9. Geology, Hydrology and Hydrogeology

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9. Geology, Hydrology and Hydrogeology

9.1 Abstract

9.1.1 This chapter presents an assessment of the potential for hydrological and geological effects associated with these construction works and also with any permanent alterations to the drainage patterns of the site. The geology, hydrology and hydrogeology assessment includes baseline data collected as part of the assessments undertaken for the Consented Development and follows the same methodology.

9.1.2 Should the Proposed Development not be consented, the "do-nothing scenario" will apply to the current baseline environment, in that the Applicant will construct the Consented Development. The Consented Development was environmentally assessed and consented in 2015 and the assessment is reported within the Sandy Knowe Wind Farm Environmental Statement (2015).

9.1.3 This chapter outlines the potential geological, hydrological and hydrogeological effects of the Proposed Development and an assessment is provided based on the value of the receptor and the magnitude of the impact giving the significance of the effect. Where appropriate, mitigation measures to enhance, prevent, minimise or control identified effects are presented. These include both design mitigation (such as the avoidance of areas of deep peat where possible), construction mitigation (such as implementation of Construction Decommissioning Environmental Management Plan, correct management of excavated peat, protection of banking) and operation mitigation (such as appropriate drainage design and maintenance). Following the implementation of the mitigation measures there would be no significant adverse effects on geological, hydrological or hydrogeological receptors.

9.1.4 The predicted residual significant effects for the Proposed Development are exactly the same as those which would arise from the 'do-nothing scenario', which would result in the implementation of the Consented Development.

9.1.5 The EIA Regulations, at Schedule 4, require the EIA Report to provide a

"description of the likely significant effects of the development on the environment resulting from, inter alia:

… (e) the cumulation of effects with other existing and/or approved development, taking into account any existing environmental problems relating to areas of particular environmental importance likely to be affected or the use of natural resources;"

9.1.6 In this regard, the Proposed Development would be indiscernible from the Consented Development.

9.2 Legislation, Policy and Guidelines

Legislation

9.2.1 Regulation of activities relating to the water environment in Scotland is the responsibility of the Scottish Environment Protection Agency (SEPA) and the relevant local authorities.

9.2.2 The European Union (EU) Water Framework Directive (WFD) has been implemented in Scotland through the Water Environment and Water Services (Scotland) Act 2003 (WEWSA). This Act introduced a regulatory system for the water environment with SEPA as the lead authority working alongside the public, private and voluntary sectors. The Act ensures that all human activities with the potential to cause a harmful effect on the water environment can be controlled by establishing a framework for co-ordinated controls on water abstraction and impoundment, engineering works affecting watercourses, and discharges to the water environment.

9.2.3 The EC Groundwater Directive provides specific measures to protect groundwater against pollution and deterioration. This Directive is implemented through the Water Environment (Controlled Activities) (Scotland) Regulations 2011 (CAR) and The Water Environment (Controlled Activities) (Scotland) Amendment Regulations 2013, introduced under WEWSA to provide the main regulatory controls for protecting the water environment from harm. CAR introduced specific controls for activities affecting watercourses and waterbodies and which encompass the following activities relevant to the Proposed Development:

- discharges to all wetlands, surface waters and groundwater's; and,
- engineering works in inland waters and wetlands.

9.2.4 SEPA maintains water monitoring and classification systems that provide the data to support the aim of the WFD. The classification system covers all rivers, lochs, transitional, coastal and groundwater bodies, and is based on an ecological classification system with five quality classes: High, Good, Moderate, Poor and Bad. It has been devised following EU and UK guidance and is underpinned by a range of biological quality elements, supported by measurements of chemistry, hydrology (changes to levels and flows) and morphology (changes to the shape and function of waterbodies).

9.2.5 The Water Resources (Scotland) Act 2013 makes provisions for the development of Scotland's water resources through improved water quality, the creation of contracts for non-domestic sewerage services, protection of the public sewer network and the maintenance of private sewerage works.

9.2.6 The Flood Risk Management (Scotland) Act 2009, which replaces the Flood Prevention (Scotland) Act 1961 (as amended) is the key piece of legislation relating to flood risk management.

9.2.7 UK legislation on contaminated land is principally contained in Part IIA of the Environmental Protection Act 1990 (EPA). This legislation endorses the principle of a 'suitable for use' approach to contaminated land, where remedial action is only required if there are unacceptable risks to health or the environment, taking into account the use of the land and its environmental setting.

9.2.8 The Environment Act 1995 creates a system whereby local authorities must identify and, if necessary, arrange for the remediation of contaminated sites. The provisions are set out in Section 57, which inserts Part IIA into the EPA 1990. In addition to these requirements, the operation of the regime is subject to regulation and statutory guidance.

9.2.9 The Contaminated Land (Scotland) Regulations 2005 (as amended) sets out the responsibilities of the local authority and SEPA in the identification and management of contaminated land.

9.2.10 The Polhote and Polneul Burns SSSI is protected under the Nature Conservation (Scotland) Act 2004. The following activities, which will need to be undertaken within the boundary of the SSSI to enable bridge construction, will require consent from SNH:

- modification of the structure of water courses (e.g. rivers and streams), including their banks and beds, by re-alignment, regrading and dredging;
- construction, removal or destruction of roads, tracks, hardstands, banks, or other earthworks, or the laying of pipelines and cables below ground; and
- erection of permanent or temporary structures, or the undertaking of engineering works.

Policy

9.2.11 The following planning policy is relevant to hydrology, geology and hydrogeology and has been considered as part of this assessment:

- Scottish Planning Policy (Scottish Government, 2014);
- PAN 33 Development of Contaminated Land (Scottish Government, 2000);
- PAN 51 Planning, Environmental Protection and Regulation (Scottish Government, 2006a);
- PAN 79 Water and Drainage (Scottish Government, 2006b); and
- Policy NE11, NE12 and NE13, of the Dumfries and Galloway Local Development Plan (2014).

9.2.12 Further discussion on relevant planning policy is presented in Chapter 5.

Guidance

9.2.13 SEPA Policy 19 'Groundwater Protection Policy for Scotland' (Version 3, 2009) aims to provide a sustainable future for Scotland's groundwater resources by protecting legitimate uses of groundwater and providing a common SEPA framework to:

- protect groundwater quality by minimising the risks posed by point and diffuse sources of pollution; and
- maintain the groundwater resource by authorising abstractions and by influencing developments, which could affect groundwater quantity.

9.2.14 SEPA Policy No. 41 'A Planning Authority Protocol Development at Risk of Flooding: Advice and Consultation' (SEPA, 2000). Outlines the statutory roles of both SEPA and the Planning Authorities and provides a framework for consultation and advice. SEPA's remit in this respect is the statutory duty set out in the Environment Act 1995. Section 25 (2) of the Environment Act 1995, gives SEPA a duty, if requested by a planning authority to do so, to provide that authority with advice, on the basis of such information as it holds, as to the risk of flooding in any part of the authority's area. However, SEPA's Policy No.41 makes it clear that in cases where SEPA becomes aware of a flood risk even if the planning authority did not specifically request flooding comments it will inform them of any risk of flooding.

9.2.15 The Pollution Prevention Guidelines (PPGs) and their replacements the Guidelines for Pollution Prevention (GPPs) provide high level guidance on best practice construction methods.

9.2.16 SEPA 'Special Requirements for Civil Engineering Contracts for the Prevention of Pollution v2' (SEPA, 2006) and 'Guidance on the Special Requirements v2' (SEPA, 2006). Provide construction best practice with regards to pollution prevention and waste minimisation and a definitive list of clauses for inclusion within contractual documents.

9.2.17 Scottish Renewables, Scottish Natural Heritage, SEPA, Forestry Commission Scotland and Historic Environment Scotland 'Good Practice during Wind Farm Construction' (Version 3, 2015) provides guidance on 'Good Practice' construction methods which ensures that harm to the surrounding environment is minimised whilst taking cognisance of the practicalities of construction.

9.2.18 CIRIA C532 'Control of Water Pollution from Construction Sites - Guidance for Consultants and Contractors' (CIRIA, 2001). Provides guidance on environmental good practice for the control of water pollution arising from construction activities. It focuses on the potential sources of water pollution from within construction sites and the effective methods of preventing its occurrence.

9.2.19 BS5930:2015 - Code of Practice for Site Investigation (British Standards Institute, 2015).

9.2.20 Other relevant guidelines issued by the Department of the Environment, Transport and the Regions (DETR) and the Royal Institution of Chartered Surveyors (RICS).

9.3 Consultation

9.3.1 The following consultation responses were received during the consideration of the Consented Development application for planning permission and from the Scoping process for the Proposed Development.

Table 9.9.1 – Consultation Responses

Consultee	Consultation Response	Key Actions
SEPA	Consented Development response	
	Request that the Applicant contacts the local team to discuss the authorisation required for works on Crossing 2.	Following determination of the Proposed Development the Applicant will consult with SEPA at the earliest opportunity.
	SEPA does not require further assessment of the risk to PWS by the Proposed Development.	No action required.
	The generic and specific mitigation measures outlined appear to be acceptable for groundwater dependent terrestrial ecosystems and include a commitment to restore 25ha of dry and modified blanket bog. This should be detailed in the Habitat Management Plan along with information on how the re-establishment of flushes in particular will be achieved.	This information will be included in the Habitat Management Plan developed post-consent of the Proposed Development.
	The Applicant indicates that surplus topsoil and peat will be used to restore track edges. Peat should only be used for this purpose where it already exists alongside tracks.	Noted and mitigation measures within this EIA Report amended accordingly.

Consultee	Consultation Response	Key Actions
	SEPA wish to review and approve the CEMP and OEMP and the detailed drainage strategy	The Applicant confirms that they will provide the CEMP, OEMP and detailed drainage strategy to SEPA for agreement prior to construction.
	Any dewatering during excavations should be in compliance with GBR 2 and GBR 15 under the Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended) (CAR).	The Applicant can confirm that dewatering will be undertaken in compliance with GBR 2 and GBR 15.
	Scoping response	
	SEPA consider that it is unlikely that the Proposed Development will raise any new or additional issues within their remit, however the following should be submitted in support of the application.	
	a) Map and assessment of all engineering works within and near the water environment including buffers, details of any flood risk assessment and details of any related CAR applications	This information is provided in Appendix 9.3, Figure 9.1 and within this EIA Report chapter.
	b) Map and assessment of impacts upon Groundwater Dependent Terrestrial Ecosystems and buffers	Figure 9.8 shows the areas of high groundwater dependent terrestrial ecosystems. In their response to the Consented Development dated 21st August 2015, SEPA stated that they were content that the generic and specific mitigation measures outlined appear to be acceptable for groundwater dependent terrestrial ecosystems. These Generic and Specific mitigation measures are also included for the Proposed Development
	c) Map and assessment of impacts upon groundwater abstractions and buffers.	No groundwater abstractions are proposed at this time, if groundwater abstractions are required in the future this will be subject to a separate application.
	d) Peat depth survey and table detailing re-use proposals.	This information is provided within this chapter and the accompanying figures and appendices.
	e) Map and table detailing forest removal.	Information and mapping regarding forestry removal is provided in Chapter 17.
	f) Map and site layout of borrow pits	No borrow pits are included within the Proposed Development design.
	g) Schedule of mitigation including pollution prevention measures	A Schedule of Mitigation is provided in Chapter 18.
	h) Quarry or Borrow Pit Site Management Plan of pollution prevention measures.	No borrow pits or quarries are included within the Proposed Development design.
	i) Map of proposed waste water drainage layout.	A septic tank will be located at the substation. During construction all

Consultee	Consultation Response	Key Actions
		sewage and grey water will be removed from the site..
	j) Map of proposed surface water drainage layout.	Information regarding the surface water drainage is provided within Appendix 3.1. While this is based on a 30 turbine scheme the same principles apply and detailed drainage plans will be confirmed following detailed design post-consent.
	k) Map of proposed water abstractions including details of the proposed operating regime.	No water abstractions are proposed at this time, if water abstractions are required in the future this will be subject to a separate application
	l) Decommissioning statement	Information on decommissioning is provided in Chapter 3 of the EIA Report.
Dumfries and Galloway Council Flood Risk Management Team	Consented Development response No objection to the Consented Development	No action required.
	Scoping response Has no objection to the proposed increase in power generation capacity at this site and has nothing further to add to comments provided in relation to the previous Environmental Statement submitted.	No action required.
Coal Authority	Consented Development response None	N/A
	Scoping response None	N/A
Scottish Water	Consented Development response None	N/A
	Scoping response None	N/A
Marine Scotland	Consented Development response None	N/A
	Scoping Response MSS advises the developer to carry out up to date baseline surveys of aquatic biota (fish populations and macroinvertebrates) and hydrochemical parameters- including turbidity and flow/stage height, in watercourses within and downstream of the Proposed Development site. The uninhibited passage of fish to be considered in the design of all watercourse crossings and the conditions applied to the Consented Development should also apply to the Proposed Development.	Fish surveys and water quality monitoring will be undertaken prior to and throughout the construction period.

9.4 Assessment Methodology

9.4.1 The following section sets out the approach that was followed to collect relevant baseline information and the methodology for assessing impacts and the significance of effects.

Study Area

9.4.2 The study area has largely incorporated the area within the site boundary, but has also included consideration of hydrological effects 1 km downstream of the site. Private Water Supplies within 1 km of the site have been considered.

9.4.3 The criteria for defining the study area with regard to hydrological resources have been established based on professional judgement and experience with regard to likely access and working areas, consultation with SEPA and with due consideration to the relevant guidance on hydrological assessment.

Desk Study

9.4.4 Baseline conditions have been established primarily via desk-based research and has included the following:

- consultation with SEPA as described in Table 9.1 above;
- identification of the locations and characteristics of catchments and principal watercourses and waterbodies as shown on 1:50,000 scale OS mapping which may be affected by construction activities;
- identification of SEPA/WFD watercourse and waterbody classifications;
- review and collation of pertinent information on surface hydrology, flooding, climate etc.;
- review of published geological mapping of the area, Scotland Sheet 15W, New Cumnock, 1:50,000 Series, solid geology edition (published 1999) and Scotland Sheet 15W, New Cumnock, 1:50,000 Series, solid & drift geology edition (published 1999);
- review of hydrogeological characteristics and groundwater resource; and
- review of Private Water Supply records held by Dumfries & Galloway Council and comparison with Scottish Water asset plans.

9.4.5 An Outline Drainage Strategy has been prepared for the Proposed Development – this is provided in Appendix 3.1.

Site Visits

9.4.6 The findings of the desk study have been supported by site surveys of surface watercourses which were undertaken between 2012 and 2015. These have included visual inspections of surface watercourses where works are likely to occur within or in the close vicinity and visual assessment of gradients and drainage pathways across the site.

9.4.7 Peat probing has been undertaken across the site on a number of occasions between 2012 and 2018 to inform peat slide risk assessment and hence the infrastructure layout (refer to Appendices 9.1 and 9.2).

Significance Criteria

9.4.8 The characterisation of hydrological sensitivities has been guided by the matrix presented in Table 9.2 which lists the characterisation criteria.

Table 9.2 – Catchment Sensitivity

Sensitivity	Description
High	Areas containing geological, geomorphological or hydrological features considered to be of national interest, for example Aquatic Natura 2000 sites, SACs, SSSIs. Highly permeable superficial deposits allowing free transport of contaminants to groundwater and surrounding surface waters. Wetland/watercourse of High or Good Ecological Potential. Raised or blanket bog. High risk of flooding.
Medium	Areas containing features of designated regional importance, for example Regionally Important Geological and Geomorphological Sites (RIGS), considered worthy of protection for their educational, research, historic or aesthetic importance. Moderately permeable superficial deposits allowing some limited transport of contaminants to groundwater and surrounding surface waters. Wetland/watercourse of Moderate Ecological Potential. Significant peat deposits. Moderate risk of flooding.
Low	Geological features not currently protected and not considered worthy of protection. Low permeability superficial deposits likely to inhibit the transport of contaminants. Wetland/watercourse of Poor or Bad Ecological Potential or no WFD classification. Thin superficial peat deposits. Low risk of flooding.

9.4.9 The criteria for sensitivity has been developed based on a hierarchy of factors relating to quality of the aquatic and geological environment including international and national designations, water and soil quality information, watercourse status from the WFD review work undertaken to date by SEPA, consultations, site visits and the professional judgement of the assessment team.

9.4.10 The prediction and assessment of effects on hydrology, hydrogeology and geology has been undertaken using a series of tables to document the various potential impacts from aspects of the construction works and operations. Effects have been predicted for the proposed project based on the guideline criteria for impact magnitudes set out in Table 9.3.

Table 9.3 – Impact Magnitude

Impact Magnitude	Guideline Criteria
High	Total loss of, or alteration to, key features of the baseline resource such that post development characteristics or quality would be fundamentally and irreversibly changed e.g. extensive excavation of peatland or watercourse realignment.

Impact Magnitude	Guideline Criteria
Medium	Loss of, or alteration to, key features of the baseline resource such that post development characteristics or quality would be partially changed e.g. instream permanent bridge supports or partial excavation of peatland
Low	Small changes to the baseline resource, which are detectable but the underlying characteristics or quality of the baseline situation would be similar to pre-development conditions e.g. culverting of very small watercourses/drains
Negligible	A very slight change from baseline conditions, which is barely distinguishable, and approximates to the 'no-change' situation e.g. short term compaction from machinery movements

9.4.11 Using these criteria, potential effects have been assessed for the project. These effects are presented in Section 9.7. Further information on generic and site specific mitigation is set out in Section 9.8. Residual effects of the project have been predicted in Section 9.8 taking into account this mitigation.

9.4.12 The significance of the predicted effects has been assessed in relation to the sensitivities of the baseline resource. A matrix of significance was developed to provide a consistent framework for evaluation, and is presented in Table 9.4. Guideline criteria for the various categories of effect are included in Table 9.5.

Table 9.4 – Effect Significance Matrix

	Sensitivity			
Magnitude	**High**	**Moderate**	**Low**	**Not Sensitive**
High	Major	Major	Moderate	Minor
Medium	Major	Moderate	Minor	Minor
Low	Moderate	Minor	Minor	None
Negligible	Minor	Minor	None	None

Table 9.5 – Effect Significance Categories

Significance	Definition	Guideline Criteria
Major	A fundamental change to the environment	Changes in water quality or quantity affecting widespread catchments or groundwater reserves of strategic significance, or changes resulting in substantial loss of conservation value to geological or aquatic habitats and designations
Moderate	A larger, but non-fundamental change to the environment	Changes in water quality or quantity affecting part of a catchment or groundwaters of moderate vulnerability, or changes resulting in loss of conservation value to geological or aquatic habitats or designated areas

Significance	Definition	Guideline Criteria
Minor	A small but detectable change to the environment	Localised changes resulting in minor and reversible effects on soils, surface and groundwater quality or habitats
None	No detectable change to the environment	No effects on geological resources, drainage patterns, surface and groundwater quality or aquatic habitat

9.4.13 In the above classification, fundamental changes are those which are permanent, either adverse or beneficial, and would result in widespread change to the baseline environment. For the purposes of this assessment, those effects identified as being major or moderate have been evaluated as significant environmental effects in terms of the EIA Regulations and, therefore, are those which may have an adverse effect on the status of waterbodies, watercourses, groundwater or geological resources.

9.4.14 These matrices have been used to guide the assessment, although they have been applied with a degree of flexibility, since the evaluation of effects will always be subject to location-specific characteristics which must be taken into account. For this reason the evaluation of the significance of effects in particular will not always correlate exactly with the cells in the relevant matrix, especially where professional judgement and knowledge of local conditions may result in a slightly different interpretation of the impact concerned.

9.4.15 Cumulative effects have been accounted for through the prediction and evaluation of effects at a catchment-wide level.

Requirements for Mitigation

9.4.16 Proposed mitigation measures are presented within this chapter where the potential to affect sensitive geological, hydrological or hydrogeological receptors has been predicted. These may include temporary effects from construction or permanent/longer-term effects associated with the operational phase of the Proposed Development and its associated infrastructure.

Assessment of Residual Effect Significance

9.4.17 An assessment of any predicted significant residual effects on sensitive geological, hydrological or hydrogeological receptors is presented within this chapter.

Limitations to Assessment

9.4.18 No water quality monitoring or intrusive investigations, other than targeted peat probes, have been undertaken.

9.5 Baseline Conditions

Geography, Topography and Geomorphology

9.5.1 The Proposed Development site occupies a rural setting in the upland terrain overlooking the valley of the River Nith. The upland comprises a complex topography with smooth, rounded hills covered with open grassy moorland, incised river valleys, coniferous plantations, and expanses of peatland. The former Glenmuckloch Open Cast Coal Pit occupies the opposite side of the valley to the north and the constructed Hare Hill Wind Farm lies approximately 1.7 km south-west of the site boundary. At the Proposed

Development site, the uneven upland lies between 240 m and 450 m above sea level with the highest point on White Hill in the southwest corner of the site.

9.5.2 In general, the ground slopes vary from very gentle with broad almost level watersheds to steep slopes on the banks of deeply incised watercourses associated with Polneul Burn and Polmeur Burn. Over much of the peatland study area, slopes average around 4°. The peatland occupies several geomorphologies but it dominates in the broad tracts of ground lying between the principal hilltops and across the headwaters of the principal watercourses. The peat varies in depth according to local topographic conditions with relatively small pockets of deep peat linked by shallower and more extensive masses of peat (see Figure 9.6). In addition, the peatland appears severely degraded by grazing and burning as well as forestry and agricultural drainage schemes. Natural erosion of the peatland gives rise to minor disruption of the ground surface in a few places.

9.5.3 Elevations range from about 240 m above ordnance datum (AOD) in the northeast corner of the development site to between 300 m AOD and 350 m AOD across much of the Proposed Development to almost 450 m AOD on White Hill in the southwest corner of the site.

9.5.4 Generally, surface water flows along a number of streams and drainage channels flowing either northwards into Polneul Burn and Polmeur Burn or southwards into Polbroc Burn.

9.5.5 Much of the landscape of the Proposed Development district was created during complex phases of glaciation affecting this region in Late Pleistocene (Devensian) time (approximately 10,000 years before present). The movement of glaciers carved and moulded the rocks and left behind varied accumulations of glacial deposits. Glacial landforms range from upland fringe hills to river valleys.

Land Use, Historical Developments and Man-Made Features

9.5.6 Farming, forestry and coal mining have dominated the land use pattern. At the Proposed Development, most of the ground is used for grazing cattle and sheep. However, the area of Libry Moor at the eastern side of the site is given over to plantation forestry over artificial (man-made) ground affected by former open cast coal extraction activities. To the south and west of the site, forestry plantations account for the largest proportion of land use and to the north open cast mining of coal is underway.

Surface Water

9.5.7 The Proposed Development is located within the Nith Valley and the watercourses in the area form part of the catchment of the River Nith which flows from west to east some 1.5 km to the north of the Proposed Development site boundary.

9.5.8 The two principal watercourses within the Proposed Development site boundary are the Polneul Burn and the Polmeur Burn. The Polbroc Burn flows adjacent to part of the southern boundary. The Polhote Burn flows close to the western boundary.

9.5.9 The Nith catchment covers an area of approximately 1,230 km^2. It stretches from the industrialised landscape of New Cumnock in South Ayrshire down through the predominately farmed and wooded landscapes of Thornhill and Auldgirth, and the urbanised area of Dumfries south to the sea at Glencaple. It extends westwards to Moniaive and eastwards to the Lowther Hills. The River Nith is one of the most highly

productive salmon and sea trout rivers in Scotland, and provides a habitat for a wide range of other species.

Geomorphology

Polneul Burn

9.5.10 The Polneul Burn rises in the shallow valley between Polnagrie Hill and Mynwhirr Hill immediately to the south west of the Proposed Development site boundary and flows in a generally northerly direction through the site.

9.5.11 The burn meanders through the western part of the site for approximately 3 km, and is fed from a number of tributaries including Red Sike and Macan's Burn which flow down the sides of White Hill in steeply incised channels.

9.5.12 Polneul Burn flows through a steep sided valley, with the valley sides reaching up to 20 m in height in places. The watercourse is generally 1 m to 2 m in width and 0.5 m to 1 m in depth. It is fast flowing, with several waterfalls and has a rocky substrate with numerous boulders within the watercourse. The banks of the watercourse are generally densely vegetated with patches of mixed woodland and large swathes of bracken and coarse grass. New woodland planting has also occurred on the higher slopes of the valley.

9.5.13 Parts of the banks and valley sides have exposed rock features which form the designating interest for the Polhote and Polneul Burns Geological SSSI, which is a geological SSSI, as described in greater detail later in this chapter.

Polmeur Burn

9.5.14 The upper reaches of the Polmeur Burn, which lie within the Proposed Development site boundary, have been heavily modified through the excavation of land drains to collect and divert surface water flows. These are characterised by a series of long straight channels, approximately 0.5 m in width and depth, which have been excavated in a southwest-northeast direction to connect into a larger drainage channel.

9.5.15 This large drainage channel, some 1.3 km in length, extends along the southern edge of the plantation woodland in the eastern part of the site. This channel extends to approximately 5 m in width and 2 m in depth, with the spoil from the ditch having been used to form an embankment on the northern bank of the ditch. The purpose of this drainage channel is to divert surface flows away from the plantation forestry.

9.5.16 It was noted during site visits that the upper reaches of the watercourse shown on Ordnance Survey maps as located between turbines 18 and 24 has been infilled by spoil from the drainage channel.

9.5.17 An artificial pond has been created to the southwest of the position of turbine 24, which is fed by the drainage channel, as well as by field drains which connect from the south.

9.5.18 The Polmeur Burn takes a more natural, meandering form once it reaches the northern edge of the Proposed Development site boundary. It passes through a 1.5 m concrete culvert beneath a farm access track, before flowing northwards through a steeply incised valley. At this point, the burn has a fast flowing current and has rocky bed material. The watercourse at this point is approximately 1 m in width and 0.5 m in depth. The banks of the watercourse are vegetated with coarse grass which is subject to grazing from sheep and cattle.

Polbroc Burn

9.5.19 The Polbroc Burn rises on the northern slopes of Mynwhirr Hill, which is located to the south of the Proposed Development site boundary. It flows in a north-easterly direction through dense plantation woodland adjacent to the southern site boundary for some 2.5 km, before passing beneath the forestry haul road and then meanders through arable farmland for another 1.5 km where it meets the Kello Water. The Kello Water continues to flow in a north-easterly direction for some 2 km before it meets the River Nith.

9.5.20 Other than the water-crossing for the haul road, little evidence of historical engineering activities was observed within the Polbroc Burn and its channel. As it passes closest to the site boundary it was observed to be between 0.5 m and 1 m in width and generally 0.5 m in depth. Flows were moderate to high at the time of the site visits. Bed material generally consisted of small pebbles and rocks.

Polhote Burn

9.5.21 The Polhote Burn is approximately 250 m in distance and parallel to the western edge of the Proposed Development site boundary.

9.5.22 It is formed by a number of small watercourses which rise within plantation forestry on the north-eastern slopes of Gibbon's Hill and flow through narrow channels (0.5 m wide) in a north-easterly direction for approximately 1.5 km before forming a single watercourse. The watercourse continues to flow through a steep sided valley for approximately 2 km, past High Cairn Farm before flowing under the A76 at Cairn Bridge and then eventually into the River Nith.

9.5.23 The watercourse is generally less than 1 m in width and approximately 0.5 m in depth for the first 2 km of its length before widening to up to 2 m in width and 0.5 m in depth. It is fast flowing and contains rocky bed material with occasional boulders.

Surface Water Quality

9.5.24 The SEPA Interactive River Basin Management Plans mapping does not provide a water quality classification for the burns described above.

9.5.25 The section of the River Nith between Sanquhar and New Cumnock (water body identifier code 10611) has been classified as having an overall status of Moderate.

9.5.26 The Kello Water (water body identifier code 10611) has been classified as having an overall status of Good.

9.5.27 As noted previously in Chapter 7 Ecology and Nature Conservation, an electro-fishing survey has been completed on watercourses in the local area. The numbers of fish caught indicated that these watercourses are likely to be of sufficient quality to support a population of salmon and trout.

9.5.28 For the purposes of this assessment, it is considered that all of the watercourses present within and near to the Proposed Development site boundary will have an overall status of Good and therefore will have a High sensitivity to change in water quality.

Bedrock

9.5.29 Geologically, the district is part of the extensive outcrop early Palaeozoic (Ordovician) strata which forms the Southern Uplands Terrane. At the Proposed Development, the solid

geology involves greywacke (turbidite) sandstones, siltstones and mudstones of the Kirkcolm Formation (Barrhill Group) (see Figure 9.2) that were deposited as turbidites within the Iapetus Ocean. As the ocean closed during the Caledonian Orogeny, the rocks were deformed, folded and cleaved. Generally, the strata are folded and dip steeply to the south. Typically, the greywacke sandstones are greenish-grey and brown in colour, and hard with lithic-rich lithologies. At the Proposed Development site, they occur in poorly defined beds which range from thin too thick with laminated units and underlie the hillside in the western portion of the site.

9.5.30 Importantly, the Proposed Development site straddles the south-western margin of the Sanquhar Coalfield, a basin inlier of Carboniferous strata of considerable economic significance which underlies the eastern portion of the site. The coal measures occupying this portion of the basin generally dip at shallow angles northwards. The ground beneath Libry Moor at the eastern side of the Proposed Development site (Figure 9.2) was formerly worked for open cast coal and has been restored and planted with coniferous trees. A previous assessment identified an area of High risk from mining subsidence in the very north of the Proposed Development site. The design of the Proposed Development has deliberately avoided placing infrastructure in this area.

9.5.31 The effects of glaciation are seen on scattered outcrops where rockhead surfaces are severely fractured and roughened by plucking during glacial advance. Plucking instead of polishing is generally ascribed to the presence of close spaced discontinuities in bedrock that provide readily exploited weaknesses in the rock mass.

Superficial Deposits

9.5.32 At the Proposed Development, bedrock is overlain by mixed deposits of drift of glacial derivation and tracts of peatland of post-glacial age (see Figure 9.3).

9.5.33 Surface exposures of the glacial drift were observed to consist of brown and grey brown, heterogeneous, silty, sandy, gravelly till (boulder clay) containing lenses of fluvio-glacial sand and gravel. The tills are generally very compact, poorly stratified, matrix-supported diamictons, containing angular to rounded clasts up to boulder size.

9.5.34 The majority of slopes where bedrock is not exposed were probably covered with a thin veneer of glacial till after the retreat of the ice. This would subsequently have been modified by solifluction. Hence, the present day slopes are expected to be mantled by a thin cover (1 m to 2 m) of modified till and superficial deposits consisting of clayey silts and silty clays with a variable gravel, cobble and boulder content.

9.5.35 Extensive areas of peat appear widespread. The deposits of peat usually overlie glacial drift but in a few places particularly on higher ground, they may rest directly on bedrock or weathered bedrock.

9.5.36 The ground beneath Libry Moor at the eastern side of the development site was formerly worked for coal extraction and has been restored and planted with coniferous trees. This artificial ground consists of compacted mine overburden materials covered by a thin layer of peaty topsoil.

Designated Sites

9.5.37 The Polhote and Polneul Burns Geological SSSI (site code: 1298) is located within the site boundary and incorporates the Polneul Burn and a nominal area of the banks on either side, as illustrated on Figure 9.4.

9.5.38 The citation for the SSSI states that “this locality shows key exposures through the Namurian and Westphalian strata of the Sanquhar Coalfield, complementing the sequence of higher strata at Lagrae Burn. Its rocks in the Passage Group and the Coal Measures (Westphalian A and B) yield important data on the fauna, flora and stratigraphy of the Upper Carboniferous and represent the most continuous and fossiliferous sequence of Namurian and Westphalian A strata in southwest Scotland.”

9.5.39 The Site Management Statement notes that the rocks were laid down around 313 million years ago, during the Carboniferous geological period. At that time, the area appears to have been part of a large tropical delta, which was heavily wooded. Much of the accumulated vegetation was subsequently covered in sand, mud and silt.

9.5.40 From an analysis of the layers of small fossils, such as 'Mussel Bands' and the 'Skipsey Marine Band' within these sediments, it has been found that the sediment was deposited from both rivers and the sea. As there was little oxygen, the layers of vegetation did not break down but were compressed as the sediments built up and progressively formed thin seams of coal. Since their formation, these rock layers have been undisturbed by movements in the Earth's crust, and remain horizontal.

9.5.41 The site is the best exposure of the rocks forming the lower part of the Sanquhar Coalfield. It also includes layers of small marine invertebrate fossils known as the 'Marine Bands'. These occur throughout most of the coalfields in Scotland and further afield. This allows comparisons to be drawn with other coalfields where the geological history is understood in greater detail.

9.5.42 The junction between the Upper Carboniferous rocks and much older Ordovician rocks, which underlie the Sanquhar Coalfield, is exposed within the site.

9.5.43 It is reported in the Site Management Statement that the landowners manage the majority of the land for rough grazing, although the whole of the SSSI is under SNH management agreements, to encourage access and to provide interpretation of the geological interests. SNH management aims include the prevention of tipping which can obscure rock exposures, appropriately planned tree planting also to avoid obscuring rock exposures, control of mineral extraction and maintenance of access for visiting researchers.

9.5.44 For the purposes of this assessment, the SSSI is considered to have a High sensitivity to damage from construction works.

Peat

9.5.45 SNH Carbon and Peatland Map published in 2016 shows that the majority of the site is identified as Class 3 (dominant vegetation cover is not priority peatland habitat but is associated with wet and acidic type) with the exception of the area of Libry Moor Woodland which is classified as Class 5 (no peatland habitat recorded). None of the site is covered by national impotent resources of peat (classes 1 and 2) (Scotland’s Soil, 2018).

9.5.46 In recent years, peatslides have emerged as a new and significant consideration for wind farm projects on peatlands. Developers need to understand peatslide risk and demonstrate

that it is being properly controlled, kept under review and further reduced as and when possible.

9.5.47 A peat slide risk assessments were undertaken by WSP in 2012 and Wardell Armstrong LLP in 2013 based on an alternative design to evaluate peatland stability at the Proposed Development site. This work identified the salient features of the local bedrock, geomorphology, topography, peat profile, glacial drift deposits, drainage and weather that influence peat slope stability (refer to Appendices 9.1 and 9.2). A brief summary of the findings of the previous assessments undertaken is presented below.

9.5.48 Peat is essentially an accumulation of plant remains at various stages of decomposition, formed in waterlogged areas. It developed as a result of the cool wet climate (Lindsay, 1995). The peat at the Proposed Development is mostly less than 1 m deep but in exceedingly localised pockets thicknesses exceed 2.5 m associated with the central southern sector of the Proposed Development site.

9.5.49 Much of the peatland at the Proposed Development appears severely degraded with surface disturbances associated mainly with agricultural, mining and forestry activities. During the field survey, six noteworthy examples of minor peatslides were identified but no surface indications of shallow subterranean drainage pipes were detected.

9.5.50 The peat profile at the Proposed Development comprises a layer of brown to dark brown fibrous peat with patches of woody peat in certain places. It lies between the present-day root mat at the top and the boundary with the underlying material at the bottom. Generally, the layer of peat possesses a textile-like fabric with relatively good engineering characteristics with abundant twigs and bark of birch. Exposed faces in stream banks and drainage ditches reveal a well-developed banded or laminated structure in the peat profile with marked variations in thicknesses of individual layers over short distances.

9.5.51 The surface vegetation consists predominantly of grasses, mosses and reeds but diverse floras have been identified across various geomorphologies. Such vegetation is indicative of relatively dry peat slopes.

9.5.52 Figure 9.5 illustrates peat probe locations. Although peat depth as a single factor would mean some of the site to be at very high risk of peat slides, due to the relatively shallow gradients in these areas, this has led much of the site to be classed as negligible or low risk.

9.5.53 Notwithstanding the relatively low hazard in relation to peat thicknesses, the peat study area is relatively sensitive to the occurrence of a peat failure due to the presence of onsite drainage systems, and nearby and onsite watercourses, ecologically or geologically designated sites, public dwelling and public roads. Areas of relatively shallow peat exist on relatively steep gradients and in close proximity to the Polneul Burn SSSI. However, it has been possible to 'embed' mitigation through avoidance of the particular problem characteristics in the layout design.

Hydrogeology

9.5.54 The groundwater body underlying the site is listed by SEPA as the "Sanquhar bedrock and localised sand and gravel aquifers" (water body identifier code 150169). This groundwater body is of Poor overall status, with High confidence (2008). The quantity of groundwater has been classified as Good, with High confidence. Mining and quarrying of coal has been identified as a diffuse source of pollution to groundwater in this area.

9.5.55 Therefore, for the purposes of this assessment, the sensitivity of groundwater is considered to be low.

Flood Risk

9.5.56 The SEPA Indicative River & Coastal Flood Map illustrating the areas where there is a 0.5 % or greater probability of being flooded in any given year, i.e. the 1:200 year flooding event, in the vicinity of the site has been reviewed.

9.5.57 This map does not indicate that any flooding would occur throughout the site, however it should be noted that this map does not cover areas or watercourses with a catchment area of less than 3 km^2.

9.5.58 At the downstream end of the site, the Polneul Burn has a catchment area of approximately 2.7 km^2, which covers the majority of the site. Rainfall would either infiltrate into the ground or route over the surface and would feed into the main burn channel and its tributaries.

9.5.59 The burn and its tributaries are located in deep gorges which route the flow in a northerly direction. The level difference between the beds of the watercourses and the general ground within the site is estimated to be as much as 10 m in some locations.

9.5.60 In extreme events where the flows within the burns would be high, the capacity of these gorges to contain the water and route it north would mean that the risk of flooding to the majority of the site will be small.

9.5.61 As a large proportion of the site consists of peaty soil, the ground tend to be saturated the majority of the time. Channels have been constructed some areas of the site to assist in draining the agricultural grazing land, however localised low spots around the site could potentially be susceptible to pluvial flooding.

9.5.62 It is considered that due to the topography of the site, with the ground levels falling to the north, and the deep gorges that the watercourses flow through, that the flood risk to the site is low.

Groundwater Dependent Terrestrial Ecosystems

9.5.63 A National Vegetation Classification (NVC) survey was undertaken across the Proposed Development site. The NVC report is presented in Appendix 7.4. NVC Target Notes.

9.5.64 In its consultation response letter dated 09 May 2013, SEPA recommended a number of adjustments to the layout of the Proposed Development in order to negate and/or reduce the level of impact to GWDTEs.

9.5.65 The Applicant's ecological and hydrological consultants undertook a site visit on 13th June 2013 to identify opportunities to include these adjustments within the design of the wind farm. These were incorporated into the updated infrastructure design of the Proposed Development.

9.5.66 In its response to the updated design, dated 20th August 2013, SEPA commented that:

'We are content that the applicant…..has addressed all the above issues, the NVC surveys have been clarified, our concerns regarding the presence of turbines in the identified heavily GWDTEs have been addressed by re-siting turbines to areas that are either non GWDTE or areas that are only moderately ground water dependent, this is illustrated in

the proposed new development layout which accompanies this consultation. We note the commitment to install permeable layers in all tracks where issues of groundwater connectivity were highlighted plus the installation of cross drains and support the approach in this instance.'

9.5.67 Following submission of the Consented Development application SEPA stated in their response dated 2 May 2017 that the generic and specific mitigation measures outlined in the Consented Development application appear to be acceptable for groundwater dependent terrestrial ecosystems and include a commitment to restore 25 ha of dry and modified blanket bog.

9.5.68 As the Proposed Development does not propose any changes to the Consented Development design it is therefore considered that all concerns associated with GWDTEs have been addressed through infrastructure design.

Private Water Supplies

9.5.69 Private Water Supplies (PWS) within a 1 km radius of the site boundary were identified through consultation with Dumfries and Galloway Council and a review of Scottish Water utility plans.

9.5.70 Only one PWS has been identified within 1 km of the Proposed Development site (see Figure 9.7). This is located at Hillend, some 980 m to the south of the Proposed Development site. This is located to the south of the Polstacher Burn, within the catchment of the Kello Water and is therefore not hydraulically connected to the Proposed Development site.

9.5.71 No risk to PWS has been identified associated with the Proposed Development and therefore PWS is not considered further in this assessment.

Water Crossing Schedule

9.5.72 Table 9.6 presents a summary of the watercourses that will require crossings to be installed during construction. A detailed Water Crossing Schedule is presented in Appendix 9.3.

Table 9.6 – Summary of Watercourse Crossings

Watercourse ID	Grid Reference	Type	Proposal	CAR Requirement
WC01	270597,610454	New	Bottomless/arch culvert	GBR6
WC02	269737,610923	Existing	Bridge	Registration
WC03	269304,610778	New	Bottomless/arch culvert	GBR6
WC04	269130,610978	New	Bottomless/arch culvert	GBR6
WC05	268968,610823	New	Bottomless/arch culvert	GBR6

9.6 Assessment of Do-Nothing Scenario

9.6.1 Should the Proposed Development not be consented, the "do-nothing scenario" will apply to the current baseline environment, in that the Applicant will construct the Consented Development.

9.6.2 The Consented Development was environmentally assessed and consented in 2015 and the assessment is reported within the Sandy Knowe Wind Farm Environmental Statement (2015).

9.7 Assessment of Proposed Development Potential Effects

Construction

9.7.1 The construction phase includes all activities prior to the operation of the Proposed Development, i.e. up to the point at which the turbine(s) begin generating electricity. The following outlines the potential effects identified, with respect to geology, hydrology and hydrogeology.

Pollution Impact from Silt-laden Runoff

9.7.2 Surface runoff containing silt, particularly during and after rainfall events, has the potential to enter the watercourses and field drains on-site. Silt laden surface water runoff is predicted to arise from excavations, exposed ground and any temporary stockpiles. This has the potential to temporarily impact on the water quality and hydrological and ecological function of the receiving watercourse at and downstream of the works.

9.7.3 The magnitude of change, prior to mitigation, is medium. Therefore, there is likely to be a direct, temporary, short-term effect of **major** adverse significance prior to the implementation of mitigation measures on watercourses.

Pollution Impact from Chemical Contaminated Runoff

9.7.4 Pollutants such as oils, fuel and cement may be mobilised through mechanical leaks or spillage and carried in surface drainage. Unless managed appropriately, the pollutants could be washed into watercourses, impacting on freshwater quality and ecological value.

9.7.5 The magnitude of change, prior to mitigation, is medium. Therefore, there is potential for a direct, temporary, medium-term effect of **major** adverse significance on watercourses prior to the implementation of mitigation measures. The underlying glacial till is considered to represent a barrier to downward movement of contaminants into groundwater.

Impact from Soil Compaction

9.7.6 Soil compaction can occur as a result of construction of permanent roads and by movement of construction vehicles and plant. Soil compaction can cause a reduction in water permeating to the ground, resulting in an increase in potentially contaminated surface runoff. Reduced permeability in soils also reduces the site's flood storage capacity which may result in localised flooding incidents.

9.7.7 The magnitude of change, prior to mitigation, is low. Therefore, there is likely to be a direct, temporary, medium-term effect of **moderate** adverse significance on watercourses prior to the implementation of mitigation measures.

Impact on Integrity of Banking

9.7.8 Construction activities on or close to the sides of watercourses can detrimentally affect the structural integrity of the burn banks, either through direct damage to bankside material or indirect loosening of soil structure thus impacting on the localised morphology and water quality of the watercourse through erosion or even collapse of the banking.

9.7.9 Permanent watercourse crossings will be required across a number of watercourses and field drains to allow access for construction and maintenance vehicles. In particular, a permanent bridge will be required across the Polneul Burn.

9.7.10 The sensitivity of the structure and morphology of the Polehote Burn is considered to be high and the magnitude of change, prior to mitigation, is also considered to be medium. Therefore, there is potential for a direct, permanent, medium-term effect of **major** adverse significance prior to the implementation of mitigation measures.

Direct discharge of untreated foul drainage

9.7.11 Unless appropriately sited and managed, there is potential for direct discharge of untreated foul sewage from welfare facilities from site compounds during construction.

9.7.12 The magnitude of change, prior to mitigation, is medium. Therefore, there is likely to be a direct, temporary, medium-term effect of **major** adverse significance on watercourses prior to the implementation of mitigation measures.

Impact on Integrity of Geological Features within SSSI

9.7.13 Construction activities close to the banks to the Polneaul Burn associated with the permanent bridge could detrimentally affect the designating features of the SSSI, i.e. through direct damage of the exposed rock faces. The sensitivity of the exposed geological features is considered to be high and the magnitude of change, prior to mitigation, is also considered to be medium. Therefore, there is potential for a direct, permanent, medium-term effect of **major** adverse significance prior to the implementation of mitigation measures.

9.7.14 However, controlled excavation may expose additional rock face which could enhance the qualifying features of the SSSI. Therefore, there is potential for a direct, permanent, medium-term effect of **major** beneficial significance.

Impact to Peat

9.7.15 The magnitude of change, prior to mitigation, is medium. Therefore, there is likely to be a direct, temporary, medium-term effect of major adverse significance on peat at the Proposed Development site prior to the implementation of mitigation measures.

Operation

Surface Water Drainage

9.7.16 The permanent access track and crane hardstandings for the wind turbines could result in additional surface water flows, potentially resulting in soil erosion and silt-laden runoff, which could pollute watercourses, ditches and ponds.

9.7.17 The magnitude of change, prior to mitigation, is high. Therefore, there is potential for a direct, permanent, short-term effect of **major** adverse significance prior to the implementation of mitigation measures.

Fluvial Geomorphology

9.7.18 The permanent access tracks for the wind turbines will cross a number of watercourses and field drains. If standard box or pipe culverts were to be used, this could potentially adversely affect the geomorphology of the streams by reducing heterogeneity.

9.7.19 The magnitude of change, prior to mitigation, is medium. Therefore, there is potential for a direct, permanent, short-term effect of **major** adverse significance prior to the implementation of mitigation measures.

Access to Geological Features within SSSI

9.7.20 The permanent water crossing over the Polneul Burn (WC02) will provide greater access to the qualifying features of the SSSI for researchers. This is one of the management objectives of the SSSI and therefore the magnitude of change is medium. This is considered to be a direct, permanent, long-term effect of **major** beneficial significance to the SSSI.

Decommissioning

9.7.21 Potential effects of decommissioning the development are similar to those encountered in the construction phase, however, generally with less magnitude, as the level of site activity is lower. Discussions will be held with Dumfries and Galloway Council and the appropriate Regulatory Authorities prior to decommissioning to agree an appropriate Decommissioning Strategy.

9.8 Mitigation Measures

Project Design

9.8.1 A summary of the hydrological influences on the project layout are given below with full details of the project design provided in Chapter 3. Due to the nature of the environment occupied by the Proposed Development, it is imperative that the design of the infrastructure helps to maintain or even improve the local hydrology. Poor design of wind farm infrastructure can result in significant implications for the hydrological environment with secondary effects on peat stability and ecology.

9.8.2 Based on the findings of the peat depth and Peat Slide Risk Assessment (refer to Appendices 9.1 and 9.2), where practicable the infrastructure has been sited outside areas of deep peat and away from areas identified as potentially at risk from peatslides. The design has sought to minimise peat excavation whilst having cognisance to the long-term durability of the infrastructure required.

9.8.3 The only exception to this is the access track immediately to the west of water crossing 2 (WC02). This area of potential peat slide risk could not be avoided; however the assessment has concluded that the risk in this area can be mitigated via appropriate design and mitigation. Further details on the geotechnical mitigation measures to reduce the risk of peat slide are provided in Appendices 9.1 and 9.2.

9.8.4 A 50 m buffer was implemented for all watercourses considered to have continuous flow throughout the year. Figure 9.1 confirms that all turbines are located outwith the 50 m buffers.

9.8.5 The construction compounds and substation have also been located greater than 50 m from known watercourses.

Peat Reuse and Management

9.8.6 Where peat is required to be excavated, it will be reused and managed in line with the guidance document, 'Developments on Peatland: Guidance on the Assessment of Peat

Volumes, Reuse of Excavated Peat and the Minimisation of Waste' (a joint publication by Scottish Renewables and SEPA, 2012).

9.8.7 It is proposed that peat which has been excavated for construction of the Proposed Development will be reused on site. A Peat Management Plan be submitted for approval to DGC prior to construction.

Construction

Water Quality Monitoring Programme

9.8.8 A Water Quality Monitoring Programme will be implemented before and during construction to record the existing water condition and ensure no deterioration to water quality during construction.

Pollution Impact from Silt-laden Runoff

9.8.9 With specific reference to the SEPA 'Guidelines for Water Pollution Prevention from Civil Engineering Contracts' and 'Special Requirements', the contractor will produce a Construction Decommissioning Environmental Management Plan (CDEMP) which contains a construction method statement that includes:

- a detailed breakdown of the phasing of construction activities;
- a pollution risk assessment of the site and the proposed activities;
- identification of all Controlled Waters that may be affected by the works and temporary discharge points to these watercourses;
- planning and design of appropriate pollution control measures during earthworks and construction;
- management of the pollution control system, including dewatering of excavations away from watercourses;
- contingency planning and emergency procedures; and
- on-going monitoring of construction procedures to ensure management of risk is maintained.

9.8.10 All earth moving works or similar operations will be carried out in accordance with BSI Code of Practice for Earth Works BS6031:1981.

9.8.11 While it is acknowledged that best practice to minimise run-off would be to undertake construction and dismantling during the driest period of the year, given the location of the Proposed Development site in Dumfries and Galloway, there are likely to be significant periods of rainfall throughout the year. Therefore, site management will check the local weather forecast daily and prime all site staff to ensure that everyone is aware of their responsibilities to maintain the pollution control system during wet weather.

9.8.12 Where topography dictates that working platforms are needed, these will be formed to ensure that surface water drains away from watercourses.

Pollution Impact from Chemical Contaminated Runoff

9.8.13 All fuel and other chemicals will be stored in accordance with best practice procedures, including in a designated fuelling site located at a safe distance from existing watercourses and in appropriate impermeable bunded containers/areas which will be defined within the

CDEMP. These will be designed to capture any leakage, whether from a tank or from associated equipment such as filling and off-take points, sighting gauges etc., all of which will be located within the bund.

9.8.14 Oil booms and soakage pads will be maintained in all work areas and spill kits kept in all vehicles to enable a rapid and effective response to any accidental spillage or discharge. All construction staff will be trained in the effective use of this equipment.

9.8.15 Construction vehicles and plant will be regularly maintained and all maintenance, fuelling and vehicle washing will be undertaken on appropriate impermeable surfaces away from watercourses in order to minimise risks of leaks to soil and surface waters.

9.8.16 The contractor will develop a method statement to address the transport, transfer, handling and pouring of liquid concrete at foundations.

9.8.17 Cement, grout and unset concrete will not be allowed to enter the water environment. No operations involving concrete transfer between vehicles or into vehicles will take place within 30 m of watercourses and waterbodies.

9.8.18 All vehicles used for delivery of concrete will only be washed out at locations to be agreed with SEPA. Excess concrete or wash-out liquid will not be discharged to drains or watercourses on site or at compounds. Drainage from washout facilities will be collected and treated or removed to an appropriate treatment point/licensed disposal site.

9.8.19 The requirement for dewatering will be minimised in all locations by timely and efficient excavation of the foundation void and subsequent concrete pouring and backfilling.

Impact from Soil Compaction

9.8.20 The proposed access tracks have been designed to use the shortest amount of track possible, while respecting topographical constraints. The tracks will be designed to spread load over the underlying soils thus minimising compaction of soils.

Impact on Integrity of Banking

9.8.21 The Polneul Burn is currently fenced and this fence will be maintained during construction to ensure that there is no incursion towards the burn, other than to construct the bridge crossing. The Polmeur Burn will be similarly fenced near construction activities during construction. Field drains near construction activities will be marked on site using coloured pegs to ensure that construction staff are aware of their presence.

9.8.22 Clearly labelled 'No Entry' signs will be placed on the fences and all site staff and visitors will be briefed on the importance of these watercourses and field drains.

Direct discharge of untreated foul drainage

9.8.23 Welfare facilities will either connect directly to the foul sewer, self-contained storage tanks or to a septic tank, subject to approval from Scottish Water and SEPA.

9.8.24 If self-contained or septic tanks are to be used, these will be maintained and emptied on a regular basis by a suitably licensed contractor.

Impact on Integrity of Geological Features within SSSI

9.8.25 All construction impacts will be undertaken in line with the agreed CDEMP. No unauthorised incursion into the SSSI, other than at the location of the bridge crossing will

be permitted. A detailed method statement for construction of the watercourse crossing within the SSSI will be provided to SNH prior to works being undertaken.

Operation

Surface Water Drainage

9.8.26 The proposed track, hardstanding and bridge drainage principles for the Proposed Development are presented in the Drainage Strategy in Appendix 3.1. Prior to construction, a Detailed Drainage Strategy (DS) will be developed and agreed with SEPA and Dumfries and Galloway Council. The DS would detail the site drainage design, including the type of surface to be used for the access track, the soft engineering and habitat enhancement measures proposed to slow surface water flows and any necessary ponds, swales, cross drains and bunds, to ensure that runoff from hard surfaces will be controlled.

Acidification

9.8.27 Potential effects from acidification will be mitigated through an appropriately designed drainage system to be agreed with DGC and SEPA.

Fluvial Geomorphology

9.8.28 The detailed design for the watercourse crossings, and the requirements for Controlled Activities Regulations authorisations or licences, will be agreed with SEPA prior to construction in order to ensure that impacts are minimised and acceptable to SEPA.

9.9 Assessment of Proposed Development Residual Effects

9.9.1 When the committed mitigation measures set out in Section 9.7 are implemented with the appropriate management and monitoring required, then no significant adverse residual effects from the Proposed Development are predicted on hydrological, hydrogeological, peat and geological resources.

9.10 Assessment of Proposed Development Cumulative Effects

9.10.1 There are no proposed or operational wind farms which are directly hydrologically connected to the watercourses within the Proposed Development site. Hare Hill Wind Farm and Hare Hill Extension are located approximately 1.8 km to the west of the Proposed Development site. These wind farm drains ultimately to the River Nith via a number of small burns and channels.

9.10.2 Sanquhar Community Wind Farm and Sanquhar Six Wind Farm are within the catchment of Kello Water and are not hydrologically connected to the Proposed Development site, but also ultimately drain into the River Nith.

9.10.3 Operation of all these wind farms are likely to have similar long-term impacts on the water environment prior to mitigation as has been predicted for the Proposed Development.

9.10.4 Therefore, the in-combination magnitude of change on the River Nith catchment, prior to mitigation, is considered to be High. However, as these wind farms are either operational or under construction, it is assumed that appropriate mitigation has been implemented and that it is functioning successfully. It is further assumed that similar appropriate mitigation is proposed for the extension. Therefore, there is potential for an in-combination direct, permanent, long-term effect of **minor** adverse significance, and

therefore no additional mitigation measures over and above those committed to in this chapter are considered necessary to address potential cumulative effects on hydrology or hydrogeology.

9.11 Conclusions

9.11.1 The Proposed Development is located within the Nith Valley and the watercourses in the area form part of the catchment of the River Nith which flows from west to east some 1.5 km to the north of the Proposed Development site boundary.

9.11.2 The two principal watercourses within the Proposed Development site boundary are the Polneul Burn and the Polmeur Burn. The burns and also the field drains which are present are considered to have good water quality.

9.11.3 The rock beneath the site is typically sandstone, which is covered by stiff clay. This in turn is covered by a thin layer of peat, much of which is severely degraded through agricultural, mining and forestry practices.

9.11.4 Potential construction and operational effects include pollution of watercourses resulting in adverse effects on water quality and loss of soil integrity resulting in changes to drainage patterns and effects on the integrity of watercourse banks.

9.11.5 The mitigations measures will be drawn together into a Construction Environmental Management Plan. These mitigation measures are considered to be robust and implementable and will reduce the magnitude of effects on watercourses to **minor**. Therefore, the significance of residual effects on geology, surface water and groundwater, following the implementation of these mitigation measures, is considered to be **minor or negligible** and therefore not significant.

9.11.6 The predicted residual significant effects for the Proposed Development are exactly the same as those which would arise from the 'do-nothing scenario', which would result in the implementation of the Consented Development.

9.11.7 The EIA Regulations, at Schedule 4, require the EIA Report to provide a

"description of the likely significant effects of the development on the environment resulting from, inter alia:

… (e) the cumulation of effects with other existing and/or approved development, taking into account any existing environmental problems relating to areas of particular environmental importance likely to be affected or the use of natural resources;"

9.11.8 In this regard, the Proposed Development would be indiscernible from the Consented Development.

Table 9.7 – Summary of Proposed Development Effects

Description of Effect	Potential Effect		Mitigation	Residual Effect	
	Significance	Adverse/Beneficial		Significance	Adverse/Beneficial
Construction and decommissioning					
Pollution from silt-laden runoff	Major	Adverse	Develop and enforce a CDEMP	Minor	Adverse
Pollution from chemical contaminated runoff	Major	Adverse	Develop and enforce a CDEMP	Minor	Adverse
Soil compaction	Moderate	Adverse	Minimise vehicle movements to use of access tracks only. Appropriately designed access tracks to spread load over soils.	Negligible	N/A
Impact on fluvial geomorphology	Moderate	Adverse	Fence off banks of watercourses and mark out field drains in close proximity to construction areas. Use 'No Entry' signs on fence.	None	N/A
Peat loss	Major	Adverse	Implementation of Peat Management plan	Minor	Adverse
Discharge of untreated foul drainage	Major	Adverse	Connect to foul sewer or use self-contained tanks or a septic tank.	Minor	Adverse
Operation					
Change in surface water drainage	Major	Adverse	Agree detailed Drainage Strategy with SEPA and Dumfries and Galloway Council.	Moderate	N/A
Impact on fluvial geomorphology	Moderate	Adverse	Agree use of bridge or bottomless culverts with SEPA.	Minor	Adverse

Table 9.8 – Summary of Cumulative Effects

Description of Effect	Residual Effect		Cumulative Wind Farms	Cumulative Effect	
	Significance	Adverse/Beneficial		Significance	Adverse/Beneficial
Construction and decommissioning					
Pollution of River Nith from contaminated runoff	Minor	Adverse	Hare Hill , Hare Hill Extension, Sanquhar Community and Sanquhar Six	Minor	Adverse
Operation					
Pollution of River Nith from contaminated runoff	Minor	Adverse	Hare Hill , Hare Hill Extension, Sanquhar Community and Sanquhar Six	Minor	Adverse

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