastructure should be re-used or upgraded where possible. Design should minimise new works on undisturbed ground	1.1 **Figure 9.1** to **9.8** contain plans with hydrological sensitivity. **Figure 9.1** contains an overview of assessed hydrological sensitivities and **Figure 9.2** to **9.7** contain individual receptors, and **Figure 9.8** contains hydrological constraints. All figures are overlain with the proposed Development. Where possible existing tracks have been utilised (see **Figure 5.1**). Floating tracks have been utilised as a design feature to minimise disturbance to undisturbed ground.
	2. Engineering activities which may have adverse effects on the water environment.	2.1 The number of watercourse crossings has been minimised where engineering constraints allow. **Figure 9.1** shows all watercourse crossings, as well as infrastructure and watercourse buffers.

Consultee	Scoping Response	Addressed in EIA Report
	2.1 The site layout should be designed to minimise watercourse crossings and avoid other direct impacts on water features. The submission must include a map showing: a) All proposed temporary or permanent infrastructure overlain with all lochs and watercourses. b) A minimum buffer of 50 m around each loch or watercourse. If this minimum buffer cannot be achieved each breach must be numbered on a plan with an associated photograph of the location, dimensions of the loch or watercourse and drawings of what is proposed in terms of engineering works. Measures should be put in place to protect any downstream sensitive receptors. 2.2 Further advice and our best practice guidance are available within the water engineering section of our website. Guidance on the design of water crossings can be found in our Construction of River Crossings Good Practice Guide (https://www.sepa.org.uk/media/151036/wat-sg-25.pdf) 2.3 Refer to our Flood Risk Standing Advice for advice on flood risk. Crossings must be designed to accommodate the 0.5% Annual Exceedance Probability flows (with an appropriate allowance for climate change), or information provided to justify smaller structures. If it is considered the development could result in an increased risk of flooding to a nearby receptor then a Flood Risk Assessment (FRA) must be submitted. Our Technical flood risk guidance (ss-nfr-p-002-technical-flood-risk-guidance-for-stakeholders.pdf (sepa.org.uk) for stakeholders outlines the information we require to be submitted in an FRA. Please also refer to Environmental Authorisations (Scotland) Regulations (EASR) Flood Risk Standing Advice for Engineering, Discharge and Impoundment	Breaches to the 50 m watercourse buffer are detailed in **Section 9.7.3**. 2.2 SEPA water crossing guidance has been applied (see **Table 9.1**). 2.3 SEPA flooding guidance referred to in **Table 9.1** and referenced in **Section 9.7.4** and **9.7.5,** and **Technical Appendix 9.1**.

Consultee	Scoping Response	Addressed in EIA Report
	Activities (car-flood-risk-standing-advice-for-engineering-discharge-and-impoundment-activities.pdf (sepa.org.uk))	
	3. Disturbance and re-use of excavated peat and other carbon rich soils 3.1 Where proposals are on peatland or carbon rich soils the following should be submitted to address the requirements of NPF4 Policy 5: a) layout plans showing all permanent and temporary infrastructure, with extent of excavation required, which clearly demonstrates how the mitigation hierarchy outlined in NPF4 has been applied. These plans should be overlaid on: i. peat depth survey (showing peat probe locations, colour coded using distinct ii. colours for each depth category and annotated at a usable scale) iii. peat depth survey showing interpolated peat depths iv. peatland condition mapping b) an outline Peat Management Plan (PMP). c) an outline Habitat Management Plan. Detailed advice: Development design in line with the mitigation hierarch 3.2 In order to protect peatland and limit carbon emissions from carbon rich soils, the submission should demonstrate that proposals: Avoid peatland in near natural condition, as this has the lowest greenhouse gas emissions of all peatland condition categories. Minimise the total area and volume of peat disturbance. Clearly demonstrate how the infrastructure layout design has targeted areas where carbon rich soils are absent or the shallowest peat reasonably practicable. Avoid peat > 1m depth.	3.1 a) **Figure 9.4** shows proposed Development infrastructure, peat depth survey results and peat interpolation. **Figure 9.3** shows proposed Development infrastructure and peatland condition assessment. b) See **Technical Appendix 9.4** c) See **Technical Appendix 7.5**. Detailed advice: Mitigation hierarchy for peat is outlined in **Technical Appendix 9.4**. 3.2 a) See **Figure 9.3**. Infrastructure located within near natural peatland has been limited to a floating track to limit disturbance to the peatland. b) Mitigation hierarchy for peat is outlined in **Technical Appendix 9.4**. c) No true GWDTE was identified within the proposed Development (see

Consultee	Scoping Response	Addressed in EIA Report
	Minimise impact on local hydrology; and Include adequate peat probing information to inform the site layout and demonstrate that the above has been achieved. As a minimum this should follow the requirements of the Peatland Survey – Guidance on Developments on Peatland (2017). (Guidance+on+developments+on+peatland+-+peatland+survey+-+2017.pdf (www.gov.scot)) 3.3 The Peatland Condition Assessment photographic guide (Guidance-Peatland-Action-Peatland-Condition-Assessment-Guide-A1916874.pdf (Nature.Scot)) lists the criteria for each condition category and illustrates how to identify each condition category. This should be used to identify peatland in near natural condition and can be helpful in identifying areas where peatland restoration could be carried out. 3.4 In line with the requirements of Policy 5d of NPF4, the development proposal should include plans to restore and/or enhance the site into a functioning peatland system capable of achieving carbon sequestration. The outline PMP should also include • Information on peatland condition. • Information demonstrating avoidance and minimisation of peat disturbance. • Excavation volumes of acrotelmic, catotelmic and amorphous peat. These should include a contingency factor to consider variables such as bulking and uncertainties in the estimation of peat volumes. • Proposals for temporary storage and handling. • Reuse volumes in different elements of site reinstatement and restoration.	**Technical Appendix9.3**). Mitigation to maintain local hydrology is outlined in **Section 9.7**. d) Peat probing campaign conducted as per guidance and used to inform site layout. 3.3 Peatland condition is detailed in **Section 9.6.11** and **Technical Appendix 9.4**. The results of the survey are presented in **Figure 9.3**. 3.4 Peatland condition is detailed in **Section 9.6.11 and Technical Appendix 9.4**. The results of the survey are presented in **Figure 9.3**. **Technical Appendix 9.4** also presents methodology applied to minimise and avoid peat disturbance (**Section 4.3**), excavation volumes for peat (**Section 5.1**), temporary storage and handling methodology (**Section 4.4**), and reuse opportunities and volumes (**Section 5.3**).

Consultee	Scoping Response	Addressed in EIA Report
	3.5 Handling and temporary storage of peat should be minimised. Catotelmic peat should be kept wet, covered by vegetated turves and re-used in its final location immediately after excavation. It is not suitable for use in verge reinstatement, reprofiling/ landscaping, spreading, mixing with mineral soils or use in bunds. 3.6 Disposal of peat is not acceptable. It should be clearly demonstrated that all peat disturbed by the development can be used in site reinstatement (making good areas which have been disturbed by the development) or peatland restoration (using disturbed peat for habitat restoration or improvement works in areas not directly impacted by the development, which may need to include locations out with the development boundary). 3.7 The faces of cut batters, especially in peat over 1m, should be sealed to reduce water loss of the surrounding peat habitats, which will lead to indirect loss of habitat and release of greenhouse gases. This may be achieved by compression of the peat to create an impermeable subsurface barrier, or where slope angle is sufficiently low, by revegetation of the cut surface. (c) The Outline Habitat Management Plan should include: • Proposals for reuse of disturbed peat in habitat restoration, if relevant. • Details of restoration to compensate for the area of peatland habitat directly and indirectly impacted by the development. • Outline proposals for peatland enhancement in other areas of the site. • Monitoring proposals. 3.8 To support the principle of peat reuse in restoration the applicant should demonstrate that they have identified locations where the addition of excavated peat will enhance the wider site into a functional peatland system capable of achieving carbon sequestration. The following information is required:	3.5 Handling and temporary storage methodology outlined in **Section 4** of **Technical Appendix 9.4**. 3.6 **Section 6** of **Technical Appendix 9.4** demonstrates that there is sufficient capacity on site to accommodate all extracted peat. 3.7 Outlined in **Section 4.5 of Technical Appendix 9.4**. (c) No excavated peat is proposed to be used in the peatland restoration areas (see **Technical Appendix 7.4**) 3.8 Outlined in **Section 4** of **Technical Appendix 7.4** Refer to figure 7.4.2 for location plan of proposed restoration areas. 3.9 No proposed restoration areas are out with the landowner boundary.

Consultee	Scoping Response	Addressed in EIA Report
	•Location plan of the proposed peatland re-use restoration area(s), clearly showing the size of individual areas and the total area to be restored. •Photographs, aerial imagery, or surveys to demonstrate that the area identified is appropriate for peat re-use and can support carbon sequestration. This should include consideration of an appropriate hydrological setting and baseline peatland condition. 3.9 In addition, if any proposed re-use restoration areas are outwith the ownership of the applicant, information should be provided to demonstrate agreement in principle with the landowner, including agreed timescales for commencement of the works, and proposed management measures to ensure the restored areas can be safeguarded in perpetuity as a peatland. 3.10 NatureScot's technical compendium of peatland restoration techniques (Peatland ACTION - Technical Compendium | NatureScot) provides a useful overview of the procedural and technical requirements for peatland restoration.	3.10 Guidance is referenced in **Technical Appendix 7.4.**
	4. Disruption to GWDTE and existing groundwater abstractions 4.1 Groundwater Dependent Terrestrial Ecosystems (GWDTE) are protected under the Water Framework Directive. Excavations and other construction works can disrupt groundwater flow and impact on GWDTE and existing groundwater abstractions. The layout and design of the development must avoid impacts on such areas. A National Vegetation Classification survey which includes the following information should be submitted: a) A map demonstrating all GWDTE and existing groundwater abstractions are out with a 100 m radius of all excavations shallower than 1m and out with 250m of	4.1 **Technical Appendix 9.3** concludes there are no true GWDTE on Site.

Consultee	Scoping Response	Addressed in EIA Report
	all excavations deeper than 1 m and proposed groundwater abstractions. The survey needs to extend beyond the site boundary where the distances require it. b) If the minimum buffers cannot be achieved, a detailed site specific qualitative and/or quantitative risk assessment will be required. Please refer to Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems for further advice and the minimum information we require to be submitted.	
	6. Borrow pits 6.1 The following information should also be submitted for each borrow pit: 1. A map showing the location, size, depths and dimensions. 2. A map showing any stocks of rock, overburden, soils and temporary and permanent infrastructure including tracks, buildings, oil storage, pipes and drainage, overlain with all lochs and watercourses to a distance of 250 m. You need to demonstrate that a site specific proportionate buffer can be achieved. On this map, a site-specific buffer must be drawn around each loch or watercourse proportionate to the depth of excavations and at least 10 m from access tracks. 3. Sections and plans detailing how restoration will be progressed including the phasing, profiles, depths and types of material to be used	6. This information would be provided post consent to fulfil a planning condition. Outline borrow pit information is provided in **Technical Appendix 9.5.**
	7. Pollution prevention and environmental management 7.1 A schedule of mitigation supported by the above site specific maps and plans must be submitted. These must include reference to best practice pollution prevention and construction techniques (for example, limiting the maximum area to be stripped of soils at any one time) and regulatory requirements. They should	7. Pollution prevention and environmental management is detailed in **Section 9.7** and **Technical Appendix 5.1**. Guidance referred to in **Table 9.1**.

Consultee	Scoping Response	Addressed in EIA Report
	set out the daily responsibilities of Ecological Clerk of Works, how site inspections will be recorded and acted upon and proposals for a planning monitoring enforcement officer. Please refer to the Guidance for Pollution Prevention (GPPs) (Guidance for Pollution Prevention (GPP) documents | NetRegs | Environmental guidance for your business in Northern Ireland & Scotland) and our water run-off from construction sites webpage (Water run-off from construction sites | Scottish Environment Protection Agency (SEPA)) for more information	
Fish Management Scotland (FMS) – 29 November 2023	The proposed development falls within the district of the Nith District Salmon Fishery Board, and the catchment relating to the Nith Catchment Fisheries Trust. It is important that the proposals are conducted in full consultation with these organisations. Due to the potential for such developments to impact on migratory fish species and the fisheries they support, FMS have developed, in conjunction with Marine Scotland Science, advice for DSFBs and Trusts in dealing with planning applications. We would strongly recommend that these guidelines are fully considered throughout the planning, construction and monitoring phases of the proposed development. • 170412-Guidance-Terrestrial-windfarms.pdf (fms.scot) • DSFB & Trust map – Fisheries Management Scotland (fms.scot)	Guidance referred to in **Table 9.1** and considered within Chapter e.g. water quality monitoring plan detailed in embedded mitigation (**Section 9.7**). Consultation undertaken with Nith Catchment Fisheries Trust (see below).

Consultee	Scoping Response	Addressed in EIA Report
Nith Catchment Fisheries Trust – 05 April 2024	Provided that all aquatic surveys are included in a water monitoring plan for the site, NDSFB have no objections to this proposed development. For the fish and freshwater aquatic invertebrates. avoidance of doubt those surveys need to be conducted prior to any development commencing, no later than 12 months prior to development commencing, during each year of construction and following completion for an agreed period.	A water quality monitoring plan is stipulated within the embedded mitigation (see **Section 9.7**). A map detailing locations of sampling points would be produced post consent to fulfil a planning condition. Any aquatic fish surveys information is detailed in **Chapter 7.**
Scottish Water - 30 November 2023	A review of our records indicates that there are no Scottish Water drinking water catchments or water abstraction sources, which are designated as Drinking Water Protected Areas under the Water Framework Directive, in the area that may be affected by the proposed activity.	Noted in **Section 9.6.8**.
The Coal Authority – 24 April 2024	The proposed turbines and associated works were not in the area where coal mining features are recorded to be present.	Noted.
Marine Directorate – September 2023	It is important that matters relating to freshwater and diadromous fish and fisheries, particularly salmon and trout, continue to be considered during the construction and operation of future onshore windfarm. EIA Checklist: 1. A map outlining the proposed development area and the proposed location of: • associated crane hard standing areas, • borrow pits, • permanent meteorological masts, • access tracks including watercourse crossings, • all buildings including substation, • battery storage; • permanent and temporary construction compounds;	1. See **Figure 9.1**.

Consultee	Scoping Response	Addressed in EIA Report
	• all watercourses; and • contour lines	
	2. A description and results of the site characterisation surveys for fish (including fully quantitative electrofishing surveys) and water quality including the location of the electrofishing and fish habitat survey sites and water quality sampling sites on the map outlining the proposed turbines and associated infrastructure. This should be carried out where a Special Area of Conservation (SAC) is present and where salmon are a qualifying feature, and in exceptional cases when required in the scoping advice for other reasons. In other cases, developers can assume that fish populations are present.	2. Water quality monitoring plan is stipulated within the embedded mitigation (see **Section 9.7**). A map detailing locations of sampling points would be produced post consent and secured with a planning condition.
	3. An outline of the potential impacts on fish populations and water quality within and downstream of the proposed development area.	3. Potential impacts on water quality outlined in **Section 9.7**. Potential impacts on fish populations are detailed in **Chapter 7**.
	4. Any potential cumulative impacts on the water quality and fish populations associated with adjacent (operational and consented) developments including windfarms, hydroschemes, aquaculture and mining.	4. Cumulative impacts on water quality are assessed in **Section 9.8**.
	5. Any proposed site specific mitigation measures as outlined in MD-SEDD generic scoping guidelines and the joint publication "Good Practice during Wind Farm Construction" (Good practice during windfarm construction | NatureScot).	5. Embedded mitigation measures are outlined in **Section 9.7** and **Technical Appendix 5.1**.
	6. Full details of proposed monitoring programmes using guidelines issued by MD-SEDD and accompanied by a map outlining the proposed sampling and control sites in addition to the location of all turbines and associated infrastructure.At least 12 months of baseline preconstruction data should be	6. Water quality monitoring plan is stipulated within the embedded mitigation (see **Section 9.7**). This would be produced post consent and secured with a planning condition.

Consultee	Scoping Response	Addressed in EIA Report
	included. The monitoring programme can be secured using suitable wording in a condition.	
	7. A decommissioning and restoration plan outlining proposed mitigation/monitoring for water quality and fish populations. This can be secured using suitable wording in a condition.	7. Water quality monitoring plan is stipulated within the embedded mitigation (see **Section 9.7**). This would be produced post consent and secured by planning condition.
	8. Developers should specifically discuss and assess potential impacts and appropriate mitigation measures associated with the following: •Any designated area (e.g. SAC), for which fish is a qualifying feature, within and/or downstream of the proposed development area • The presence of a large density of watercourses; • The presence of large areas of deep peat deposits; • Known acidification problems and/or other existing pressures on fish populations in the area; and • Proposed felling operations.	8. No sites designated for fish are in hydrological connectivity with the Site. See **Section 9.4.1, 9.6.4** and **9.7.3**. Watercourses assessed from Section **9.6.5** to **9.6.10**, **9.7.3, 9.7.4, 9.9.2, 9.9.4** and **9.9.5** and mitigation presented in Section **9.7**. Known pressures on fish populations assessed in **Chapter 7**. Proposed felling operations discussed in **Chapter 14.**
	9. MD-SEDD recommends that a water quality and fish population monitoring programme is carried out to ensure that the proposed mitigation measures are effective. A robust, strategically designed and site specific monitoring programme conducted before, during and after construction can help to identify any changes, should they occur, and assist in implementing rapid remediation before long term ecological impacts occur.	8. Water quality monitoring plan is stipulated within the embedded mitigation (see **Section 9.7**). This would be produced post consent and secured with a planning condition. Guidance referred to in **Table 9.1**.

Consultee	Scoping Response	Addressed in EIA Report
	MD-SEDD has published guidance on survey/monitoring programmes associated with onshore windfarm development (https://www2.gov.scot/Topics/marine/Salmon- Trout-Coarse/Freshwater/Research/onshoreren) which developers should follow when drawing up survey and/or monitoring programmes.	
Annan District Salmon Fishery Board	No response received.	N/A
Dumfries and Galloway Council	No response received.	N/A
East Ayrshire Council	No response related to hydrology, hydrogeology and geology.	N/A

9.6. Baseline

35. This section characterises the local hydrological, geological and hydrogeological environment so that the likely effects of the proposed Development can be determined and appropriate mitigation identified. It also provides the point of reference against which the success of the adopted mitigation measures can be assessed.

36. The following description is based on the desk study utilising the data sources listed in **Table 9.2** together with the findings of the survey works carried out between May 2024 and March 2025.

9.6.1. Site Area

37. The majority of the proposed Development is located over open moorland with some areas of commercial coniferous forestry plantation located in the east and north east of the Site. A topographical high point is reached at Hare Hill (601 m Above Ordnance Datum; (AOD)) at approximately NS 65490 09779. The Site also sits on the slopes of a number of other high points including Blackcraig Hill and Blacklorg Hill, with Afton reservoir situated approximately 2 km to the south east of the southern extent of the Site.

38. The hydrological study area is larger in extent than the Site and includes the lower reaches of watercourse catchments that are present within the Site. The extent of the catchments are shown in **Figure 9.1**, which also shows the extent of the study area.

9.6.2. Site Investigations

39. The phase 1 peat depth surveys and hydrological walkover were undertaken in May 2024 to inform the initial design of the proposed Development. The phase 1 peat survey consisted of peat probing the entire Site boundary on a 100 m grid. Further surveys, including phase 2 peat surveys, a watercourse crossing assessment and a peatland condition assessment were undertaken in November 2024, February 2025, March 2025 and September 2025. The phase 2 peat surveys consisted of a 10 m grid across infrastructure elements and at 50 m intervals along tracks with 20 m offsets.

9.6.3. Climate

40. The standard average annual rainfall (calculated from 1961-1990) for the proposed Development has been derived from the Flood Estimation Handbook (FEH) web service (FEH, 2025) as approximately 1528 - 1822 mm based on the proposed Development catchments. To put this into context, rainfall in Scotland varies from 800 mm a year in mainland Eastern Scotland in areas such as Fife, to over 3000 mm on the mainland Western Highlands.

41. The Met Office 1991-2020 average annual rainfall data was taken from Glenlee Climate Station (Met Office, 2023), situated approximately 29 km south of Site (at an elevation of 55 m AOD) in Dumfries and Galloway and from Saughall Climate Station (Met Office, 2023), situated approximately 28 km north of Site (at an elevation of 221 m AOD) within East Ayrshire. The annual rainfall total for Glenlee Climate station is 1780.61 mm with an average of 186.42 days of rainfall with greater than 1 mm recorded, compared with Saughall which records 1413.12 mm and an average of 185.05 days of rainfall with greater

than 1 mm recorded. Both of these climate stations record slightly lower volumes than the those for the west of Scotland, which sees an average annual rainfall of 1817.65 mm and 196.86 days of rainfall greater than 1 mm recorded. Although the proposed Development is situated between these climate stations and at a higher elevation, the comparison with the regional Met Office and FEH data will give a good indication of rainfall totals likely to be experienced at the Site.

42. The highest rainfall totals as shown in **Chart 9.1** are typically experienced during the winter months, from October to January, while the lowest rainfall totals are typically recorded during the summer months, from April to July. **Chart 9.1** indicates that Saughall generally experiences slightly lower rainfall volumes compared to Glenlee and the West of Scotland, however, indicates that rainfall levels experienced at the proposed Development are likely to follow the same seasonal trend.

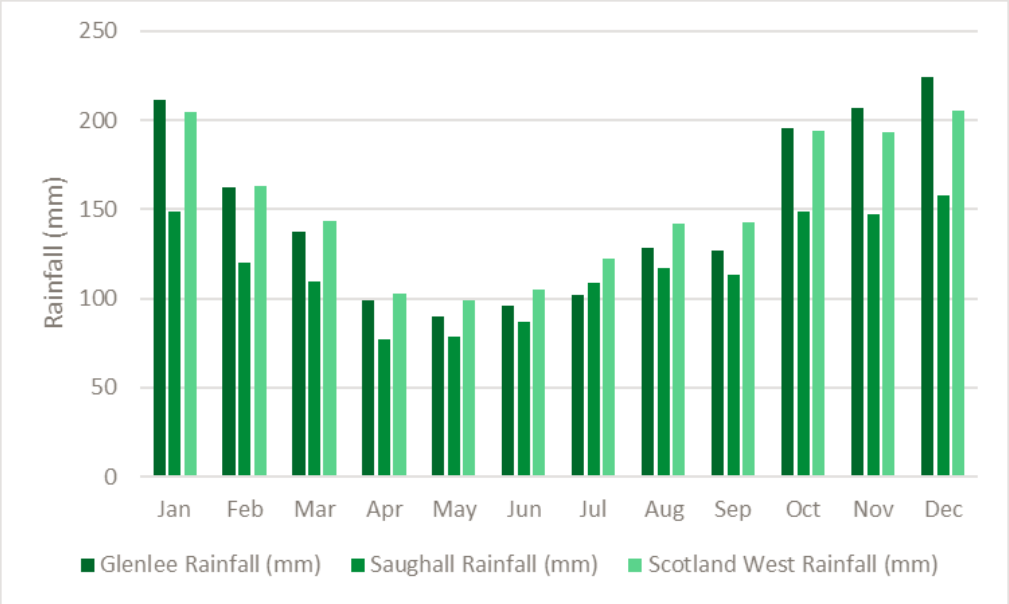

Chart 9.1: Average monthly rainfall data for climate period 1991 – 2020

9.6.4. Conservation Sites

43. There are five designated sites within 5 km of the proposed Development. The location of these in relation to the proposed Development are presented in **Figure 9.1** and the details of each site, including their qualifying interests are presented in **Table 9.7**. Of these five designated sites, only two are located within the proposed Development or are potentially hydrologically connected. Fountainhead is located on Hare Hill and is designated as a SSSI and GCR site due to its mineralogical significance and exposure relating to the historical mining land use. Polehote and Polneul Burns are located on the northern slope of White Hill, with the proposed Development located in the upper catchment of these watercourses. They are designated as SSSI and GCR sites for exposure of Upper Carboniferous and Ordovician stratigraphy.

44. Note that Nith Bridge SSSI, which has a geological designation, is presented on **Figure 9.1**, but is not located within the 5km search area for designated sites. As such, it has not been described in **Table 9.7** or assessed in **Sections 9.7** or **9.8.**

Table 9.7: Designated areas within the vicinity of the proposed Development

Name	Designation	Type	Location
Fountainhead SSSI (named 'Hare Hill – The Knipe' for GCR)	SSSI, GCR site	Geological	Located on the Site boundary, on the northern slopes of Hare Hill.
Polehote and Polneul Burns	SSSI, GCR site	Geological	0.4 km north east of the Site boundary. The proposed Development is located in the upper catchment of these watercourses.
Lagrae Burn	SSSI / GCR site	Geological	3 km north east of the Site boundary. Situated north of the River Nith and not hydrologically connected to the proposed Development.
Muirkirk and North Lowther Uplands	SSSI, SPA	Geological / Biological	3 km north of the Site boundary. Situated north of the River Nith and not hydrologically connected to the proposed Development.

9.6.5. Surface Water Hydrology

45. The proposed Development lies within the catchment of the River Nith. The River Nith forms a catchment of the Solway Tweed river basin district and flows for approximately 89.7 km before joining the Nith Estuary in Dumfries. The Site lies within a number of sub-catchments, with the Kello Water draining the majority of the Site to the east and Afton Water draining a smaller area within the west of the Site. A number of smaller watercourses also drain the Site towards the north, directly into the River Nith. Watercourses within the proposed Development typically drain from upland or moorland catchments with channels often narrow and incised into the superficial geology. Generally, bed substrate of the watercourses comprises a variety of exposed bedrock, sands and gravels, peat and vegetation. Due to the predominant agricultural land use, drainage ditches as well as channel engineering is evident (**Plate 9.1** and **9.2**), along with artificial drainage systems associated with the commercial forestry located within the

east of Site. Additionally, areas of peat hagging and erosion can be seen across the Site (Plate 9.3 and 9.4).

Source: Natural Power

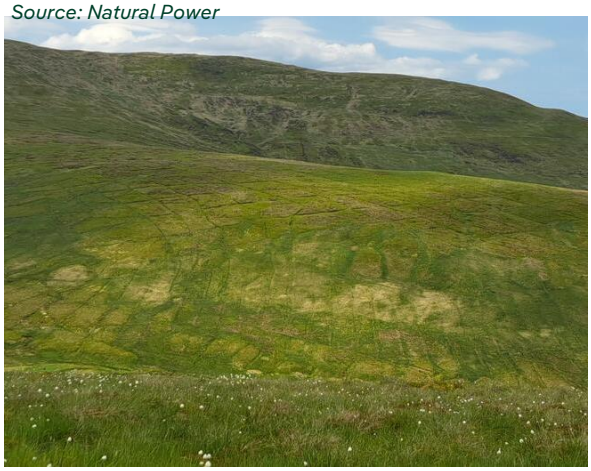

Plate 9.1 Example of cross cutting drainage channels on Mahago Rig. Photo taken from NS 67058 06510 looking west

Source: Natural Power

Plate 9.2 Example of artificial drainage channel at NS 67492 07036. Channel runs SW direction, 0.57 m deep and 0.64 cm wide

Source: Natural Power

Plate 9.3 Overview of peat hags on Earlseat Hill

Source: Natural Power

Plate 9.4 Example of peat hag at NS 65961 06517

Kello Water

46. Kello Water (Plate 9.5) is approximately 14.7 km in length and drains an area of 31.17 km^2, with roughly 60% of the Site sitting within this catchment. Kello Water drains the proposed Development towards the north east and joins the River Nith at NS 74685 11620. The main watercourse is joined by a number of smaller tributaries of which the proposed Development drains to including Shiel Cleuch, Pikieston Burn, Sike Burn, Black Burn, Big Torry Burn, Little Torry Burn, Earlseat Burn (Plate 9.6), Little Poljorg Burn, Poljorg Burn, Bottom Burn, March Burn, Polhigh Burn, Polstacher Burn, Gibbon's Burn and Polnagrie Burn.

Plate 9.5 : Example of headwaters of Kello Water at NS 65733 05502

Plate 9.6: Earlseat Burn taken from NS 65909 06153

Afton Water

47. Afton Water is approximately 15.4 km in length and drains an area of 40.69 km^2, with roughly 5% of the Site sitting within this catchment. Afton Water drains the proposed Development towards the west before joining the River Nith at approximately NS 62169 14007. The main stem is joined by three smaller tributaries of which the proposed Development drains into. These include Langlee Burn which joins Afton Water at NS 63191 08009, Pollach Burn which joins Afton Water at NS 62885 09764 and March Burn which joins Afton Water at NS 62793 08989.

Tributaries Draining to the River Nith

48. The north of the proposed Development drains directly into the River Nith via a number of smaller catchments of which approximately 32% of the Site sits within. The main sub-catchments include the Garepool Burn, the March Burn (**Plate 9.7**), the Polmarlach Burn (**Plate 9.8**) and the Polhote Burn (**Plate 9.9**).

49. The Garepool Burn (catchment area 3.62 km^2) drains the north west of the proposed Development and enters the River Nith at NS 65156 13652. The March Burn (catchment area 2.10 km^2) drains the north of the proposed Development, entering the River Nith at NS 67302 13269. The Garepool Burn catchment also contains the smaller tributary of Blackdams Burn while the March Burn catchment contains the two smaller tributaries of Dochen Burn and Spout Burn.

50. To the north east, the proposed Development is drained via Polmarlach Burn (catchment area 1.23 km^2) which enters the River Nith at NS 68238 13037 and Polhote Burn (catchment area 2.68 km^2) which enters the River Nith at NS 68505 12972.

51. Additionally, there is a small watercourse named Gillie's Burn which enters the River Nith at NS 67941 13125. This smaller catchment sits between March Burn and Polmarlach Burn. Further west, between Garepool Burn and March Burn, the Site crosses a number of smaller unnamed watercourses and Park Burn (**Plate 9.10**) which enters the River Nith at NS 67163 13271.

Plate 9.7: March Burn at NS 67204 12397

Plate 9.8: Polmarlach Burn taken north of NS 67462 10611

Plate 9.9: Polhote Burn at NS 67575 10093

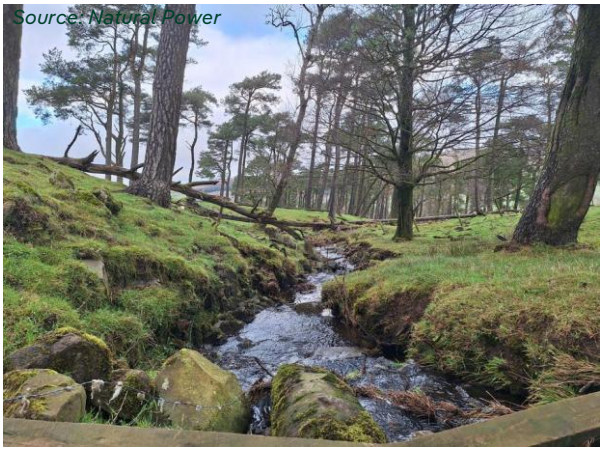

Plate 9.10: Park Burn at NS 66576 12586

Euchan Water

52. Euchan Water flows to the south of the proposed Development and is 15.2 km in length. This watercourse enters the River Nith at NS 77992 09162 and, although 3% of the Site sits within this catchment, no proposed infrastructure would be situated within the catchment.

Flow and Runoff

53. Base Flow Index (BFI) and Standard Percentage Runoff (SPR) data for the catchments covering the Site were also taken from the FEH Web Service. The BFI is taken from the updated BFI Hydrology of Soil Types (HOST19) and is a measure of the proportion of a catchment's long-term run-off that derives from stored sources, with the BFI ranging from 0.1 in relatively impermeable catchments to 0.99 in highly permeable catchments. The SPR values represent the percentage of rainfall that is likely to contribute to run-off.

54. The BFI values are relatively low, ranging from 0.277 to 0.383. This indicates that the Site catchments vary from having just under to just over a third of streamflow derived from

stored sources such as groundwater. The SPR values for the Site catchments range from 43.83% to 51.96% indicating that about half of the rainfall during a rainfall event contributes to run-off. The BFI and SPR values show that the Site is located on relatively impermeable ground.

9.6.6. Flood Risk

55. The Flood Risk Management (Scotland) Act 2009 sets in place a statutory framework for delivering a sustainable and risk-based approach to managing flooding.

Fluvial Flood Sources

56. Flood information available on the SEPA Flood Map (SEPA, 2023) indicates that there is a high risk of fluvial (watercourse) flooding (10% (1 in 10 year) likelihood of fluvial flooding in any given year) in the main reaches of Afton Water and Kello Water, including within the Site. Out with the application boundary, there is also a high risk of fluvial flooding along the River Nith which extends over a much wider area indicating a larger flood plain along the main river associated with the shallower topography. There is also a medium risk (0.5% (1 in 200-year event) likelihood of fluvial flooding in any given year) recorded within the same watercourses, extending to a slightly wider extent. However, the risk areas are generally contained within riparian channel.

Pluvial Flooding Sources

57. There are multiple small and scattered patches of medium and high potential pluvial (surface water) flooding indicated on the SEPA Flood Map (SEPA, 2023) within the Site. However, these are limited in spatial extent and primarily occur within the riparian zone of existing watercourses, flush areas or sections of flatter topography.

Coastal Flooding Sources

58. The proposed Development is located approximately 33 km from the nearest coast. Due to distance along with topographical position >220 m AOD, there is no risk of tidal flooding.

Groundwater Flooding Sources

59. Flooding can also result from high groundwater levels if the water table rises above the surface level. Groundwater flooding can occur in a variety of geological settings including river valleys with thick deposits of alluvium and river gravels. Groundwater flooding happens in response to a combination of already high groundwater levels (usually during mid- or late-winter) and intense or unusually lengthy storm events. Such flooding also often lasts much longer than flooding caused by a river over-flowing its banks. Groundwater flooding is difficult to predict as it rarely follows a consistent pattern and the response time between rainfall and groundwater flooding is also relatively long.

60. Groundwater flooding is often associated with the shallow unconsolidated sedimentary aquifers that overlie non-aquifers with minimal permeability. Such aquifers are susceptible to flooding as the storage capacity within these deposits is often limited and direct rainfall recharge can be relatively high, subsequently increasing the water levels within the groundwater and providing a good hydraulic connection with adjacent river networks.

61. The SEPA Flood Risk Management Map (SEPA, 2023) does not indicate any areas within the Site at risk of groundwater flooding. Due to the nature of the superficial geology (as discussed below), it is unlikely that there will be any significant groundwater flooding risk within the Site, with any risk likely to be minimal and limited to areas of well-sorted fluvial deposits including alongside watercourses.

Flooding from Artificial Drainage Systems

62. There is the potential for flooding due to increased runoff rates associated with artificial drainage channels present within the Site. It is also possible that artificial drains associated with the commercial forestry located in the north east of the Site could increase runoff rates and result in localised flooding in the receiving watercourses.

Cumulative Flood Risk

63. The Site sits within the existing HH and HHE Windfarms which are also located within the catchment of the River Nith. The River Nith also holds a number of other developments. Without appropriate drainage management the Site has the potential to increase flood risk, especially to vulnerable areas downstream of it, by increasing existing runoff and altering the flow regime.

9.6.7. Water Quality

64. The surface waters within the study area that have been classified under SEPA's RBMP are the Afton Water, Kello Water, River Nith, Euchan Water and Water of Ken. Other watercourses within the study area are not classified within the RBMP.

65. The RBMP is one of the requirements of the WFD (2000/60/EC) and is the plan designed for protecting and improving the water environment. The classification information for the WFD waterbodies are summarised in **Table 9.8** below. Current WFD status classifications discussed below are derived from information available within SEPA's Water Classification Hub (SEPA, 2020). The projected status classifications are derived from SEPA's Water Environment Hub (SEPA, 2020). Waterbody status classifications can be either: High; Good; Moderate; Poor; or Bad.

66. The Water of Ken is not hydrologically connected to the proposed Development and there is no Development infrastructure proposed within the catchment of the Euchan Water. The Afton Water, Kello Water and River Nith are all hydrologically connected to the proposed Development and are discussed in further detail below.

67. Both Afton water and Kello Water have been assigned an overall status in 2023 of Good, while the stretch of the River Nith between Sanquhar and New Cumnock has been assigned an overall status of Moderate Ecological Potential. Afton Water has been designated as a heavily modified water body on account of physical alterations that cannot be addressed without a significant impact on water storage for public drinking water. The River Nith has also been designated as a heavily modified water body on account of physical alterations that cannot be addressed without a significant impact on the drainage of agricultural land. The statuses remain the same for long term prediction except the River Nith which increases from Moderate to Good.

68. The groundwater bodies within the study area that have been classified under SEPA's RBMP are the Upper Nithsdale, Cumnock, Wardlaw Hill, Lesmhagow, Sanquhar and

Galloway groundwater bodies. The application boundary is entirely underlain by the Upper Nithsdale groundwater body.

Table 9.8: WFD classification of waterbodies within the study area

ID	WFD Water Body	WFD ID	Current Overall Status (2023)	Morphology (2023)	Overall Hydrology (2023)	Projected Overall Status (2027)[1]	Long Term Predicted Overall Status
SW01	Afton Water	10614	Good	High	Moderate	Good	Good
SW02	Kello Water	10616	Good	High	High	Good	Good
SW03	River Nith (Sanquhar – New Cumnock)	10611	Moderate Ecological Potential	Moderate	High	Good	Good
SW04	Euchan Water	10617	Good	Good	High	Good	Good
SW05	Water of Ken	10559	Poor	Bad	High	Moderate	Moderate
GW01	Upper Nithsdale	150663	Poor	N/A	N/A	Good	Good
GW02	Cumnock	150646	Poor	N/A	N/A	Poor	Good
GW03	Wardlaw Hill	150489	Good	N/A	N/A	Good	Good
GW04	Lesmahagow	150673	Good	N/A	N/A	Good	Good
GW05	Sanquhar	150518	Poor	N/A	N/A	Poor	Good
GW06	Galloway	150694	Good	N/A	N/A	Good	Good

9.6.8. Water Resources

EASR (formerly known as CAR) Licenced Activities

69. EASR (formerly known as CAR) licenced activities within the study area are shown in Table 9.9, and these potential receptors are also shown on Figure 9.1.

Table 9.9: EASR (formerly known as CAR) licenced activities within the study area

ID	Category	Site	Activity Type	Authorisation Type
A1	Registration	Restoration Works	Abstraction	Abstraction and/or Borehole

ID	Category	Site	Activity Type	Authorisation Type
A2	Registration	Restoration Works	Abstraction	Abstraction and/or Borehole
A3	Registration	Pencloe Windfarm	Abstraction	Abstraction and/or Borehole
A4	Registration	Sandy Knowe Windfarm	Abstraction	Abstraction and/or Borehole
D1	Licence	Glenmuckloch	Discharge	Other Effluent Mine Water
D2	Licence	Well Hill Quarry	Discharge	Other Effluent Mine Water
D3	Licence	Sandy Knowe Windfarm	Discharge	Construction Runoff
D4	Registration	Shephards Cottage	Discharge	Sewage (Private) Primary
D5	Registration	Laigh Cairn Farm	Discharge	Sewage (Private) Primary
D6	Registration	Hare Hill Windfarm,	Discharge	Sewage (Private) Primary
D7	Registration	East Polquhirter Farm,	Discharge	Sewage (Private) Primary
D8	Registration	Cottages 1-3, Rigg Farm	Discharge	Sewage (Private) Tertiary
D9	Registration	Over Cairn Farm	Discharge	Sewage (Private) Primary
D10	Registration	Merkland Farm	Discharge	Sewage (Private) Primary
D11	Registration	March Cottage	Discharge	Sewage (Private) Primary
D12	Registration	Dalhanna Farm	Discharge	Sewage (Private) Primary
D13	Registration	Lochbrowan Farm	Discharge	Sewage (Private) Primary
D14	Registration	Black Craig Farm	Discharge	Sewage (Private) Primary
D15	Registration	Hillend	Discharge	Sewage (Private) Primary
D16	Registration	High Cairn Farm +	Discharge	Sewage (Private) Primary
D17	Registration	Corsencon Farm	Discharge	Sewage (Private) Primary
D18	Registration	Corsencon Cottage	Discharge	Sewage (Private) Primary
D19	Registration	Glenhall Farm	Discharge	Sewage (Private) Primary
D20	Registration	Cairn Dairy	Discharge	Sewage (Private) Primary
D21	Registration	High Polquhirter	Discharge	Sewage (Private) Primary
D22	Registration	Burnton Farm	Discharge	Sewage (Private) Primary
D23	Registration	Hare Hill Windfarm Control Building	Discharge	Sewage (Private) Secondary
D24	Registration	Afton Windfarm,	Discharge	Sewage (Private) Secondary

ID	Category	Site	Activity Type	Authorisation Type
D25	Registration	Lochingerroch Farm	Discharge	Sewage (Private) Primary
D26	Registration	Euchanbank	Discharge	Sewage (Private) Primary
D27	Registration	Meikle Westland Farm	Discharge	Sewage (Private) Primary
D28	Registration	Glenbay Lodge	Discharge	Sewage (Private) Primary
D29	Registration	Pencloe Farm	Discharge	Existing Sewage Treatment System
D30	Registration	Glenshee	Discharge	Existing Sewage Treatment System
D31	Registration	Sandy Knowe Windfarm,	Discharge	New Sewage Treatment System to Land
D32	Registration	Sandy Knowe Windfarm Site Compound	Discharge	New Sewage Treatment System to Water
D33	Licence	Nusery View	Discharge	Sewage (Private) Secondary
D34	Licence	Craigdarroch	Discharge	Sheep Dip onto Land
D35	Licence	Pencloe Windfarm	Discharge	Point Source - Construction Runoff

70. **Table 9.9** shows that 39 no. EASR (formerly known as CAR) activities were identified within the study area. Of these, 33 no. are registrations and six are licenced activities. Of the 33 no. registered activities, four are abstraction and/or borehole construction and operation for a registration level abstraction, 26 no. are private (primary, secondary and tertiary) sewage discharges and four are existing or new sewage treatment systems. The licenced activities are effluent mine water, point source- construction run off, private sewage (secondary) and sheep dip onto land.

71. Scottish Water confirmed that there are no Scottish Water assets or abstractions within the Study Area. The proposed Development is also not within a Drinking Water Protected Area and therefore Scottish Water assets will not be considered further in this assessment.

9.6.9. Private Water Supplies

72. EAC and DGC were consulted regarding the presence of Private Water Supplies (PWS) within a 3 km search area from the Site. Fourteen PWS sources were identified which are presented on **Figure 9.1**. **Table 4.1.1** of **Technical Appendix 9.2** lists the eight PWS sources that were initially screened out of the assessment and rationale for doing so including, for example, the supply catchment lying outside that of the proposed Development. A

further six PWS sources were taken forward for individual consultation, via a questionnaire, and risk assessment. Table 4.2.1 of Technical Appendix 9.2 summarises the PWS details and findings from the questionnaire responses. As a result of information provided, Hillend Spring source (ID:2i) was not taken forward for assessment.

73. The PWS Risk Assessment identified that Hillend Surface Water source (ID:2ii), Nether Waistland Farm (ID:20) and Meikle Westland Farm (ID:25) were at Low risk from the proposed Development, that Blackcraig Farm (ID:12), was at Medium/Low risk from the proposed Development and that Overcairn Farm (ID:24) was at Medium risk from the proposed Development.

9.6.10. Fisheries and Recreation

74. The Site sits within the catchment of the River Nith which covers an area of approximately 1,200 km^2 and includes many sub-catchments. There are economically important fisheries for both salmon and sea trout in the River Nith catchment. In addition, other freshwater species co-exist with these migratory salmonid species and are the subject of some limited angling effort (Nith District Salmon Fishery Board, 2020). The Site is located in the upper reaches of the Afton Water and Kello Water catchments. Although the proposed Development is situated in the headwaters of these watercourses, there is a potential risk of habitat degradation stemming from the anthropogenic development that could ultimately impact on juvenile fish populations (downstream) of the site. Further details can be found in Technical Appendix 7.3: Aquatic Ecology Survey Report.

9.6.11. Peatland

Carbon and Peatland Mapping

75. The Carbon and Peatland Map (2016) presented in Figure 9.2, shows that the peat deposits found within the Site are primarily Class 1 (Nationally important), Class 3 (Occasional peatland habitat) and Class 5 (No peatland vegetation) soils with pockets of Class 0 (Mineral Soil), Class 2 (Nationally important) and 4 (Unlikely peatland habitat) soils also present.

76. Table 9.10 outlines the different carbon and peatland designations and the areas of the application boundary associated with each type.

Table 9.10: Carbon and Peatland Classification within the Application Boundary

Class	Description	Indicative Soil	Area (hectares)	Area %
1	Nationally Important	Peat soil	359	27
2	Nationally Important	Peat soil with occasional peaty soil	17	1
3	Occasional Peatland Habitat	Predominantly peaty soil with some peat soil	429	33

Class	Description	Indicative Soil	Area (hectares)	Area %
4	Unlikely Peatland Habitat	Predominantly mineral soil with some peat soil	173	13
5	No peatland habitat recorded.	Peat soil	335	25
0	Peatland habitats are not typically found on such soils	Mineral soils	7	1

77. The Carbon and Peatland Map is an initial strategic planning tool that predicts likely areas of carbon-rich soils, deep peat and priority peatland habitat across Scotland. NatureScot notes that site-specific surveys will always be required to confirm the quality and distribution of peatlands across a site (NatureScot, 2015). The consideration of the Carbon and Peatland Map is therefore superseded by site-specific surveys, for example a peatland condition assessment and peat depth surveys to determine the true baseline condition.

Peatland Condition Assessment Results

78. A peatland condition assessment was conducted in February 2025 using the NatureScot Peatland Condition Assessment Guidance (Peatland ACTION, 2016). The UKHab survey (see Chapter 7) identified 518.5 hectares as being peatland habitats which were brought forward for the peatland condition assessment. The results are presented in Figure 9.3 and Table 9.11.

Table 9.11: Peatland Condition Assessment Results within the Site

Peatland Condition	Key Features	Area (hectares)	Area (%)
Near Natural	Sphagnum dominated, no known fires (either prescribed or wild) within living memory, evidence of grazing and trampling impacts is rare or absent, little or no bare peat surface and heather (Calluna vulgaris) is not dominant.	1.2	0.2
Modified	Bare peat in small patches, fires or fire history, frequent impacts of grazing and trampling, sphagnum mosses rare or absent, extensive cover of heather (Calluna vulgaris) or purple moor grass (Molinia caerulea) and an undesirable level of scrub which is drying out the bog.	321.1	61.9
Drained	Within 30 m of either an artificial drain (grip) or a re-vegetated hagg/gully system	194.6	37.5
Actively Eroding	Actively eroding hagg/gully system (most of their length having no vegetation in gully bottoms , with steep bare peat “cliffs”, extensive continuous bare peat surfaces (peat	1.6	0.3

Peatland Condition	Key Features	Area (hectares)	Area (%)
	"pans"), extensive bare peat surfaces at former peat cutting sites and restoration may require a period de-stocking and exclusion of wild herbivores.		
Total		**518.5**	**100**

79. Within the peatland areas, the vast majority was identified as modified (61.9 %) and drained (37.5%). Near natural condition was identified for 0.2 % of the surveyed area, located in three discrete land parcels.

80. Plates 9.12 and 9.13 show evidence of modified and drained peatland condition within the Site. Further details relating to the condition of peat and the approach to management and enhancement can be found in Technical Appendix 7.5, 9.2 and 9.6.

Source: Natural Power

Plate 9.11: Heather dominant hill side indicating modified peatland condition, looking north from NS 65406 09465 towards Hare Hill

Source: Natural Power

Plate 9.12: Extensive drainage system indicating drained peatland condition looking north west from NS 65558 05709 towards Blackcraig Hill

Peat Depth Survey Results

81. Peat depth surveys were undertaken between May 2024 and September 2025 to carry out Phase 1 and Phase 2 investigations, in accordance with Scottish Government guidance (Scottish Government, Scottish Natural Heritage, SEPA, 2017). This was supplemented with peat depth data collected in 2013 as part of the Hare Hill Windfarm planning application.

82. Peat depths were recorded on a 100 m grid spacing across the entirety of the Site, on a 10 m grid spacing over all proposed infrastructure and on a 50 m spacing between 3 points transects along all tracks. The data covered 10,459 individual peat probe points.

83. Table 9.12 provides a summary of the depths of the 10,459 points surveyed and Figure 9.4 provides an interpolated representation of this.

Table 9.12 Total number of locations surveyed within each category.

Soil / Peat Depth Range (m)	Results	% of Points Surveyed
≤0.5	7,410	71
>0.5 - ≤1.0	2,040	19
>1.0 - ≤2.0	802	8
>2.0	207	2
Total	**10,459**	**100**

84. In Scotland, where soils of less than 0.5 m are recorded, these are categorised as mineral soil and/or organo-mineral soil (Joint Nature Conservation Committee, 2011). The peat depth survey indicates approximately 70% of the surveyed area consists of peaty soils (≤0.5 m depth). Approximately 20% of the peat probe data indicates areas of shallow peat (>0.5 – 1.0 m depth), and 10% of the peat probe data indicates deep peat. The vast majority of deep peat (80%) is less than 2 m in depth.

85. For each turbine location the average peat depths have been calculated from survey results and are presented in Table 9.13.

Table 9.13: Average peat depths at turbine locations calculated from peat survey results

Location	Average Soil Depth (m)
T1	0.72
T2	0.34
T3	0.46
T4	0.34
T5	0.81
T6	0.43
T7	0.14
T8	0.36
T9	0.72
T10	0.43
T11	0.36
T12	0.22
T13	0.25
T14	0.41
T15	0.34
T16	0.31
T17	0.22

Location	Average Soil Depth (m)
T18	0.64
T19	0.39
T20	0.36
T21	0.54
T22	0.62
T23	0.39

Source: Natural Power

86. Of the 23 no. turbines, 17 no. turbines have an average depth that indicates peaty/mineral soil, six have an average depth that indicates peat and none are located on deep peat.

9.6.12. Geology

Soils & Superficial Geology

87. Review of the National soil of map of Scotland (Scotland's Soils, 2024) (see Figure 9.5) indicates the proposed Development features dystrophic blanket peat, peaty gleys, peaty gleyed podzols, and humus-iron podzols. The predominant soil type is dystrophic blanket peat and peaty gleyed podzols.

88. The BGS Superficial Geology map (BGS, 2023) indicates that the majority of the proposed Development is underlain by peat deposits as shown in Figure 9.6. These are mainly situated on the higher, flatter areas of topography, with no superficial deposits present on the steeper slopes. Glacial till deposits of Quaternary sand, gravel and clay (diamicton) can also be seen within the application boundary, primarily following the line of incised channels and watercourses. In addition to these, alluvium, comprising of clay, silt, sand and gravel, associated with more recent fluvial deposition is present in riparian corridors of the main watercourses downstream of the Site. However, a small section is also present in the headwaters of Polstache Burm, a tributary of Kello Water, and within the headwaters of Kello Water itself.

89. Although outside the Site boundary, hummocky glacial deposits composed of rock debris, clayey till, sand and gravel can be seen within Euchan Water and Afton Water. Additionally, within the River Nith and Afton Water, various glaciofluvial deposits are present. These were deposited by meltwater streams and consist of coarse-grained sediments of sand and gravel with lenses of finer grained silt, clay or organic material. Smaller accumulations of alluvial fan deposits consisting of gravel, sand, silt and clay can also be seen in these main channels. These deposits are usually low, outspread relatively flat and gently sloping masses of loose rock material, shaped like a fan or segment of a cone and deposited by streams at the mouths of tributary valleys onto a plain or broad valley.

Bedrock Geology

90. The BGS Bedrock Geology map (BGS, 2023) indicates that the majority of the Site being underlain by formations of Ordovician age. Figure 9.7. shows that the Kirkcolm Formation underlies the majority of the Site. This comprises wacke, formed of a sandstone and siltstone turbidite sequence. Through the middle of the Site bedrock of the Blackcraig

Formation predominates. This is described as a massive wacke and conglomerate which interfingers with the Kirkcolm Formation. In the northern corner of the Site lies the March BurnFormation, a wacke composed of sandstones, siltstones and sporadic conglomerates (turbidite succession). Additionally, and although not underlying any of the proposed Development, it is worth noting that to the east of the Site lies the Scottish Lower Coal Measures Formation, comprising sedimentary rock cycles of sandstone, siltstone and mudstone in repeated cycles with seatclay or seatearth and coal on the top, which was formed in the Carboniferous period.

91. A number of intrusive, igneous structures are also present within the Site. The topographic high point of Hare Hill is underlain by the Harehill Pluton, while just to the north of the Site lies the Polshill Pluton, both of which are composed of granodiorite, formed in the early Devonian period. The area is also scattered by two igneous intrusive dyke suites, the North Britain calc-alkaline dyke suites composed of microdioritic rock and microgranodiorite, both of Siluruan to Devonian age. Outcrops of the Bail Hill Volcanic Group is evident in the north east of the Site, formed of lavas and pyroclastic rocks thought to be the remains of a seamount volcano, formed in the Ordovician period.

92. The Site is scattered with several structural features (faults). An inferred fault is present between the Blackcraig Formation and the Kirkcolm Formation, while a reverse or thrust fault is inferred between the Kirkcolm Formation and the Marchburn Formation. Two inferred faults are also present in the east of Site upon the Kirkcolm Formation, along with two axial plane traces (anticline and syncline) indicating folding just south of the inferred faults. Additionally, there is evidence of contact metamorphic aureoles in the west of Site upon the Blackcraig Formation and encircling the Harehill and Polshill Plutons upon the Kirkcolm and Marchburn Formations.

93. Fountainhead is located on Hare Hill and is designated as a SSSI and GCR site due to its mineralogical significance and exposure relating to the historical mining land use. Polehote and Polneul Burns are located on the northern slope of White Hill, with the proposed Development located in the upper catchment of these watercourses. They are designated as a SSSI and GCR site for exposure of Upper Carboniferous and Ordovician stratigraphy.

94. Within or downgradient of the Site, two specific geological features of interest have been identified. Fountainhead is located on Hare Hill and is designated as a SSSI and GCR site due to its mineralogical significance and exposure relating to the historical mining land use. Polehote and Polneul Burns are located on the northern slope of White Hill, with the proposed Development located in the upper catchment of these watercourses. They are designated as SSSI and GCS for exposure of Upper Carboniferous and Ordovician stratigraphy. These areas lie adjacent to the Site, however, no elements of proposed infrastructure are located in close proximity, therefore, although understanding the subsurface geology is important, specific mitigation to protect geodiversity during construction, operation and decommissioning is not required.

Hydrogeology

95. The presence of water within both the bedrock and the superficial deposits underlying the Site is closely controlled by the hydrogeological characteristics of the hosting lithology. According to the Hydrogeological 1:625,000 data set (BGS, 2020), the entirety

of the Site is underlain by the Blackcraig and Galdenoch Formation aquifer. These highly indurated greywackes are classed as a low productivity aquifer, with limited groundwater being found in near surface weather zone and in secondary fractures, with flow virtually all through these fractures and other discontinuities. However, to the north east of the proposed Development, the area is underlain by the Scottish Coal Measures Group which is a moderately productive aquifer with low yields from sandstones and higher yields where mining has taken place, but with poor water quality typified by high iron and fluoride concentrations.

96. Alluvial or glaciofluvial deposits have a high content of sand and gravel deposited by glacial meltwater rivers or post-glacial riverine processes and will have the highest permeability. These are likely to be situated closer to existing channels or valley basins across the Site. Conversely, where these sediments are interbedded with finer grained, lower permeability deposits such as silts and clays, water transmission will be more limited resulting in more heterogeneous flow conditions. Where present, the overlying peat may also host a shallow and potentially perched water table.

97. According to SEPA RBMP mapping (SEPA, 2020), the majority of the Site lies within the Upper Nithdale Groundwater Body (ID: 150663) which is classified as of Poor for overall status. According to the Groundwater Vulnerability Map of Scotland, the aquifer underlying the Site is considered vulnerable to most pollutants.

9.6.13. Groundwater Dependant Terrestrial Ecosystems

98. A detailed review and assessment of GWDTE habitats on the Site has been undertaken with details provided in **Technical Appendix 9.3**. The following section provides a summary.

99. A buffer search distance of 250 m from all proposed new infrastructure was adopted for all elements deemed to require excavations >1 m bgl (below ground level); this was applied to turbine foundations and the borrow pit. A 100 m buffer was applied to all access tracks, including existing tracks which may be subject to local widening and typically may require excavations <1 m bgl. National Vegetation Classification (NVC) habitat data (refer to **Chapter 7**) and SEPA's list of potential groundwater (GW) dependent communities was used to identify potential GWTDEs within the proposed Development. For a habitat to be designated as a GWDTE there is the requirement for hydraulic connectivity between the GW body and the habitat.

100. Review of the NVC data highlighted a number of potential GWDTEs using the list of communities identified in the SEPA guidance document (SEPA, 2024b). It is acknowledged in this document that the listed communities may be considered GWDTEs only in certain hydrogeological settings. For the purposes of the GWDTE assessment, where the habitat is overlying and/or in the immediate vicinity of permeable or faulted geology, the likelihood of a groundwater contribution is deemed to be the same as the original UKTAG list of NVC communities and associated groundwater dependency scores. The identified potentially GW dependent NVC communities are summarised in **Table 9.14**.

Table 9.14: NVC communities and potential GW dependency (within 250 m and 100 m buffer zones)

NVC Community	GWDTE Potential (SEPA, 2024b)
M6 - Carex echinata – Sphagnum recurvum mire	High
M15 - Scirpus cespitosus – Erica tetraix wet heath	Moderate
M23 - Juncus effusus/acutiflorus – Galium palustre rush-pasture	Moderate
MG9 - Holcus lanatus – Deschampsia cespitosa grassland	Moderate
MG10 - Holcus lanatus – Juncus effusus rush pasture	Moderate

101. The GWDTE assessment identified that the underlying superficial geology for the potential GWDTE habitats comprised peat, with glacial till localised to watercourses. The glacial till deposits are largely associated with watercourses within the Site, with many of the identified habitats located within or next to the banks of mapped watercourses. Although peat can be a superficial aquifer, it is believed in this instance to be surface water fed and therefore not reliant on groundwater supply. This is influenced by the relatively flat topography and underlying impermeable strata resulting in the pooling of surface water.

102. The assessment also identified that the bedrock underlying the Site is the Kirkcolm Formation and the Blackcraig Formation, formed of fine to course grained wackes of marine origin. This bedrock primarily of low groundwater productivity which offer only small amounts of groundwater.

103. The results of the NVC survey indicated that 91 no. habitats with the potential of moderate to high groundwater dependency are present within the Site boundary. However, based on the underlying geology and hydrological context, and geographical position of the identified habitats, all habitats have been assessed as not truly groundwater dependent. These habitats are more likely to be almost entirely fed by precipitation and/or surface or very near surface runoff/infiltration. Details and assessment of each of the 91 no. habitats recorded is provided in **Technical Appendix 9.3**.

9.6.14. Modifying Influences

104. Changes could potentially occur to the study area in the future in relation to climate and land use. This section defines the period for which the assessment needs to be carried out and the developments / changes that need to be considered within the assessment.

105. The conditions at the Site would be affected by climate change, which could affect the amount and intensity of rainfall, temperature and evapotranspiration. Information regarding climate change was obtained from the UK Climate Projections (UKCP18) website. The UKCP18 is a climate analysis tool which features comprehensive projections for different regions of the UK. General climate change trends projected over UK land for the 21st century show an increased chance of warmer, wetter winters and hotter, drier

summers along with an increase in the frequency and intensity of weather extremes. This is seen in the Probabilistic (25 km), Global (60 km), Regional (12 km) and Local (2.2 km) projections.

106. Warmer and wetter winters suggest less snow and more rain. This would create increased risk for flood events, and issues with water quality as less precipitation will be held in its frozen state during the winter season. If climate predictions are correct, summer months would become drier. This would create pressure on the needs of water abstractions and on sensitive ecosystems that rely on aquatic habitats. Evidence also suggests that although the summer months would have an average decrease in rainfall, summer storms will be more frequent and intense. This may lead to more extreme flow values during and immediately following such events, with consequential flooding and water quality issues. This is of key importance for the hydrological environment during summer construction periods.

107. Given the nature of the terrain and distance from any major urban land use, change from its current rural nature is unlikely over the lifespan of the proposed Development.

9.7. Assessment of Potential Effects

9.7.1. Potential receptors requiring assessment

108. Following establishment of the baseline setting, the receptors that are considered as requiring impact assessment (i.e. 'scoped in') are listed in **Table 9.15**, ordered broadly in accordance with their first appearance in the **Section 9.6**. They are also shown on **Figure 9.8**.

109. It is important to note that this Chapter examines potential changes of the proposed Development on the water environment supporting GWDTEs, not the habitats themselves, which is instead a matter for **Chapter 7**.

Table 9.15 Hydrology, Geology and Hydrogeology receptors requiring assessment

Receptor	Details	Location
WFD surface water bodies and associated tributaries		
Afton Water (SW01)	Overall 2023 status of Good. Hydrologically connect to the proposed Development.	Catchment within and downstream of the Site.
Kello Water (SW02)	Overall 2023 status of Good. Hydrologically connect to the proposed Development.	Catchment within and downstream of the Site.
River Nith (Sanquhar – New Cumnock) (SW03)	Overall 2023 status of Moderate Ecological Potential.	Catchment within and downstream of the Site.
Aquifer and associated WFD groundwater body		

Receptor	Details	Location
Upper Nithsdale (GW01)	The underlying aquifer classified as Poor overall status.	Beneath the Site.
Water Resources		
PWS (PWS2ii, PWS12, PWS20, PWS24, PWS25)	As part of the **Technical Appendix 9.2**, it was judged that these properties assessed as Low to Medium risk.	Catchment within and downstream of the Site.
Flood Risk		
Flood risk downstream of the Site (F02)	Unmitigated, elevated run-off from the proposed Development could potentially be discharged to the fluvial network and give rise to flashier hydrographs and potentially increased incidences of flooding downstream. The River Nith and the Kello Water show high likelihood of river flooding beyond the main channel of the watercourses.	Flood risk downstream of the Site.
Soils and Peat		
Peatland habitat	According to the NatureScot Carbon and Peatland 2016 map, the proposed Development is underlain by Class 1 peatland, defined as nationally important carbon-rich soils, deep peat and priority peatland habitat. Peatland Condition Assessment indicates that >99% of the bog habitats on Site are modified, drained or actively eroding, with <1% of near natural peatland identified. Peatland depth surveys recorded 71% of survey points on peaty soils (≤0.5 m), 19% of survey points on shallow peat (>0.5 - ≤1.0 m) and 10% of survey points on deep peat (>1 m).	Within the Site.

110. Table 9.16 presents the theoretical receptors that have been 'scoped out' from further assessment because the potential effects are not considered likely to be significant.

Table 9.16 Hydrology, Geology and Hydrogeology receptors scoped out for further assessment

Receptor	Rationale for scoping out of assessment
Designated sites	

Receptor	Rationale for scoping out of assessment
Fountainhead (named 'Hare Hill – The Knipe' for GCS)	The site is located >300 m from proposed Development infrastructure and is designated for a geological interest. Therefore, the integrity of the geological features will not be compromised.
Polehote and Polneul Burns	The site is located >850 m from the proposed Development infrastructure and is designated for a geological interest. Therefore, the integrity of the geological features will not be compromised.
Lagrae Burn	The site is not in hydrological connectivity with the Site and is located at a significant distance from proposed Development infrastructure (>.3.8 km).
Muirkirk and North Lowther Uplands	The site is not in hydrological connectivity with the Site and is located at a significant distance from proposed Development infrastructure (>1.9 km).
Watercourses and associated WFD surface water bodies	
Euchan Water (SW04)	The watercourse and its tributaries are not in hydrological connectivity with the Site, therefore this receptor would not be affected by the proposed Development.
Water of Ken (SW05)	The watercourse and its tributaries are not in hydrological connectivity with the Site, therefore this receptor would not be affected by the proposed Development.
Aquifer and associated WFD groundwater body	
Cumnock (GW02) Wardlaw Hill (GW03) Lesmahagow (GW04) Sanquhar (GW05) Galloway (GW06)	The geology of the area is low permeability, and these groundwater bodies not located beneath the Site. Therefore, is not considered that the groundwater body could be affected by changes in water quality or flow as a result of the proposed Development.
Superficial Aquifer	The till deposits underlying the-Site are regarded as a low productivity aquifer and, as such, the presence of groundwater would be limited. Where peat is present, the BGS do not consider these as aquifers that would be considered receptors.
Water Resources	
PWS (PWS1, PWS2i, PWS5, PWS9, PWS11, PWS15, PWS16, PWS21, PWS23)	As part of the **Technical Appendix 9.2**, it was judged that these properties were not in hydrological connectivity with the proposed Development or were noted as being on a mains water supply. As such these have been scoped out of further assessment.

Receptor	Rationale for scoping out of assessment
EASR (formerly known as CAR) Licenced Abstractions (A1, to A4)	All abstractions are out with surface water catchments associated with the proposed Development infrastructure; therefore they are not in hydrological connectivity and would not be impacted by the proposed Development. All abstractions are also out with the SEPA guidance (2024a) 250m buffers and, as such are considered unlikely to be impacted by the proposed Development. Abstractions have therefore been scoped out of further assessment.
EASR (formerly known as CAR) Licenced Discharges (D1-D35)	As these receptors are discharges rather than abstractions, they would not be impacted by the proposed Development. As such these have been scoped out of further assessment.
Flood risk within the Site (F01)	SEPA flood risk mapping indicates that there are currently no flood risk issues potentially affecting the proposed Development's infrastructure and watercourse crossing locations. Provided watercourse crossings are designed to accommodate the 1 in 200-year event (plus allowance for climate change) and other infrastructure is located well away from watercourses, SEPA do not foresee, from current information, a need for detailed information on flood risk. Therefore, flood risk within the Site has been 'scoped out' from further assessment.
GWDTE	
GWDTE (01 to 91)	Of the 91 no. habitats with the potential of moderate to high groundwater dependency that are present within the Site boundary, all habitats have been assessed as not truly groundwater dependent. As such GWDTE has been scoped out of further assessment.

9.7.2. Proposed Development Indicators

111. The proposed Development would introduce physical changes which have the potential to alter the hydrological characteristics within the Site. During the construction phase and to a lesser extent during the operational and decommissioning phase potential sources of pollution would be present. Hydrological surveys have been undertaken to establish the existing on-Site baseline conditions and associated areas downstream to assess the likely significant environmental effects of the proposed Development on the identified receptors, the significance of these effects on the receptors and the potential for mitigation to reduce the significance of the identified effects.

9.7.3. Construction / Operation / Decommissioning

112. As outlined in Section 9.4.2, the proposed Development will be split across two distinct construction phases. Phase 1 of the proposed Development would include the

decommissioning of HH and the installation of the first 15 no. new turbines. Phase 2 would include the decommissioning of HHE and the installation of the final eight turbines. The proposed Development includes associated foundations and hardstandings. substation, external transformer housing, batching plant, crane pads, access tracks, underground electricity cables, borrow pits and temporary construction compounds.

113. As the construction will occur over two phases, there will be two periods of earthworks which would involve earthworks inclusive of track construction, construction of hardstand areas, excavations for turbine bases, formation of turbine bases, cable installations and building of the substation.

9.7.4. Environmental Measures Embedded into the Development Proposals

114. Embedded mitigation proposals are mitigation measures that are inherent to the proposed Development. This includes all mitigation usually assumed to be in place during construction, operation and decommissioning and is generally regarded as industry standard or Best Practice. Construction and environmental management plans are introduced in **Chapter 5**, with an Outline Decommissioning and Construction Environmental Management Plan (DCEMP) provided in **Technical Appendix 5.1**. Embedded measures to manage the risk to PWSs are outlined in **Section 6** of **Technical Appendix 9.2**. An overview of some of the general (not project specific) environmental management considerations is also included in **Chapter 5**. Water environment-specific embedded mitigation measures are presented below.

Introduction

115. A qualitative, preliminary screening assessment for the potential location of the proposed Development's wind turbines and infrastructure was undertaken as part of a desk-based study. The purpose of this study was to identify potential significant constraints which may be posed by the baseline conditions of the proposed Development, so that the construction plan and layout of the proposed Development (as described in **Chapter 5**) could be developed /refined to account for these constraints and so minimise the potential risks and impacts to certain receptors during construction and operation.

116. A review of the baseline information for the study area (**Section 9.6**) identified potential development constraints associated with the proposed Development. This led to areas being discounted for the siting of turbines and access tracks and other areas being considered for development only if appropriate mitigation could be provided.

117. The preliminary constraints map generated as part of the screening process was used to 'scope out' potential locations for the wind turbines and Site infrastructure. To establish an indicative layout, buffer zones were placed around specific areas of the proposed Development where significant constraints were identified to exclude these from the possible areas of the proposed Development. A map of water environment constraints for the proposed Development is presented in **Figure 9.8**.

Avoidance and minimisation of peat disturbance

118. In the first instance peat depth surveys were conducted and peat depths were interpolated (see **Figure 9.4**) so areas of deep peat could be avoided entirely as part of

the design evolution of the Site layout. Avoiding such areas serves to minimise the volume of peat needing to be excavated, but excavation of this depth of peat could also have significant local influences on hydrology and associated habitats.

119. Where areas of deep peat could not be completely avoided, methods and approaches to minimise peat disturbance have been incorporated. This includes the consideration and implementation of floating access tracks where practical as well as avoiding deeper pockets of peat, regardless of peat condition, where possible. Evolution details the evolution of the design layout to minimise peat disturbance and excavation where possible, alongside other factors that have influenced the final layout.

120. The condition of the peatland within the Site has been noted as predominantly modified (61.9%) and drained (37.5%), with only a very small proportion (0.2%) identified as near natural. ScottishPower Renewables (UK) Limited (the Applicant) would commit to restoration and enhancement of an area of peatland that would result in a net positive overall impact on peat as a resource.

Watercourse buffer zones

121. The hydrological desktop study and Site visits have identified an upland hydrological environment of open moorland which includes a significant network of artificial drainage channels as well as numerous natural watercourses. A series of buffer distances have been adopted to help reduce effects of the proposed Development on the water environment.

122. The distances presented in Table 9.17 show that all turbines are located out with the 50 m watercourse or waterbody buffers. Distances were calculated using the functionalities provided within QGIS.

Table 9.17 Distance from turbine to nearest watercourse or waterbody

Turbine ID	Turbine distance from watercourse (m) (inclusive of 50m buffer)
T1	330
T2	184
T3	234
T4	149
T5	90
T6	208
T7	228
T8	116
T9	155
T10	320
T11	139
T12	227

Turbine ID	Turbine distance from watercourse (m) (inclusive of 50m buffer)
T13	173
T14	232
T15	174
T16	180
T17	248
T18	131
T19	285
T20	119
T21	260
T22	166
T23	313

Source: Natural Power

123. For turbines and associated infrastructure (hardstanding, substation, construction compound, battery storage area and access tracks) a 50 m buffer was implemented for all identified natural hydrological features. There are, however, five encroachments into the watercourse buffers, details for which are outlined below. It should be noted that Watercourse Buffer Encroachment 01 has been assessed as not being a true watercourse following a Site survey. Further details are provided below and in **Technical Appendix 9.1**. Watercourse Buffer Encroachments 02 – 05 can be microsited out with the watercourse buffers by applying the micrositing allowances of 50 m, as set out in **Chapter 5**.

124. Furthermore, 30 no. watercourse crossings associated with the new access tracks are required as part of the proposed Development, with 10 no. crossings proposed to be upgraded (outlined in **Appendix 9.1: Watercourse Crossing Assessment**).

Watercourse Buffer Encroachment 01

125. Borrow Pit 3 (BP3) encroaches on a watercourse at approximately NS 66902 609788 (see **Plate 9.13**). However, this watercourse is an artificial drainage channel as seen in (**Plate 9.14** and **9.15**). Typical of an artificial drainage channel, it has no obvious valley sides, a straight linear form with steep sided edges. Furthermore, during the survey in November 2024 the surveyor observed heavy rainfall, but zero flow within the channel. Furthermore, the channel was noted as being completely vegetated and not very well defined, indicating that this is perhaps only an ephemeral waterbody.

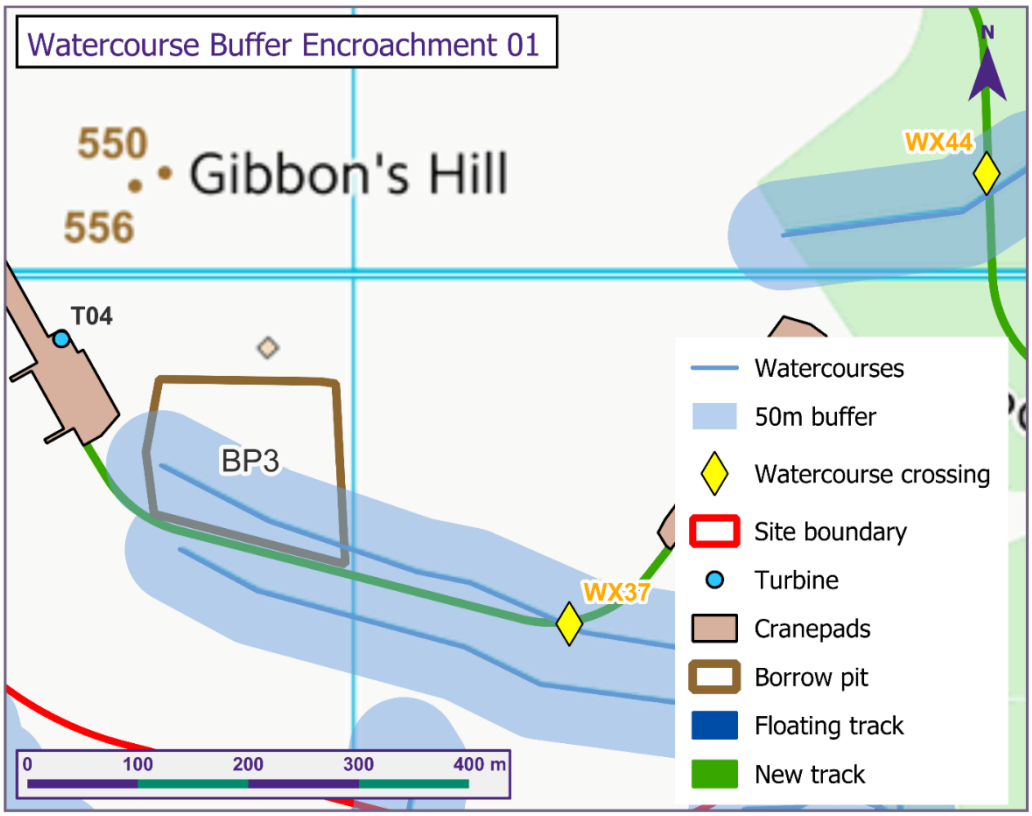

Plate 9.13 **BP3 crane pad encroachment of the 50 m waterbody buffer**


Source: Natural Power

Plate 9.14 **Bird's eye view of artificial drainage channel that intersects with BP3. Photo taken at NS 67197 09685**


Source: Natural Power

Plate 9.15 **Downgradient view of artificial channel that intersects with BP3. Photo taken at NS 67197 09685**

Watercourse Buffer Encroachment 02

126. The crane pad at T05 encroaches on a watercourse buffer by <5 m at approximately NS 67401 09860 (see **Plate 9.16**). By applying the 50 m micrositing allowance (as outlined in **Chapter 5**) the crane pad can be moved outside the 50 m buffer.

Source: Natural Power

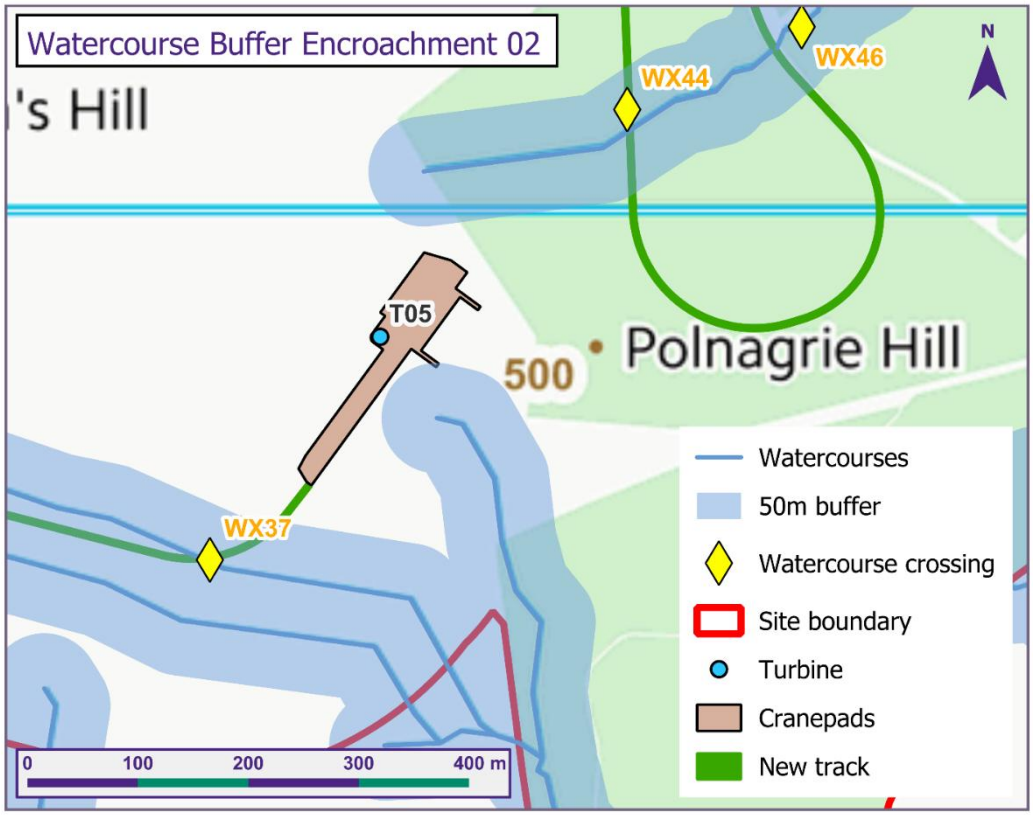

Plate 9.16 T05 crane pad encroachment of the 50 m waterbody buffer

Watercourse Buffer Encroachment 03

127. The new track, south of BP4, encroaches on a watercourse buffer by <10 m at approximately NS 65490 07180 (see **Plate 9.17**). By applying the 50 m micrositing allowance (as outlined in **Chapter 5**) the track can be moved outside the 50 m buffer.

Source: Natural Power

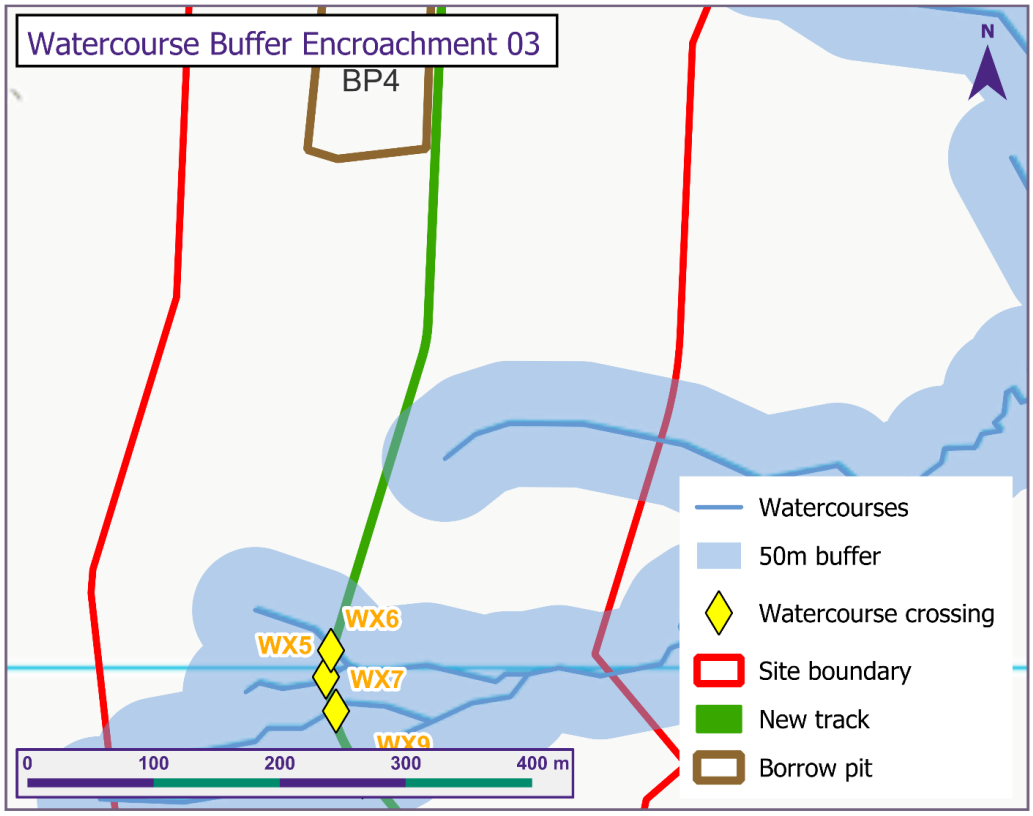

Plate 9.17 New track encroachment of the 50 m waterbody buffer, south of BP4

Watercourse Buffer Encroachment 04

128. The new track, south of BP1, encroaches on a watercourse buffer by <30 m at approximately NS 65283 05884 (see **Plate 9.18**). By applying the 50 m micrositing allowance (as outlined in **Chapter 5**) the track can be moved outside the 50 m buffer.

Source: Natural Power

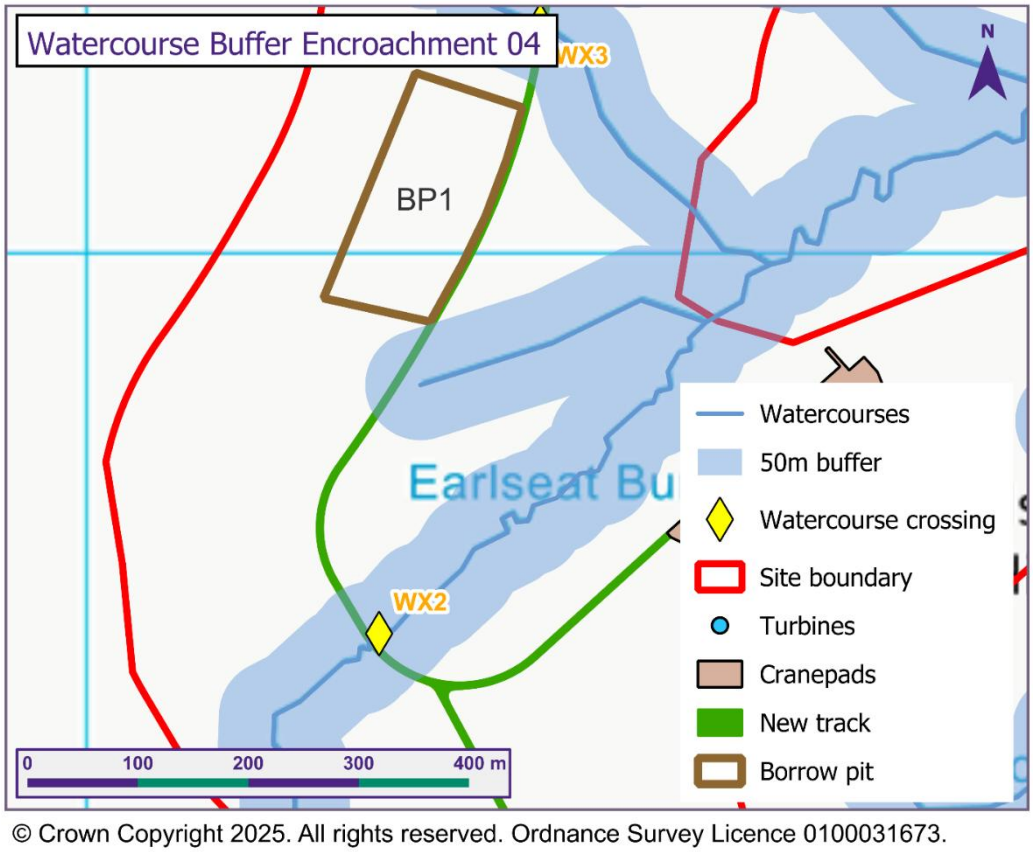

Plate 9.18 New track encroachment of the 50 m waterbody buffer, south of BP1

Watercourse Buffer Encroachment 05

129. The blade laydown areas marginally encroach on a watercourse by <10 m at approximately NS 65570 09847 (see **Plate 9.19**). By applying the 50 m micrositing allowance (as outlined in **Chapter 5**) the blade laydown areas can be moved outside the 50 m buffer.

Source: Natural Power

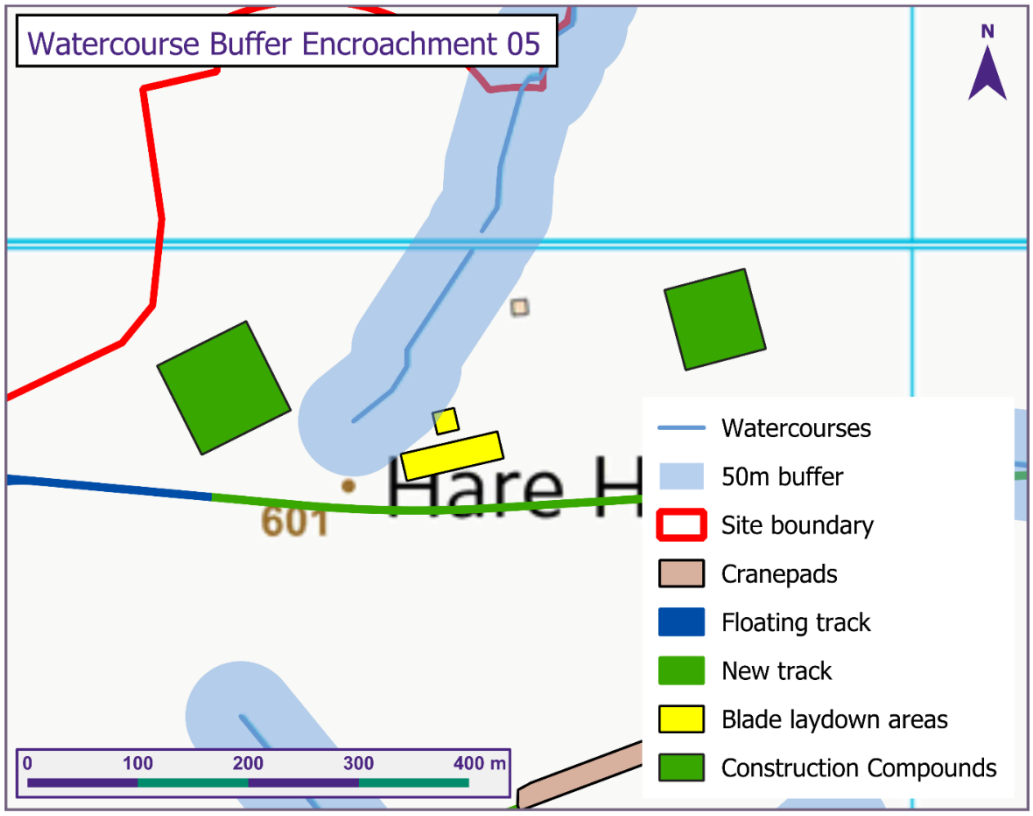

Plate 9.19 Blade laydown area encroachment of the 50 m waterbody buffer

Watercourse Buffer Encroachment 06

130. The new track, to the east of the northernmost site compound, encroaches on a watercourse buffer by <40m at approximately NS 66842 12499 (see **Plate 9.17**). The new section of track utilises an existing farm track and the stream to the west of the track has been artificially modified by existing farm activities.

Source: Natural Power

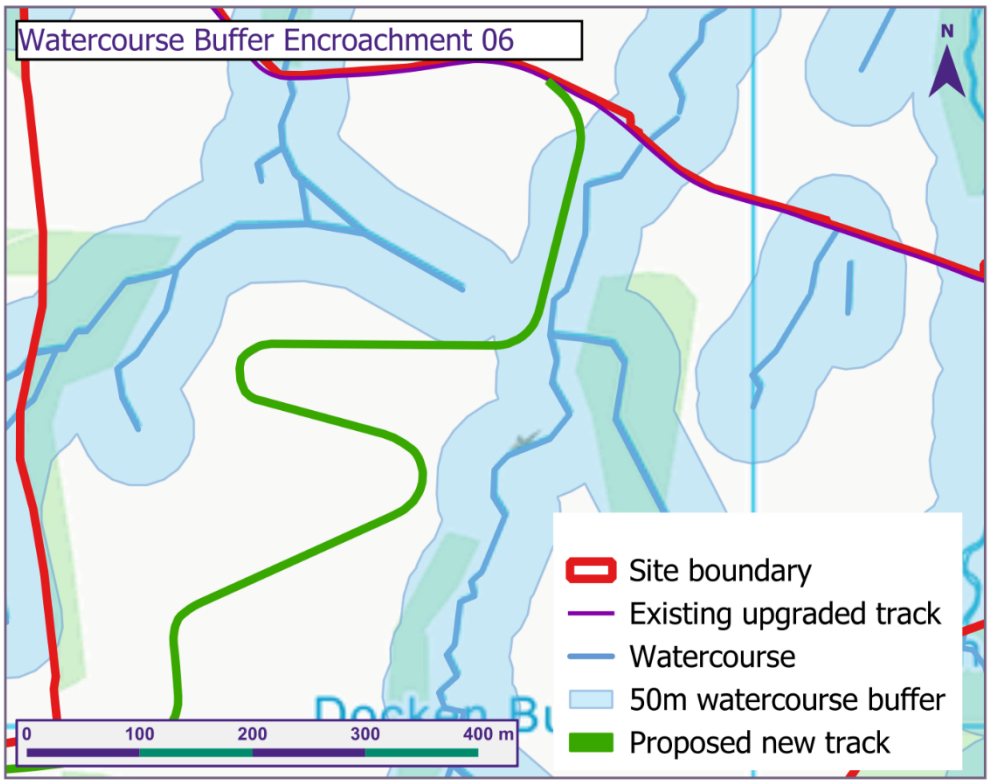

Plate 9.20 New track encroachment of the 50 m waterbody buffer, next to northern most site compound

Watercourse crossings design

131. Adherence to the Engineering in the Water Environment Good Practice Guide – River Crossings: Second Edition (SEPA, 2010), River Crossings and Migratory Fish: Design Guidance (Scottish Executive 2000) and CIRIA Culvert, Screen and Outfall Manual (C786) helps to minimise potential hydrological (including morphological) effects.

132. The watercourse crossings would be designed to convey a 1 in 200-year return period flood event with an allowance for climate change, while the watercourse/flow pathway would also be considered with respect to topography and hydrology. The watercourse crossing would be appropriately designed so that they do not alter the natural drainage or hinder the passage of aquatic fauna. During construction, it would include edge upstands or bunds e.g. sandbags or silt fences, to prevent sediment laden run-off from construction plant movement, directly entering watercourses.

133. A watercourse crossing assessment was carried out for 45 no. potential crossing locations and is detailed in **Technical Appendix 9.1**.

Avoidance of flood zones

134. The study has not identified any potential significant fluvial flood constraints within the Site. However, as a precaution, all areas identified as being located within a high to medium likelihood of surface water flooding were considered to be unsuitable for development. Developments should not be permitted in the 1 in 200-year (medium) flood zone unless it can be demonstrated that it would not affect the ability of the floodplain to store and convey water.

Micrositing

135. As discussed in Chapter 5, high-level micrositing of proposed turbine locations has been carried out to ensure that ecological, hydrological, hydrogeological and geotechnical aspects were optimised on the basis of a 50 m micrositing allowance. The proposed turbine locations are shown in Figure 5.1. In addition, there is the potential for further allowance for 50 m of micrositing (see Chapter 5) as a result of additional on-site surveys and baseline data collection prior to construction.

Construction run-off licence

136. Under EASR, a proposed construction site may need to obtain an EASR permit prior to commencing work. An EASR permit for the proposed Development is likely to be required since the construction site is greater than 4 hectares in area and includes trackways of greater than 5 km in length. This licence application requires the holder to adhere to a Pollution Prevention Plan (PPP) that SEPA has reviewed and must consider the potential impacts of construction on the water environment. Further details of SEPA's requirements for a PPP to accompany an EASR permit is provided in guidance document WAT-SG-75. A PPP would be included in a detailed site specific DCEMP that would be produced prior to the construction phase. Further details of this can be found in Technical Appendix 5.1.

Excavations and associated drainage

137. Where possible, excavations required to facilitate the construction of foundations for the wind turbines, service trenches and each crane base would be designed so that they can freely drain by gravity. Cut-off drains would be installed around the excavation areas to prevent surface run-off entering the excavations.

138. Measures based on Best Practice guidelines from SEPA would be adopted during construction to prevent pollution, with all contractors aware of a pre-planned pollution incident response procedure, as detailed in GPP21. The turbine foundation design minimises excavation requirements in accordance with BS 6031: 2009 Code of Practice for Earth Works.

139. Turbine construction would adopt mitigation measures, as detailed in the DCEMP, to prevent contaminants entering the shallow groundwater system. The main potential groundwater effect arising from the construction of the wind turbine foundations and adjacent crane pads is the risk of leaching concrete residues into the water environment and impediments to surface flow to watercourses. Therefore, to minimise the potential of concrete leaching and alkaline pollution of groundwater, suitable sulphate-resistant concrete would be used. The foundation design would be checked with SEPA, and if necessary, the foundation excavations would incorporate an adequate barrier to prevent the migration of any on-site pollutants to the underlying groundwater. Furthermore, the

use of cut-off drains installed around the excavation areas would prevent surface run-off entering the excavations and maintain the surface flow around the excavation to watercourses.

140. Should ground conditions occur during excavation where gravity drainage is not possible (i.e. where low permeability rock or superficial deposits are present), the excavations would be dammed and drained by pumping. These dewatering activities would be undertaken in accordance with Best Practice (including WAT-SG-29 on Temporary Construction Methods), which would be detailed in the DCEMP to be agreed by SEPA and the Ecological Clerk of Works (ECoW).

141. The design for the dewatering would ensure collection and settling of suspended sediment i.e. use of silt traps, fences, straw bales or lagoons. Any water removed from the excavation would be treated and pumped to a bunded and vegetated settlement and infiltration swale, downgradient of the excavation and away from watercourses, with no discharge of water directly into a watercourse. The potential for infiltration would need to be carefully assessed due to the potential presence of saturated soils across the Site. Should this be an issue, a number of these swales could be used with a wide spatial distribution to prevent oversaturation. The size of the settlement lagoons would be appropriate to the amount of dewatering, but if large quantities of dewatering are anticipated, the potential for more than one lagoon, the use of portable silt trap devices or other SuDS elements such as french drains could also be utilised (subject to ground conditions). The locations of swales or settlement lagoons, where required, would be on stable areas of shallow slope, to reduce the risk of failure. Should local topography or ground conditions prove unsuitable for construction of either infiltration swales or settlement lagoons, the use of portable silt trap devices such as 'Siltbuster' type tanks could be considered for removal of elevated suspended solids from water pumped from excavations. These activities would be designed and implemented in consultation with SEPA on a foundation-specific basis following completion of detailed ground investigations and micrositing prior to construction.

142. If any discharge to surface watercourses is required, the water would be treated beforehand and the need for any consent from SEPA agreed (it is expected that in most cases the activities would be covered by GBR3 and/or GBR15).

143. It is anticipated that the excavation of borrow pits may involve a small amount of dewatering during rock removal. However, due to the Site being underlain by a low productivity aquifer the impacts on groundwater resources would be limited. Similar controls to those detailed above would be employed to prevent contamination of surface waters with suspended sediment. The dewatering of excavations at greater than 10 m^3/day would require EASR Registration, while over 50 m^3/day would require a EASR permit. Abstractions smaller than 10 m^3/d would comply with GBR3.

Run-off and sediment management

144. The following measures will be adopted to appropriately attenuate and treat run-off during construction and operation of the proposed Development.

145. The proposed Development drainage system will convey water away from construction activities and built infrastructure, however, due to the nature of the works at the

proposed Development there is potential for sediment and other pollutants from exposed soil and bedrock to become entrained in the surface run-off.

146. To reduce this potential, prior to the commencement of and during construction, plans showing site drainage and hydrologically sensitive areas (e.g. watercourse buffers,) will be regularly checked to review potential for run-off and ponding of water within the proposed Development so that that run-off patterns are well known.

147. The drainage systems installed within the Site would also have sediment management measures incorporated into their design to help reduce or wholly mitigate effects on the hydrological environment. The type of sediment management would depend on the volume of construction activities occurring in particular areas within the Site. For all the suggested control measures, regular inspection and maintenance would be undertaken, particularly after prolonged heavy rainfall.

148. Silt traps would be installed within the proposed Development drainage system and can take a variety of forms, including terram fences or clean stone. The ability of the silt traps to successfully treat run-off would be dependent upon the volume of run-off within the drainage channel, the type of material used (i.e. the permeability of the terram geotextile material and the size and source of the clean stone) and the frequency of monitoring and replacement of the measures.

149. Large machinery would avoid traveling through any identified spawning areas, particularly from September-April to avoid redd damage and juvenile mortality.

150. If required, flocculants could also be used to treat run-off. Flocculants are very effective at removing suspended sediment from water but they can also have effects on water chemistry. The option to use flocculants would be determined by the contractor and the necessary consent applied for, by them, post-consent as part of the application to SEPA for an EASR Permit.

Concrete works

151. Concrete would be required for the construction of the turbine and building foundations. The use of concrete as part of watercourse crossing construction would be minimised as far as practical, favouring non-cementitious material or a pre-cast concrete culvert pipe which would preclude the requirement for in-channel cement use. This section provides good practice measures that would be implemented to minimise the potential for any negative effects to the water environment from concrete works.

- Care would be taken during the transportation of concrete to the turbine and building foundations and would be carried out following good practice measures. Freshly mixed concrete and/or dry cement powder would not be allowed to enter any watercourse. This would be avoided by the following actions:
  - Turbines, concrete batching or wash out areas would be located at least 50 m from watercourses.
  - Concrete wagons would only be permitted to wash-out into specifically designed wash-out areas at predetermined and agreed locations site wide, as stipulated in the DCEMP.

- The drivers would be informed at their site induction of the location of the designated wash-out areas and issued with a location map.
- Loads would be managed and assessed with regards to the size of vehicle and ground conditions whilst keeping at appropriate speed limits to avoid spillage.
- Tools and equipment would not be cleaned in watercourses. Should it be necessary to clean tools and equipment on Site, this would be done in the designated wash-out areas.
- The designated concrete wash-out area would be constructed within the Site at a location agreed with the relevant consultees. The design and construction of these wash out areas would be agreed with SEPA.
- Wash out areas would be continually monitored, and findings recorded to reduce the chances of effluent spilling over into the water environment.

Track design

152. On areas of peat depths consistently greater than 1 m, floating roads have been considered. In a floating road, the weight of the road is supported by the peat beneath, thereby avoiding the need to construct foundations extending through to the underlying solid stratum. The floating roads would be constructed in line with the good practice guidance produced by FCS and SNH (2010) and SR et al (2019) and would include the use of geogrids and geotextiles. The geotextile used would be selected to maintain load distribution, ensure separation of aggregate and peat, and prevent peat rutting, erosion and drainage. Aggregate choice would be sensitive to peat geochemistry and would be of sufficient grade to allow infiltration through to the geotextile.

153. With floating roads some interruption of surface and near-surface flows can occur. The track layout has been designed to minimise the total track length, and to avoid, where possible, intersecting catchment areas in a manner that could significantly interrupt flow paths. Cross-drainage would be provided in areas where access tracks unavoidably intersect dominant flow pathways, as discussed below.

Site drainage

154. The following section discusses the conventional site drainage measures that would be installed during the construction and operation of the proposed Development.

155. Surface drainage ditches would be installed alongside tracks only where necessary. The length, depth and gradient of individual drains would be minimised to avoid intercepting large volumes of diffuse overland flow and generating high velocity flows during storm events.

156. Sediment traps, settlement ponds and buffer strips would be incorporated into the drainage system as necessary and would serve the dual purpose of attenuating peak flows, by slowing the flow of run-off through the drainage system and allowing sediment to settle before water is discharged from the drainage system.

157. As well as utilising sediment traps, structures such as v-notched weirs would be installed within the drainage channels. Such structures act to throttle the flow within the channel,

thus reducing erosive potential of any run-off and allowing sediment and/or pollutants to settle.

158. To reduce the impact of the proposed Development on the natural hydrological regime, the site drainage would mimic greenfield run-off response using sustainable drainage practices.

159. SuDS would be integrated into the water management to achieve pre-development runoff rates and to minimise erosion on existing watercourses. Details of the proposed SuDS regime would be included in the DCEMP and PPP that would be produced should consent be granted.

160. SuDS are used to attenuate rates of run-off from development sites and can also have water purification benefits. The implementation of SuDS as opposed to conventional drainage systems provides several benefits by:

- reducing peak flows to watercourses and potentially reducing risk of flooding downstream;
- reducing the volumes and frequency of water flowing directly to watercourses;
- improving water quality by removing pollutants;
- reducing potable water demand through rainwater harvesting; and
- replicating natural drainage patterns, including the recharge of groundwater so that base flows are maintained.

161. Whilst it is understood that the scope for SuDS measures is limited as a result of the hydrological environment, the installed drainage measures would adopt the principles highlighted above.

162. Access tracks crossing slopes could disrupt surface flow such that water collects in drains constructed upslope of the tracks. Cross-drains and/or waterbars would be constructed at regular intervals to conduct this surface flow below or across the track where it will be discharged back into the drainage system. However, all efforts would be made to segregate this run-off from more-silty run-off originating from track surfaces and other exposed construction areas, thus reducing the silt load and volume discharging to the silt treatment areas. Regular discharge points would limit the concentration of surface run-off and the diversion of flows between catchments. Such cross drains need to be strong enough to withstand the expected traffic loadings.

163. During storm events there is likely to be some ponding on the uphill side of tracks as percolation alone is unlikely to be able to accommodate surface flows. To minimise this ponding, small diameter cross drains or perforated pipes (similar to plastic pipe field drains) will be incorporated into the track base at regular intervals as required to allow more flow to pass through the track and maintain the current flow regime. Such pipes would be surrounded by free draining material that is wrapped in a separator geotextile. The number of pipes and associated dimensions will be dependent upon the width of the flush/boggy area and the hydrological regime.

164. Prior to track construction, site operatives would identify flush areas, depressions or zones which may concentrate water flow. These sections would be spanned with plastic

pipes to help maintain hydraulic pathways under the road and reduce water flow over the road surface during heavy precipitation.

165. Drains and/or cut-off drains would be installed on the upstream/upgradient sides of the turbine foundations, crane hardstands, and other excavations required across the proposed Development. The purpose of this would be to help reduce the volume of surface water run-off entering the excavations and minimise any subsequent contamination.

166. The constructed drainage system would not discharge directly to any natural watercourse, but would discharge to buffer strips, trenches or SuDS measures, preferably on flatter, lower lying ground. These buffers would act as filters and would minimise sediment transport, attenuate flows prior to discharge and maximise infiltration of water back into the soils.

167. Drainage from the construction compound, welfare facilities, the borrow pit and concrete wash out areas would be collected and treated separately from the main site drainage, as the run-off from these areas is more likely to be contaminated and therefore will require treatment. Appropriate treatment, such as oil interceptors and treatment for high alkalinity water, would be installed.

168. All mitigation and drainage would be subject to detailed design and approved by SEPA prior to construction with the ECoW ensuring compliance. The proposed Development would also be subject to a construction run-off permit.

Peat excavations and storage

169. Measures that would be employed to minimise impacts on and from excavated peat are outlined below.

170. Surface run-off from stockpiles of any excavated peat has the potential to affect surface water quality due to the transportation of suspended solids in surface water run-off. Therefore, good practice measures, such as those outlined in the guidance, "Good Practice during Wind Farm Construction" (Scottish Renewables, 2019), would be implemented to ensure that peat is appropriately stored. Any peat storage areas would be located at a distance from any watercourses and would be contained to prevent sediment or nutrient run-off from eventually reaching downstream watercourses.

171. Any storage of peat during construction would minimise slumping and maintain stratification, where possible using water derived from dewatering activities to keep the peat adequately saturated to prevent desiccation and degradation. It is anticipated that a large amount of the excavated peat can be re-used on-site. Further information on how peat would be stored and used on Site is set out in **Technical Appendix 9.4**.

Cable trench design

172. Cables would be run alongside access tracks. The trenches would be installed at the minimal depth practical, although this may reach 0.5 – 1 m deep. They would be dug and left open for the minimum time possible to ensure that they do not create open drainage routes. The trenches would be backfilled as far as possible with the excavated soils, to minimise the change to flow paths. Where other material is used to backfill the trenches, clay cut-off barriers would be installed across the trench to prevent them creating preferential flow paths.

173. Cable laying methods that do not require a dug trench would be considered. FCS/SNH (2010) suggest that it may be possible to inset the cable in peat flanks alongside the edges of the floating roads, so that they are protected but do not need to be dug into the ground, disturbing the peat and associated flow paths.

Site working practices

174. Site activities during construction and operation have been identified to have potential adverse effects on the hydrological environment. These can be controlled by the implementation of pollution prevention and control measures and Best Practice, based on the guidance outlined earlier. Further information on these measures are presented in Technical Appendix 5.1.

175. The site induction for contractors would include a specific session on good practice to prevent and control water pollution from construction activities. Contractors would be made aware of their statutory responsibility not to "cause or knowingly permit water pollution". As discussed earlier, a PPP and a Pollution Incident Response Plan (PIRP) would be prepared for the proposed Development, the latter in line with GPP 21, and all contractors would be briefed on these plans, with copies made available on-site. Equipment to contain and absorb spills would also be readily available.

176. Fuel and oil may enter the groundwater by migration vertically into the underlying groundwater or by run-off into nearby surface waters, if accidentally released or spilled during storage and refuelling. To minimise potential releases into the water environment, fuel would be stored in either a bunded area or a self-bunded above ground storage tank (AST) kept on-site during the course of the construction phase in accordance with the EASR (formerly known as CAR) and other SEPA Pollution prevention guidelines, and GBR9. The bunded area would have a capacity of 110 % of the fuel tank. All stores would be located at least 50 m from any watercourses.

177. In areas where there is a potential for hydrocarbon residues from run-off/isolated leakages, such as in plant storage areas and around fuel storage tanks and in refuelling zones in the proposed temporary site compound, surface water drainage would be directed to a hydrocarbon interceptor prior to discharge. The interceptor would filter out hydrocarbon residues from drainage water and retain hydrocarbon product in the event of a spillage to prevent release into surface waters at the discharge point and deterioration of downstream water quality.

178. Plant and machinery used during the construction phase would be maintained to minimise the risks of oils leaks or similar. Maintenance and refuelling of machinery would be undertaken off-site or within designated areas of temporary hardstanding at least 50m away from any watercourse. In these designated areas contingency plans would be implemented to ensure that the risk of spillages is minimised. Placing a drip tray beneath a plant and machinery during refuelling and maintenance would contain small spillages.

179. The main potential hydrological effects during the operational phase of the proposed Development relate to the servicing of the turbines and storage of oils and lubricants involved in the process which may be accidentally released into the water environment. This includes turbine gearbox oil changes during the lifetime of the proposed Development. The frequency of these oil changes will be decided post submission, following confirmation of turbine candidate.

180. The potential risks posed to surface water and groundwater quality, specifically related to operation, are likely to be limited and localised based on the planned works and the nature and volume of substances required. Any potential risk to the environment would be identified by the operator prior to servicing being undertaken. The operator would ensure a site-specific risk assessment is completed and that control measures are implemented to ensure all environmental risks are minimised. However, as a pre-requisite the storage, use and disposal of oils would be done in accordance with best practice and SEPA guidance (GPP 8) (see earlier).

181. Potential ongoing effects in relation to infrastructure remaining on the proposed Development during operations (including the turbine locations and access tracks) were addressed during the discussion of construction mitigation above. Ongoing maintenance would be carried out, for example, to maintain drainage and settlement ponds.

Welfare facilities / foul water

182. The following measures would be adopted for the design of the foul water drainage system:

- Any sewage associated with the temporary construction compounds, control buildings and welfare facilities would be collected in appropriately sized interceptor tanks and shall be located at the construction compounds. All wash basins, toilets and shower areas shall also be connected to an interceptor tank;
- The interceptor tanks and the tanks within any site portable toilets, which would be situated more than 50 m from any watercourse, would be emptied regularly by a suitably licensed contractor. Sewage from these facilities would be disposed of offsite in accordance with waste management legislation; and
- The discharge volumes would be small however it would comply with the requirements of the EASR and in consultation with SEPA.

Other mitigation within DCEMP

183. A site-specific DCEMP containing detailed mitigation measures would facilitate the implementation of industry good practice measures in such a manner as to prevent or minimise effects on the surface and groundwater environment and would be written and approved by stakeholders in advance of the construction phase. An Outline DCEMP has been provided in Technical Appendix 5.1. In summary the mitigation included within the DCEMP would include:

- Drainage – all run-off derived from construction activities and site infrastructure would not be allowed to directly enter the natural drainage network. All run-off would be adequately treated via a suitably designed drainage scheme with appropriate sediment and pollution management measures. The Site is situated in an upland hydrological area and it is imperative that the drainage infrastructure is designed to help maintain the existing hydrological regime;
- Storage – all equipment, materials and chemicals will be stored well away from any watercourses. Chemical, fuel and oil stores would be sited on impervious bases with a secured bund at a designated location (likely to be construction compounds);

- Vehicles and Refuelling – During refuelling of all small plant (e.g. generators), a drip containment (e.g. plant nappy) would be placed underneath to prevent oil and fuel leaks causing pollution. Where practicable, refuelling of vehicles and machinery would be carried out in designated areas, on an impermeable surface, and well away from any watercourse;
- Maintenance – maintenance to construction plant would be carried out in designated zones, on an impermeable surface well away from any watercourse or drainage, unless vehicles have broken down necessitating maintenance at the point of breakdown, where special precautions will be taken;
- Welfare Facilities – on-site welfare facilities would be adequately designed and maintained to allow the appropriate disposal of sewage. This may take the form of an on-site septic tank with soakaway, or tankering and off-site disposal depending on the suitability of the proposed Development for a soakaway. Any discharge requirements would comply with relevant requirements under SEPA's EASR;
- Cement and Concrete – fresh concrete and cement are very alkaline and corrosive and can be lethal to aquatic life. The use of wet concrete in and around watercourses would be avoided and carefully controlled through implementation of the buffer zones where applicable and good practice construction methods;
- Monitoring Plans – all activities undertaken as part of the proposed Development would be monitored throughout the construction phase for environmental compliance. Surface water and private water quality monitoring would also occur throughout each phase of the proposed Development and will help to maximise the effectiveness of embedded mitigation measures whilst monitoring effects on the hydrological environment. The frequency and duration of monitoring would be agreed following discussion with SEPA and other relevant authorities;
- Contingency Plans – a site-specific Emergency Response Plan would be implemented to allow plans to be put in place to manage a spill or other pollution incident. The plans would ensure that emergency equipment is available on-site i.e. spill kits and absorbent materials, advice on action to be taken and who should be informed in the event of a pollution incident; and
- Training – All relevant staff personnel would be trained in both normal operating and emergency procedures and be made aware of highly sensitive areas on-site.

184. A suitably qualified ECoW would be employed throughout the construction of the proposed Development. The appointed ECoW would ensure implementation of measures outlined in the DCEMP, for example, provision of advice to the contractors about how environmental effects can be minimised, and what methods can be employed to reduce effects on water quality, soils and associated habitats. As part of the WQMP and usually undertaken by the ECoW, a programme of visual monitoring would be undertaken to ensure that the designed drainage systems are compliant with the requirements under EASR with respect to GBR 10 and in particular, clauses d, g and h. Further details of the roles and responsibilities of the ECoW are provided in **Technical Appendix 5.1.**

Summary

185. A range of environmental measures have been embedded into the development proposals as outlined above. A summary of how these embedded measures relate to each of the receptor groups and the potential effects assessed is presented in Table 9.18.

Table 9.18 Summary of embedded environmental measures

Receptor	Changes and effects	Embedded measures
Watercourses and associated WFD surface water body	Soil compaction and the introduction of areas of hardstanding during construction and throughout operation increasing runoff and sediment loading, leading to changes in watercourse flow, quality and morphology.	Avoidance of flood zones Watercourse buffer zones Avoidance of steep gradients Micrositing Measures within the DCEMP (including surface and private water supply monitoring plan) outlined above Track design Drainage design Cable trench design Watercourse crossing design
	Disruption of flow paths and changes to drainage regime during construction and throughout operation can be associated with increases in runoff and less on-site water retention, leading to changes in watercourse flow and morphology.	Avoidance of flood zones Watercourse buffer zones Avoidance of steep gradients Micrositing Measures within the DCEMP (including surface and PWS monitoring plan) outlined above Track design Drainage design Cable trench design Watercourse crossing design Peat excavation and storage
	Disruption of ground during construction resulting in increased sediment loading, leading to changes in watercourse quality and morphology.	Avoidance of flood zones Watercourse buffer zones Avoidance of steep gradients Micrositing Measures within the DCEMP (including surface and PWS

Receptor	Changes and effects	Embedded measures
		monitoring plan) outlined above Track design Drainage design Cable trench design Watercourse crossing design Peat excavation and storage
	Dewatering and/or drainage during construction disrupting groundwater support (baseflow), leading to changes in watercourse flow.	Avoidance of flood zones Watercourse buffer zones Micrositing Measures within the DCEMP outline above Excavations and associated drainage
	Discharge to surface water of groundwater intercepted during construction associated with the excavation of the turbine foundations, leading to changes in watercourse flow, quality and morphology.	Avoidance of flood zones Watercourse buffer zones Avoidance of steep gradients Micrositing of turbines and tracks Measures within the DCEMP (including surface and PWS monitoring plan) outlined above Excavations and associated drainage
	Site activities during construction and operation resulting in the release of pollutants and the subsequent contamination of surface waters, leading to changes in watercourse quality and morphology.	Avoidance of flood zones Watercourse buffer zones Avoidance of steep gradients Micrositing Measures within the DCEMP (including surface and PWS monitoring plan) outlined above Watercourse crossing design Site working practices

Receptor	Changes and effects	Embedded measures
Aquifer and associated WFD groundwater body	Soil compaction and the introduction of areas of hardstanding during construction and throughout operation reducing recharge and groundwater levels, leading to a loss of water resource.	Measures within the DCEMP (including PWS monitoring plan) outlined above
	Dewatering during construction associated with the excavation of the turbine foundations leading to a decline in groundwater levels.	Measures within the DCEMP (including PWS monitoring plan) outlined above Dewatering of excavations and associated drainage consistent with requirements of GBRs 3 and 15.
	Site activities during construction and operation resulting in the release of pollutants and the subsequent contamination of groundwater, leading to a loss of water resource.	Measures within the DCEMP (including PWS monitoring plan) outlined above Site working practices
Soils and peat	Contamination of soils due to accidental release of pollutants during works.	Avoidance of deep peat (<1 m) Micrositing Measures within the DCEMP outlined above PMP PPP and PIRP Site working practices
	Peat disturbance leads to disruption of surface and near-surface flow paths and changes to the drainage regime, most typically increased runoff.	Avoidance of deep peat (<1 m) Micrositing Measures within the DCEMP outlined above PMP Avoidance of steep gradients Track design Drainage design Cable trench design Peat excavation and storage

Receptor	Changes and effects	Embedded measures
	Peat disturbance leads to breakdown of peat structure and disturbance of peat hydrology.	Avoidance of deep peat (<1 m) Micrositing Measures within the DCEMP outlined above PMP Peat excavation and storage
	Soil compaction and the introduction of areas of hardstanding during construction and throughout operation reducing recharge and groundwater levels, leading to derogation of peat resource.	Avoidance of deep peat (<1 m) Micrositing Measures within the DCEMP outlined above PMP Track design
Areas at risk of flooding downstream	Soil compaction, the introduction of areas of hardstanding and changes of land use (e.g. deforestation) during construction and throughout operation increasing runoff and flood risk	Avoidance of flood zones Watercourse buffer zones Avoidance of steep gradients Micrositing Measures within the DCEMP outlined above Track design Drainage design Cable trench design Watercourse crossings design
	Disruption of flow paths and changes to drainage regime during construction and throughout operation can be associated with increases in runoff and less on-site water retention, and increased flood risk	Avoidance of flood zones Watercourse buffer zones Avoidance of steep gradients Micrositing Measures within the DCEMP outlined above Track design Drainage design Cable trench design Watercourse crossings design
	Discharge to surface water of groundwater intercepted during construction associated with the excavation of the turbine	Avoidance of flood zones Watercourse buffer zones Avoidance of steep gradients

Receptor	Changes and effects	Embedded measures
	foundations and borrow pits and increasing flows and flood risk	Micrositing Measures within the DCEMP outlined above Excavations and associated drainage
Water Resources - groundwater	Soil compaction and the introduction of areas of hardstanding during construction and throughout operation reducing recharge and groundwater levels, leading to abstraction derogation	Groundwater abstraction buffer zones Measures within the DCEMP (including PWS method statement and monitoring plan) outlined above
	Dewatering during construction associated with the excavation of the turbine foundations leading to a decline in groundwater levels, leading to abstraction derogation	Groundwater abstraction buffer zones Measures within the DCEMP (including PWS method statement and monitoring plan) outlined above
	Site activities during construction and operation resulting in the release of pollutants and the subsequent contamination of groundwater, leading to abstraction pollution	Groundwater abstraction buffer zones Measures within the DCEMP (including PWS method statement and monitoring plan) outlined above Site working practices
Water resources – surface water	Soil compaction and the introduction of areas of hardstanding during construction and throughout operation increasing runoff and sediment loading, leading to abstraction pollution	Avoidance of flood zones Watercourse buffer zones Avoidance of steep gradients Measures within the DCEMP (including PWS method statement and monitoring plan) outlined above Watercourse crossings design
	Disruption of ground during construction leading to increased sediment loading and abstraction pollution	Avoidance of flood zones Watercourse buffer zones Avoidance of steep gradients

Receptor	Changes and effects	Embedded measures
		Measures within the DCEMP (including PWS method statement and monitoring plan) outlined above Watercourse crossings design
	Dewatering and/or drainage during construction disrupting groundwater support (baseflow) to watercourses, leading to abstraction derogation	Avoidance of flood zones Watercourse buffer zones Measures within the DCEMP (including PWS method statement and monitoring plan) outlined above
	Discharge to surface water of groundwater intercepted during construction associated with the excavation of the turbine foundations increasing flows and sediment loading, leading to abstraction pollution	Avoidance of flood zones Watercourse buffer zones Avoidance of steep gradients Measures within the DCEMP (including PWS method statement and monitoring plan) outlined above
	Site activities during construction and operation resulting in the release of pollutants and the subsequent contamination of surface waters, leading to abstraction pollution	Avoidance of flood zones Watercourse buffer zones Avoidance of steep gradients Measures within the DCEMP (including PWS method statement and monitoring plan) outlined above Watercourse crossings design Site working practices

Source: Natural Power

9.7.5. Assessment of Hydrology and Hydrogeology Effects

Potential Resultant Effects – Construction

186. The potential for effects on the water environment is greatest during the construction phase due to the high levels of activity on-site and when there is greatest change to the existing environment. As the proposed Development would be built over two phases, the effects on the water environment would be extended. The potential construction effects of the proposed Development are discussed in the following paragraphs. This information has taken account of the environmental measures embedded into the proposed Development outlined above in the Section 9.7.

187. Details of the potential construction effects is provided below and summarised in **Table 9.19.** The table assumes the successful implementation of the embedded mitigation measures outlined in **Section 9.7**.

Pollution Incidents

188. During the construction phase, several potential pollutants would be present on-Site, including oil, fuels, chemicals, unset cement and concrete, waste and wastewater from construction activities and staff welfare facilities. Many of these potential pollutants would be located or stored within the construction compound located on the border between the Kello Water catchment and the Garepool Burn catchment. In addition, there is the potential for contamination of the hydrological and terrestrial environment caused by spillages along the access tracks and construction areas.

Erosion and Sedimentation

189. Soil and sediment generation may occur in areas where the ground has been disturbed, particularly where surface run-off has been concentrated. Drainage ditches are particularly prone to this problem, due to the high velocities of surface water run-off passing through the drainage network. Considerable sediment generation is expected where the ground has been excavated for the proposed Development infrastructure.

190. Sediment transport in watercourses can result in high turbidity levels which can impact on the water quality, particularly affecting the ecological potential of the watercourses. High turbidity levels can reduce the light and oxygen levels, while sediment deposition can smother plant life and spawning grounds. Sediment deposition can also reduce the flood storage capacity of the watercourses and block culverts, resulting in an increased flood risk.

191. As a result of construction operations, all catchments with new and upgraded infrastructure present are vulnerable to erosion and sedimentation.

Increase in Run-off

192. Turbine bases, hardstand areas and access tracks would act as impermeable areas, restricting the natural movement of water within the hydrological environment, potentially resulting in increased rates of run-off into the onsite catchments.

193. Localised increases in run-off could cause issues for downstream flood storage capacity and/or pollution incidents. Increases in the volume of run-off entering watercourses could also cause erosion and sedimentation, therefore having detrimental effects on surface water hydrology.

Modification of Drainage Patterns

194. The interception of diffuse overland flow by the proposed Development infrastructure and associated drainage may disrupt the natural drainage regime of the area, concentrating flows and potentially diverting flows from one catchment to another. This may have implications for water quality and on flood issues downstream of the Site.

195. Surface water dependent habitats such as bog habitats, watercourses and riparian zones present a potential engineering constraint, therefore the necessary precautions should be taken to avoid them where possible and maintain them where avoidance is not

possible. This should include bespoke drainage arrangements that maintain surface water flows and prevent dewatering of adjacent habitat.

196. Turbine foundations and hardstand areas located up-gradient from sensitive habitats could disrupt shallow groundwater flow from dewatering and diversion of flow paths.

197. Turbine foundations and hardstand areas located down-gradient sensitive habitats could cause temporary lowering of the water table from dewatering.

198. Access tracks, drainage ditches and cable trenches located up-gradient from sensitive habitats could disrupt and divert shallow groundwater flow-paths.

199. Infrastructure located directly over wetland habitats could contaminate and lower the quality of groundwater through pollution and sedimentation.

200. Runoff from construction areas may infiltrate into shallow groundwater aquifers and contaminate and lower the quality of groundwater through pollution and sedimentation.

Impediments to Surface Water Flow

201. The construction watercourse crossings may restrict flow in the channel and reduce hydraulic capacity, resulting in an increase in flood risk along with the promotion of erosion and sedimentation. In addition, poorly designed watercourse crossings may impede the migration of fish and mammal movement in the riparian corridor.

202. Where bog habitat is located within the Site, construction of hardstands and tracks could impede surface water flow feeding the area. Careful consideration and drainage design would be required to maintain any surface flows.

Degradation of Water Quality

203. The risk from pollution via the accidental and uncontrolled release of sediment due to increased exposed soil as well as via leakages and spillages remains a risk despite embedded mitigation. The pouring of concrete and cement may also impact the chemical balance of shallow groundwater.

Modification of Groundwater Flows and Levels

204. Deep excavations, such as those required for the turbine foundations, have the potential to disrupt the shallow groundwater system and bedrock geology. Surface water ingress is minimised by utilising upgradient cut-off drains or other drainage measures. The installation of cut-off drains have the potential to lower local groundwater levels within surrounding soils.

205. Access tracks also have the potential to disrupt flow pathways, such as interrupting shallow groundwater flow or altering the hydrological regime.

Compaction of soils

206. The movement of construction traffic within the proposed Development is likely to cause localised compaction of the ground surface, leading to changes in both the hydrological and hydrogeological regime. The impacts of compaction are likely to be highly localised but would damage the vegetation and result in a reduction in the soil permeability and rainfall infiltration, thereby increasing the potential for flood risk and erosion.

Assessment of Potential Construction Effects

207. **Table 9.19** below identifies the likely construction effects on the identified receptors and their significance assuming the successful implementation of good practice and embedded mitigation measures (including the implementation of a DCEMP), described in **Section 9.7**. Definitions for receptor sensitivity and magnitude of change are provided in **Table 9.3** and **Table 9.4**, respectively.

Table 9.19 Assessment of construction effects

Potential Effects	Identified Receptor(s)	Potential Effect Assuming Implementation of Standard Good Practice and Embedded Mitigation		
		Sensitivity	Magnitude of Change	Significance of Effects
Watercourses and associated WFD surface water bodies				
Pollution incidents Erosion and sedimentation Increase in run-off Modifications to surface drainage pattern Impediments to surface water flow Degradation of water quality	Afton Water	**High**	**Negligible**	Moderate/Minor (**Not Significant)**
	Kello Water	**High**	**Negligible**	Moderate/Minor **(Not Significant)**
	River Nith – Sanquhar to New Cumnock	**Low**	**Negligible**	Minor/Negligible **(Not Significant)**
Aquifer and associated WFD groundwater body				
Pollution incidents Modification of groundwater flows and levels Compaction of soils	Upper Nithsdale	**Low**	**Negligible**	Minor/Negligible **(Not Significant)**
Water Resources - PWS				
Pollution incidents Modification to surface drainage	Hillend	**Medium**	**Negligible**	Minor **(Not Significant)**
	Blackcraig Farm	**Medium**	**Negligible**	Minor **(Not Significant)**

Potential Effects	Identified Receptor(s)	Potential Effect Assuming Implementation of Standard Good Practice and Embedded Mitigation		
		Sensitivity	Magnitude of Change	Significance of Effects
patterns Impediments to surface water flow Modification of groundwater flows and levels Compaction of soils	Nether Waistland Farm	**Medium**	**Negligible**	Minor **(Not Significant)**
	Overcairn Farm	**Low**	**Medium**	Moderate/Minor **(Not Significant)**
	Meikle Westland Farm	**Medium**	**Negligible**	Minor **(Not Significant)**
Flood Risk				
Increase in run-off Modifications to surface drainage pattern	Humans, properties and infrastructure within areas prone to flooding downstream of the Site	**Medium**	**Negligible**	Minor **(Not Significant)**
Soils and Peat				
Pollution incidents Erosion and sedimentation Increase in run-off Modifications to surface drainage pattern Impediments to surface water flow	Peatland and bog habitat	**Low**	**Low**	Moderate/Minor **(Not Significant)**

Source: Natural Power

Potential Resultant Effects – Operational

208. The effects of the proposed Development would be substantially lower during the operational phase. The following paragraphs discuss the potential effects that are predicted to occur during the operational phase of the proposed Development. The assessment of operational effects, assuming the successful implementation of the good practice and embedded mitigation measures (including the implementation of a DCEMP), described in Section 9.7. Definitions for receptor sensitivity and magnitude of change are provided in Table 9.3 and Table 9.4, respectively.

Pollution Incidents

209. The potential risk of pollution is substantially lower during operation than during construction because of the reduced levels of activity in the operational phase. Most potential pollutants would have been removed when construction was completed; however, lubricants for turbine gearboxes, and transformer oils may be stored on-site and there is the risk of possible fuel leaks from maintenance vehicles whilst on-site.

Erosion and Sedimentation

210. Levels of erosion and sedimentation during operation would be much lower than construction as there would be no excavations or bare exposed ground. Some erosion and sedimentation are still possible on the access tracks and drainage ditches as a result of scouring during extreme rainfall events. Similarly, there could be some short-term increases to erosion and sedimentation around new stream crossings as watercourses reach new equilibrium primarily within the construction and early in the operational phases of the proposed Development.

Increase in Run-off

211. Turbine bases, hardstand areas and access tracks would act as impermeable areas, restricting the natural movement of water within the hydrological environment, potentially resulting in increased rates of run-off into the onsite catchments.

Modification of Surface Drainage Patterns

212. Modification of surface run-off would occur as a result of the construction of the new infrastructure associated with the proposed Development. The operational effects can result in changes to volume and/or changes to run-off rate.

Impediments to Surface Water Flows

213. During the operational phase impediments to flows can generally occur as a result from blockages to watercourse crossings, ditches and watercourses themselves, resulting from vegetation and erosion debris.

Degradation of Water Quality

214. The risk from pollution via leakages and spillages is substantially lower during operation than during construction because of the decreased levels of activity in the operational phase. Most potential pollutants would have been removed when construction is complete; however, lubricants for turbine gearboxes, transformer oils and possible fuel leaks from maintenance vehicles would remain.

Modification of Groundwater Flow and Levels

215. Tracks and their drainage, as well as turbine foundations and hardstands will potentially alter the water table within the upslope and downslope soils and upper bedrock aquifers, which can also have implications for the long-term functionality of wetland environments. Backfilled cable trenches can also provide preferential flow pathways for shallow groundwater.

Compaction of Soils

216. The compaction of soils/peat would be significantly reduced during the operational phase as a result of significantly reduced traffic movements.

Assessment of Potential Operational Effects

217. Table 9.20 below identifies the likely operational and ongoing effects on the identified receptors and their significance assuming the successful implementation of the good practice and embedded mitigation measures, described in Section 9.7.

Table 9.20 Assessment of operational effects

Potential Effects	Identified Receptor(s)		Potential Effect Assuming Implementation of Standard Good Practice and Embedded Mitigation		
			Sensitivity	Magnitude of Change	Significance of Effects
Watercourses and associated WFD surface water bodies					
Pollution incidents Erosion and sedimentation Increase in run-off Modifications to surface drainage pattern Impediments to surface water flow Degradation of water quality		Afton Water	**High**	**Negligible**	Moderate/Minor **(Not Significant)**
		Kello Water	**High**	**Negligible**	Moderate/Minor (**Not Significant)**
		River Nith – Sanquhar to New Cumnock	**Low**	**Negligible**	Minor/Negligible **(Not Significant)**
Aquifer and associated WFD groundwater body					
Pollution incidents Modification of groundwater flows and levels Compaction of soils		Upper Nithsdale (Poor)	**Low**	**Negligible**	Minor/Negligible **(Not Significant)**
Water Resources - PWS					
Pollution incidents Modification to surface drainage		Hillend PWS	**Medium**	**Negligible**	Minor **(Not Significant)**
		Blackcraig Farm PWS	**Medium**	**Negligible**	Minor **(Not Significant)**

Potential Effects	Identified Receptor(s)		Potential Effect Assuming Implementation of Standard Good Practice and Embedded Mitigation		
			Sensitivity	Magnitude of Change	Significance of Effects
patterns Impediments to surface water flow Modification of groundwater flows and levels Compaction of soils		Nether Waistland Farm PWS	**Medium**	**Negligible**	Minor **(Not Significant)**
		Overcairn Farm PWS	**Low**	**Negligible**	Minor/Negligible **(Not Significant)**
		Meikle Westland Farm PWS	**Medium**	**Negligible**	Minor **(Not Significant)**
Flood Risk					
Increase in run-off Modifications to surface drainage pattern		Humans, properties and infrastructure within areas prone to flooding downstream of the Site	**Medium**	**Negligible**	Minor **(Not Significant)**
Soils and Peat					
Pollution incidents Erosion and sedimentation Increase in run-off Modifications to surface drainage pattern Impediments to surface water flow		Peatland and bog habitat	**Low**	**Negligible**	Minor/ Negligible (**Not Significant)**

Assessment of Potential Decommissioning Effects

218. During decommissioning of the proposed Development, potential impacts on the water environment are expected to be less than those encountered during the construction phase and therefore **Not Significant**. No specific mitigation measures are therefore identified. The decommissioning of the proposed Development would follow an approved decommissioning plan and adhere to the latest legislative and guidance requirements at the time.

9.8. Cumulative Effects

219. Consideration has been given as to whether any of the hydrology, geology and hydrogeology receptors that have been taken forward for assessment in this Chapter are likely to be subject to cumulative effects because of equivalent effects generated by other existing, consented (but not yet built) and proposed developments for which applications have been submitted.

220. In terms of cumulative residual effects on the water environment, consideration has been given to developments that would impact upon the Afton Water (SW01), the Kello Water (SW02) and River Nith (Sanquhar-New Cumnock) (SW03), areas downstream at risk of flooding and PWS (PWS2, PWS12, PWS20, PWS24 & PWS25).

221. The assessment presented here therefore assesses a zone of influence comprising the spatial area of the affected catchments, and within a 10 km radius of the proposed Development (see **Table 9.21**).

Table 9.21: Windfarm developments within 10 km of the proposed Development

Name	Status	Catchment	Location relative to the proposed Development
Afton	Operational	River Nith	3.1 km south west
Ashmark Hill	Appeal Refused	River Nith	4.7 km west
Brochloch Rig	Operational	Water of Deugh	6.0 km south west
Brochloch Rig 1	Operational	Water of Deugh	4.8 km south west
Cloud Hill	Planning Application Submitted	River Nith	5.9 km east
Enoch Hill	Under Construction	River Nith	6.5 km west
Euchanhead	Planning Application Submitted	River Nith	0.8 km south
Garleffan	Appeal Refused	River Nith	7.1 km north east
Glenmuckloch	Planning Permission Granted	River Nith	4.3 km north west

Name	Status	Catchment	Location relative to the proposed Development
Greenburn Wind Park	Planning Permission Granted	River Nith	9.1 km north east
Hare Hill	Operational	River Nith	On site
Hare Hill Extension	Operational	River Nith	On site
High Cumnock	Appeal Refused	River Nith	8.1 km north east
High Park Farm	Appeal Refused	River Nith	2.5 km north east
Knockshinnoch	Planning Permission Granted	River Nith	4.1 km north east
Lethans	Planning Permission Granted	River Nith	4.0 km north
Lethans Extension	Planning Permission Granted	River Nith	2.1 km north
Lorg	Planning Application Submitted	Water of Ken & River Nith	5.1 km south
Pencloe	Appeal Granted	River Nith	6.9 km west
Rowancraig North	Planning Application Submitted	River Nith	8.2 km east
Sandy Knowe	Operational	River Nith	1.6 km east
Sandy Knowe Extension	Planning Application Submitted	River Nith	8.1 km east
Sanquhar 2	Planning Permission Granted	River Nith	2.9 km south east
Sanquhar	Operational	River Nith	1.8 km east
Sunnyside wind cluster	Operational	River Nith	5.8 km east
Whiteside Hill	Operational	River Nith	3.0 km east
Windy Rig	Operational	Water of Ken & Water of Deugh	6.5 km south west
Windy Standard I Repower	Planning Application Submitted	Water of Deugh	4.9 km south west

Name	Status	Catchment	Location relative to the proposed Development
Windy Standard III	Appeal Granted	Water of Deugh	9.0 km south west
Windy Standard I Repower	Appeal Refused	River Nith	4.7 km west
Windy Standard III (Brockloch Rig 2)	Operational	Water of Deugh	6.0 km south west

222. It is reasonable to assume that good practice mitigation of the type outlined in this EIA Report would also be applied to the other windfarms in the same catchments (River Nith) ensuring no cumulative effects downstream. Nevertheless, as the construction phase for certain of these windfarms could overlap with that of the proposed Development, a sensible precautionary measure would be to condition an extended Water Quality Monitoring Programme (WQMP) to identify any construction phase changes in water quality from any site in the same surface water catchments and to apply appropriate mitigation measures quickly to prevent any effects.

223. Lorg, Windy Rig, Windy Standard I, Windy Standard I Repower and Windy Standard III (Brockloch Rig 2) and Windy Standard III windfarms are located within separate surface water catchments from the proposed Development, such that no other cumulative effects are possible.

224. It is concluded that following the successful implementation of the mitigation outlined in **Sections 9.7**, cumulative impacts of the proposed Development during construction and during operation would be negligible and **Not Significant**. As outlined above, it would be prudent to condition an extended WQMP to identify any construction phase changes in water quality from any site in the same surface water catchments therefore allowing appropriate mitigation measures to be quickly applied should any impacts be identified.

9.9. Conclusions

225. An assessment has been carried out of the likely significant effects of the proposed Development on the hydrological, geological and hydrogeological environment. The assessment has considered site preparation, construction and operation of the proposed Development.

226. A standalone assessment was undertaken for GWDTE, watercourse crossings, PWS and peat slide risk.

227. Based on the environmental baseline presented in **Section 9.6** and embedded mitigation described in **Section 9.7**, there are no likely significance of effects of the proposed Development for the construction, operation or decommissioning phases for all receptors.

228. **Section 9.8** indicates that there are also no cumulative water effects with other developments within the proposed Development or wider study area or in the same surface catchments.

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