11 Hydrology, Hydrogeology and Geology

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11 Hydrology, Hydrogeology & Geology

11.1 Executive Summary

11.1.1 This chapter considers the potential effects of the proposed Hagshaw Hill Wind Farm Repowering project (the Proposed Development) on hydrological, hydrogeological and geological resources.

11.1.2 A combination of desk study and field survey work was undertaken to identify and characterise the geological, hydrological and hydrogeological receptors which could be subject to impacts from construction, operation and decommissioning of the Proposed Development.

11.1.3 Surface water drainage from the site flows into local watercourses including the Podowrin Burn, Smithy Burn and Windrow Burn, which themselves flow to the Douglas Water to the south and Poniel Water to the north, both ultimately draining into the Clyde to the north-east of the site.

11.1.4 Three new water crossings will be required, where access tracks will need to traverse the Smithy Burn, an unnamed drainage ditch, and the western branch of the Windrow Burn. Additionally, a historic crossing of the Broadlea Burn will require upgrading/replacing and works will be required to the embankment above an existing crossing over the Windrow Burn.

11.1.5 Site geology comprises sedimentary bedrock sequences overlain by discontinuous till with some localised pockets of peat according to published geological mapping. A peat depth survey has identified minimal peat across the Proposed Development area, with most probes identifying no peat or <50 cm peat thickness. A peat slide risk assessment has identified negligible or low risks across the site.

11.1.6 Potential construction and operational effects arising from the Proposed Development include changes to the groundwater flow regime, the risk of pollution of watercourses resulting in adverse effects on water quality, effects on the integrity of watercourse banks, and localised impacts on peat.

11.1.7 Mitigation measures to avoid or reduce potential impacts, include developing and implementing a Construction Environmental Management Plan (CEMP), undertaking pre-construction site investigations to inform micro-siting and avoid sensitive receptors where possible, and surface water quality monitoring.

11.1.8 Outline drainage design provisions and water crossing designs have been developed to ensure appropriate control of runoff, and continuous greenfield flows. Detailed designs will be agreed with the SEPA and SLC in advance of construction.

11.1.9 Following implementation of committed mitigation measures, the significance of residual effects on geology, surface water and groundwater is considered to be minor or negligible and therefore not significant. No cumulative effects are predicted.

11.1.10 The construction and operation of the Proposed Development is not considered to result in any greater significance of effects on geological, hydrological and hydrogeological receptors than the effects arising from the Existing Development.

11.2 Introduction

11.2.1 This chapter assesses the potential impacts of the Proposed Development on hydrology, hydrogeology and geological resources. This includes detailed consideration of potential impacts on surface watercourses, groundwater and the local geology in and around the site and any potential impacts on flood risk in the local area. Potential impacts on peat deposits, and risks associated with peat slide, are also assessed.

11.2.2 For the purposes of this assessment, watercourses have been identified as those which appear on the Ordnance Survey (OS) 1:50,000 scale maps (refer to Figures 11.2a & b). However, on-site

observations of field drains and other man-made features have also been made and the presence of these has been taken into account in the design of the scheme and any mitigation measures.

11.3 Legislation, Policy and Guidelines

Legislation

11.3.1 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.

11.3.2 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.

11.3.3 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) (as amended), 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 groundwaters; and,
- engineering works in inland waters and wetlands.

11.3.4 SEPA maintains water monitoring and classification systems that provide the data to support the aim of the WFD, namely that all waterbodies would have good ecological status, or similar objective, by 2015. 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).

11.3.5 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.

11.3.6 The relevant legislation relating to flood prevention is the *Flood Risk Management (Scotland) Act 2009*, which replaces the *Flood Prevention (Scotland) Act 1961 (as amended)*.

11.3.7 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.

11.3.8 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.

11.3.9 *The Contaminated Land (Scotland) Regulations 2000 (as amended)* sets out the responsibilities of the local authority and SEPA in the identification and management of contaminated land.

Planning Policy

11.3.10 Chapter 5 sets out the planning policy framework that is relevant to the Environmental Impact Assessment (EIA). The policies set out below include those from the South Lanarkshire Local

Development Plan (LDP, 2015). This section also considers the relevant aspects of Scottish Planning Policy (SPP), Planning Advice Notes and other relevant guidance. Of relevance to the hydrological, hydrogeological and geological assessment presented within this chapter are the following policies and advice notes:

- LDP, Policy 2, Climate Change;
- LDP, Policy 4, Development management and placemaking;
- LDP, Policy 17, Water environment and flooding;
- LDP, Policy 18, Waste;
- PAN 51: Planning, Environmental Protection and Regulation (Scottish Executive, 2006);
- PAN 69: Planning and Building Standards Advice on Flooding;
- PAN 79: Water and Drainage (Scottish Executive, 2006) and
- Scottish Planning Policy (Scottish Government, 2014).

Guidance

11.3.11 The following relevant guidance has been considered as part of the assessment of hydrology, hydrogeology, flood risk and drainage:

- SEPA Supporting Guidance (SAT-SG-75) – Sector Specific Guidance: Construction Sites (2018);
- SEPA Pollution Prevention Guideline (PPG) 1: Understanding your environmental responsibilities - good environmental practices (2013);
- SEPA Guidance for Pollution Prevention (GPP) 5: Works and maintenance in or near water (2017);
- Special Requirements for Civil Engineering Contracts for the Prevention of Pollution v2 (SEPA, 2006);
- SEPA Policy 19 Groundwater Protection Policy for Scotland (Version 3, 2009);
- SEPA Policy 41 'A Planning Authority Protocol Development at Risk of Flooding: Advice and Consultation' (SEPA, 2016);
- CIRIA C532: 'Control of Water Pollution from Construction Sites - Guidance for Consultants and Contractors' (CIRIA, 2001);
- PPG6: Working at Construction and Demolition Sites (Environment Agency, 2010 – 2nd Edition 2012);
- Good practice during wind farm construction, 3rd edition (Scottish Renewables, Scottish Natural Heritage, SEPA, Forestry Commission Scotland and Historic Scotland, 2015);
- SEPA Guidance Note 4: Planning advice on wind farm developments, LUPS-GU4 (SEPA, 2017);
- Guidance on Developments on Peatland - Site Surveys (Scottish Natural Heritage, SEPA and The James Hutton Institute, 2017).
- Developments on Peatland: Guidance on the assessment of peat volumes, reuse of excavated peat and the minimisation of waste (Scottish Renewables and SEPA. 2014); and
- BS5930:2015 - Code of Practice for Site Investigation (British Standards Institute, 2015).

11.4 Consultation

11.4.1 Consultation was undertaken with a number of statutory and non-statutory consultees, in order to obtain information and advice prior to completing the EIA. In order to facilitate initial consultation on the project, consultees were provided with information on the Proposed Development and the proposed scope of survey and assessment work.

11.4.2 Table 11.1 summarises the consultation responses and provides information on where and how they have been addressed in the assessment, where relevant. Copies of relevant consultee correspondence are included in Appendix 4.1.

Table 1.1 – Consultation Responses

Consultee and Date	Scoping/Other Consultation	Issue Raised	Response/Action Taken
SLC – 29th October 2018	Direct consultation	SLC was consulted for any information held on the presence of Private Water Supplies (PWS) within 500 m of the proposed turbines and borrow pit search area, and within 250 m of the proposed new access track. SLC verbally responded that no relevant information on PWS in this area could be identified, and it was recommended that SEPA be consulted.	Information on PWS has been requested from SEPA (see below).
SEPA – 11th November 2018	Direct consultation	SEPA's consultation response provided the following key points: - Details on watercourse crossings to be subject to further discussion with SEPA. Potential increased risk of flooding due to watercourse crossings to be considered. - Findings from peat surveys to be detailed in an outline Peat Management Plan. - SEPA does not hold records of PWS; it is the responsibility of the Applicant to establish no PWS are present.	Details of proposed new and altered water crossings are provided in Appendix 11.2. A Stage 1 Flood Risk Assessment is provided in Appendix 11.3. A Peat Slide Hazard Risk Assessment and an outline Peat Management Plan are provided in Appendix 11.1. See paragraphs 11.6.24 to 11.6.26.

Consultee and Date	Scoping/Other Consultation	Issue Raised	Response/Action Taken
		- Information on potential Groundwater Dependent Terrestrial Ecosystems (GWDTE) and interpretation to be provided in the EIA Report.	See paragraphs 11.6.19 to 11.6.23.
		- Accept that use of site-won stone is more sustainable for upgrading and constructing new tracks. Further details on borrow pits and on track design to be provided in the EIA Report.	Details are provided in Chapter 3 (Section 3.3).
		- Further engagement with SEPA recommended regarding use of colliery spoil as a source of stone for construction.	Noted.
		- It is assumed there is no requirement for removal of trees.	This assumption is correct.

11.5 Assessment Methodology and Significance Criteria

Consultation

11.5.1 As noted in Section 11.3, consultation has been undertaken with SEPA and SLC. Responses and relevant considerations are noted in Table 11.1.

Study Area

11.5.2 The study area has incorporated the area within the site boundary and this assessment also considers any potential hydrological and hydrogeological effects up to 1 km from any proposed infrastructure (see Figure 11.1).

11.5.3 Efforts have been made, via consultations, site survey work and review of OS mapping, to identify any PWS for an area within 500 m of the proposed turbines and borrow pit search area, and within 250 m of the proposed new track to the southern site area.

11.5.4 The criteria for defining the study area have been established based on the professional judgement and experience of the technical authors with regard to likely access and working areas, and with due consideration to the relevant guidance on hydrological and geological assessment.

Desk Study

11.5.5 Baseline conditions have been established primarily through desk-based research which has included:

- consultation with SEPA and SLC;

- 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 classification;
- review of on-line SEPA flood mapping;
- review and collation of pertinent information on surface hydrology, flooding, climate, etc.;
- review of on-line British Geological Survey (BGS) geological mapping of the area; and
- review of drainage / surface water and hydrogeological characteristics and groundwater resource.

Site Visit

11.5.6 A site visit, in conjunction with peat depth survey work (see below) was undertaken by an experienced geologist and hydrologist on 6th and 7th August 2018. Field notes were taken on site, noting ground constraints and details of ground conditions not apparent on available mapping. Peat depth probing was undertaken at all proposed infrastructure locations. A review of surface watercourses including existing and proposed water crossings was also undertaken, although a more detailed review of proposed water crossings, to input to their detailed siting and design, was undertaken by the project engineer (Aecom) on 6th August 2018.

11.5.7 A Phase 1 Habitat Survey and National Vegetation Classification (NVC) survey was undertaken by MacArthur Green on 23rd and 24th May and 7th August 2018. This survey work included identification of habitats which may be groundwater dependent, in accordance with SEPA guidance document LUPS-GU4 (see paragraph 11.3.11 above).

Peat Depth Survey

11.5.8 Based on a desk study review of published geological mapping, it was anticipated that peat could be present across at least parts of the Proposed Development site. A peat depth survey was therefore undertaken, comprising the following pattern of peat probing:

- Probe at each proposed turbine location plus approximately 50 m from the turbine location to the north, south, east and west;
- Five probes at each proposed turbine hardstanding area (centre and four outside corners);
- Every 50 m along proposed access tracks, plus approximately 50 m either side of each probe, perpendicular to the route of the track;
- Seven probes at the proposed substation and main temporary compound location;
- Nine probes at the proposed temporary laydown area; and
- Thirty-four probes at and adjacent to the proposed borrow pit search area.

11.5.9 Data obtained from the peat depth survey were used to plot the presence and distribution of peat across the proposed infrastructure development areas at the site, create a contour plan, and feed into detailed design iteration. The data were subsequently used to inform a Peat Slide Risk Assessment (PSRA) and development of an outline Peat Management Plan (PMP); refer to Appendix 11.1.

Assessment of Potential Effect Significance

11.5.10 The sensitivity characteristics of hydrological, hydrogeological and geological resources have been guided by the matrix presented in Table 11.2, which lists indicative criteria.

Table 11.2 - Sensitivity Criteria (Hydrology, Hydrogeology and Geology)

Sensitivity	Description
High	Areas containing geological, geomorphological or hydrological features considered to be of national interest, for example, Aquatic Natura 2000 sites, Special Areas of Conservation, Sites of Special Scientific Interest. Highly permeable superficial deposits allowing free transport of contaminants to groundwater and surrounding surface waters. Wetland/watercourse of High or Good Ecological Status. Raised or blanket bog. High risk of flooding. Land capable of supporting Arable Agriculture i.e. Class 1, 2 and 3.1.
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 Status. Significant peat deposits. Moderate risk of flooding. Land capable of supporting Mixed Agriculture i.e. Class 3.2, 4.1 and 4.2.
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 Status or no WFD classification. Thin superficial peat deposits. Low risk of flooding. Land capable of supporting improved grassland or rough grazing only i.e. Class 5.1 to 7.

11.5.11 The criteria for sensitivity have 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, waterbody status from the WFD review work undertaken to date by SEPA, consultations, site visits, and the professional judgement of the assessment team.

11.5.12 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 and operational phases of the Proposed Development. Impacts have been predicted based on the guidance criteria for the magnitude of change set out in Table 11.3. Impacts from aspects of decommissioning are considered to be the same as for construction.

Table 11.3 - Magnitude of Change Criteria (Hydrology, Hydrogeology and Geology)

Magnitude of Change	Guidance 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, for example, extensive excavation of peatland or watercourse realignment.
Medium	Loss of, or alteration to key features of the baseline resource such that post development characteristics or quality would be partially changed, for example, in-stream 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, for example short term compaction from machinery movements.

11.5.13 Using these criteria, potential effects resulting from the Proposed Development have been assessed. These effects are presented in Section 11.7. Details of generic and site-specific mitigation measures are given in Section 11.8, with the remaining residual effects detailed in Section 11.9.

11.5.14 The significance of the predicted effects has been assessed in relation to the sensitivities of the baseline resource. A matrix of significance, based on the combination of magnitude of change and sensitivity of receptor, was developed to provide a consistent framework for evaluation. This is shown in Table 11.4 below.

Table 11.4 – Significance of Effect Matrix

Sensitivity of Receptor	Magnitude of Change			
	High	**Medium**	**Low**	**Negligible**
High	Major	Major	Moderate	Minor
Medium	Major	Moderate	Minor	Negligible
Low	Moderate	Minor	Negligible	Negligible
Negligible	Minor	Negligible	Negligible	Negligible

11.5.15 The guideline criteria for the various categories of effect are provided in Table 11.5.

Table 11.5: Significance Criteria (Hydrology, Hydrogeology and Geology)

Significance	Definition	Guidance 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 large, 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 values to geological or aquatic habitats or designated areas.
Minor	A small but detectable change to the environment.	Localised changes resulting in minor and/or reversible effects on soils, surface and groundwater quality or habitats.
Negligible	No detectable change to the environment.	No effects on geological resources, drainage patterns, surface and groundwater quality or aquatic habitats.

11.5.16 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.

11.5.17 These matrices have been used to guide the assessment, though 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.

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

Requirements for Mitigation

11.5.19 Committed 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

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

Limitations to Assessment

11.5.21 No water quality monitoring or intrusive investigations, other than peat depth survey work as described in paragraph 11.5.8, have been undertaken.

11.6 Baseline Conditions

Geology (including Soils)

11.6.1 BGS online mapping for the area shows that the bedrock geology underlying the site comprises early Devonian and Silurian sedimentary strata (sandstone, siltstone, mudstone) mainly of the Quarry Arenite Formation, Swanshaw Sandstone Formation, Hagshaw Group, Glenbuck Group and Monks Water Group. An igneous intrusion (mafite of the North Britain Palaeogene Dyke Suite) trends roughly east-west in the north-east site area. Further east along the site's access route the underlying bedrock comprises younger (Carboniferous) sedimentary strata, including Scottish Lower Coal Measures, Limestone Coal Formation, and Passage Formation.

11.6.2 The bedrock geology as shown on BGS 1:50,000 scale mapping is shown on Figure 11.3.

11.6.3 BGS mapping shows that the north-west part of the site (approximately the extent of the Existing Development) has little or no recorded superficial geology, with the exception of a few small and localised areas of peat. The south-east site area is largely underlain by till, which in this area would typically be expected to comprise stiff to hard clay with variable inclusions of sand, gravel and boulders. There is one localised area of peat shown on the BGS mapping at the north end of the proposed temporary laydown area, and a smaller area of peat just to the south.

11.6.4 In respect of the soil resource across the site, it is noted that in the north-west part of the site is classified as Organic Soils, with the central and part of the southern area classified as Ettrick (peaty gleyed podzols). The south-east site area is classified as Rowanhill (peaty gleys).

11.6.5 The superficial geology as shown on BGS 1:50,000 scale mapping is shown on Figure 11.4.

Mining

11.6.6 The main site area has not been subject to historical coal mining and is not in a coal mining risk area. However, the proposed site access route, from the M74 up to and including the existing Douglas West bing on the north side of the Broadlea Burn, is within a mining risk area.

11.6.7 A Mining Risk Assessment, informed by a Consultant's Coal Mining Report by the Coal Authority, has been undertaken by Wardell Armstrong (Appendix 11.4). This has identified no recorded mine entries within the site boundary, nor historical mine workings beneath the site. No mining-related risks were identified and no mitigation measures were considered to be required. Mining hazards are therefore not considered further in this assessment.

Peat

11.6.8 There are no areas of Class 1 or 2 peat (based on SNH carbon and peatland mapping, 2016) within or adjacent to the site boundary. The nearest such areas are over 2 km away from any proposed new infrastructure.

11.6.9 However, given that BGS mapping shows some localised peat deposits at the site and soils mapping shows peaty soils, a peat depth survey was undertaken as descripted in paragraph 11.5.10, in line with *Guidance on Developments on Peatland - Site Surveys* (2017) and the *Good Practice during Wind Farm Construction Guidance*, to identify any peat deposits that may be present around proposed turbines and associated infrastructure. The locations and findings of the peat probes are illustrated on Figure 11.5.

11.6.10 *The Guidance on Developments on Peatland - Site Surveys* (2017) uses the definition of peat, deep peat and organo-mineral (peaty) soils which is presented in the *Joint Nature Conservation Committee (JNCC) report 445 Towards an Assessment of the State of UK Peatlands* (2011). This definition, which has been used within this chapter, is summarised below:

- **Peaty (or organo-mineral) soil:** a soil with a surface organic layer less than 0.5 m deep;
- **Peat:** a soil with a surface organic layer greater than 0.5 m deep which has an organic matter content of more than 60 %;

- **Deep peat:** a peat soil with a surface organic layer greater than 1.0 m deep.

11.6.11 The peat depth survey identified that the site is underlain by thin layers of till and/or peaty soils, with rockhead at or near surface. Only very isolated areas of deeper peat were recorded, and site observations indicate that these are associated with shallow topographical "bowls" in which vegetation has accumulated.

11.6.12 Of 609 probes advanced during the peat depth survey, the peat depth was zero or less than 0.5 m at 563 probes (92.4 %), defined as peaty or organo-mineral soil. Forty probes (6.6 %) recorded peat between 0.5 m and 1 m deep, and the remaining six probes (1 %) recorded deep peat, i.e. peat between 1 m and 1.5 m deep.

11.6.13 The six probes which recorded deep peat (between 1 m and 1.5 m) were located: at the proposed track south-east of the main site area (one probe); near the proposed track west of T2 (two probes); near the existing track at the north-east edge of the site (one probe); and just east of the proposed borrow pit search area (two probes). No turbines, crane hardstandings, compounds or other major infrastructure components are sited on areas of deep peat.

11.6.14 Full details of the peat depth survey, together with a Peat Slide Risk Assessment and outline Peat Management Plan are provided in Appendix 11.1.

11.6.15 Overall, the sensitivity of the baseline geological resources at this site are considered to be low.

Hydrogeology

11.6.16 The groundwater body beneath the site is indicated by SEPA to comprise the Lesmahagow groundwater (ID 150673). This groundwater body was classified by SEPA in 2017 as having an overall status of good, a quantitative status of good and a chemical status of good.

11.6.17 Hydrogeology mapping data from the BGS shows the bedrock beneath the main site area (where all turbines are proposed to be located) to comprise a low productivity aquifer, in which flow is virtually all through fractures and other discontinuities. Part of the proposed southern access road, the proposed borrow pit search area, and the existing bing are underlain by bedrock which is identified as a moderately permeable aquifer, again with virtually all flow being through fractures and other discontinuities.

11.6.18 Till, where present, is anticipated to be relatively low permeability, inhibiting groundwater flow. Peat and peaty soils would be more permeable, allowing groundwater flow.

Potential Groundwater Dependent Habitats

11.6.19 Habitats indicative of GWDTE were identified during National Vegetation Classification survey work (see Figure 11.6 for a summary of potential GWDTE within the main site area and see Chapter 7 and Figure 7.3 for further detail). Across much of the southern site area (i.e. outside the Existing Development area), potentially moderately groundwater dependent habitats were identified as being present. In some localised areas both within the Existing Development area and in the southern site area, potentially highly groundwater dependent habitats were identified.

11.6.20 As noted above, superficial geology at the site largely comprises till, except on the higher ground in the north of the site where there is no recorded superficial geology. Till deposits are anticipated to comprise a clay matrix with variable inclusions of sand, gravel and cobbles. Typically, such deposits would contain little groundwater, with groundwater flow limited to localised areas of higher sand and gravel content. With the bedrock underlying the main site area comprising a low productivity aquifer, this would suggest there is little groundwater present near the surface across much of the main site.

11.6.21 The areas in which habitats suggesting potential groundwater dependency have been identified are mainly on the slopes of Broomerside and Hagshaw Hill, and on the relatively flat ground at the foot of these hills, in the south of the site. Given the nature of the geology and anticipated absence of substantial groundwater, it is considered that surface water flow running off the hillsides and

ponding on low-permeability till at the foot of the hills is likely to be sustaining the habitats identified.

11.6.22 Even in the area north of the proposed laydown area, where BGS mapping shows a localised area of peat, the peat depth survey identified peat depths consistently less than 50 cm, with till beneath. It is again considered likely that surface water flow shedding from the nearby hillsides sustains the habitats identified at this location.

11.6.23 It is therefore considered that GWDTE are not present at the Proposed Development site, and impacts on GWDTE are not considered further.

Private Water Supplies

11.6.24 SLC and SEPA were consulted regarding the presence of PWS within 500 m of the proposed turbines and borrow pit search area, and within 250 m of the proposed new access track. No information was available.

11.6.25 Evidence of a possible PWS was observed during the ecology site survey work, at NGR 79806 29434. A stone structure was identified, with a clay pipe leading to a trough-like structure, fenced off from the surrounding grazing land. The structure appeared to be disused, as shown in the photographs below. It is located between the former properties at High Broomerside and Low Broomerside, and it is considered likely that it was used for a water supply when those properties were occupied and in use. There is no evidence to suggest that the structure is currently used to supply water, and no other PWS within the search area have been identified. An assessment of effects on private water supplies is therefore not considered further within this chapter.

Photographs of Possible Disused PWS between High Broomerside and Low Broomerside

11.6.26 Overall, the sensitivity of baseline hydrogeological resources beneath this site is considered to be medium.

Watercourses

11.6.27 As shown on Figures 11.2a and 11.2b, there are three principal watercourses flowing roughly north to south across the site. The Smithy Burn forms the western site boundary; a branch of the Windrow Burn flows across the central part of the site, separating Broomerside Hill from Hagshaw Hill; and another branch of the Windrow Burn flows along the eastern part of the site. There are also minor tributaries of the Podowrin Burn flowing north to south at the far south-west edge of the site and in the south-central part of the site. All of these drain into the Douglas Water to the south/south-east of the site, which itself flows into the River Clyde some 7 km north-east of the site boundary.

11.6.28 The 2017 SEPA classification of the Douglas Water is an overall status of good. The Smithy Burn, Windrow Burn and Podowrin Burn do not have SEPA classifications, however as tributaries of the Douglas Water they can be expected to have similar overall status.

11.6.29 Other watercourses flowing into the Douglas Water within the study area are noted below. These do not have SEPA classifications however are again expected to have similar overall status to the Douglas Water.

- the Robshill Burn, flows between the two borrow pit search areas and under the old railway track which forms the proposed southern site access route;
- the Broadlea Burn, which flows west to east from near the existing Douglas West bing on the proposed access route;
- The Bloodmyre Syke, which flows north-west to south-east in the north-east part of the study area; and
- Several unnamed tributaries of the Douglas Water in the eastern part of the study area.

11.6.30 In the northern part of the study area are the Hagshaw Burn and the Shiel Burn, into which drainage from the northern part of the site flows (except the far north-west i.e. T13 area which drains to the Podowrin Burn to the west). The Hagshaw Burn and Shiel Burn drain into the Poniel Water approximately 1.6 km north of the site boundary. The Poniel Water flows into the River Clyde to the north-east of the site.

11.6.31 The Alder Burn is also located in the north-east of the study area, rising just to the north-east of the existing northern access road, flowing north-east to almost meet the proposed new access road (along the existing old railway track), then north where it is crossed by the existing coal road and into the Poniel Water.

11.6.32 The 2017 SEPA classification of the Poniel Water is moderate. The Hagshaw Burn, Shiel Burn and Alder Burn do not have SEPA classifications but they are anticipated to have overall status of at least moderate.

11.6.33 As noted above, all of the watercourses on site, and into which the site drain, form part of the wider catchment of the River Clyde.

11.6.34 Some of the proposed access tracks to turbines will require new watercourse crossings to be constructed, namely: an unnamed tributary of the Podowrin Burn between T2 and T3, the Smithy Burn east of T2, and the western branch of the Windrow Burn between T5 and T6. The location of these proposed water crossings are shown on Figures 11.2a and b, labelled WC01, WC02 and WC03, respectively. Indicative water crossing designs are included in Appendix 11.2

11.6.35 Additionally, a historic crossing of the Broadlea Burn on the old railway (proposed access route to the southern site area) will require to be upgraded/replaced. The location of this existing water crossing is shown on Figure 11.2b, labelled WC04. There are additional existing water crossings along the old railway line (proposed access route), including minor drainage ditches and a more significant crossing of the Windrow Burn (WC05). These are not anticipated to require significant upgrading but any localised works will be discussed and agreed with SEPA and SLC prior to commencement of development. Localised works to the embankment above the existing Windrow Burn crossing (WC05) will be required and are illustrated in Appendix 11.2 for information. All final water crossing designs will be subject to authorisation under the CAR Licensing regime.

11.6.36 A water crossing schedule is presented in Appendix 11.2.

11.6.37 For the purposes of this assessment, the sensitivity of baseline hydrological resources at this site is considered to be high.

Borrow Pit Search Areas

11.6.38 As shown on Figures 11.2a and 11.2b, there are two circular borrow pit search areas adjacent to the proposed access route to the southern part of the site. It is proposed that the actual borrow pit(s) would be located within these search areas, however, would only require using a portion of the search areas.

11.6.39 The bedrock geology at the borrow pit search areas is Greywacke Conglomerate Formation, considered to have potential for providing suitable rock for site construction. As set out in Chapter 3, intrusive site investigation work will be undertaken to further characterise the rock, identify its suitability, and allow a specific excavation location or locations within the search areas to be confirmed prior to commencement.

11.6.40 Subject to appropriate environmental and geotechnical testing, it is also proposed that colliery spoil within the existing Douglas West bing adjacent to the proposed access track could be suitable for providing some road construction material. If this is found to be the case then material would be excavated from the bing in accordance with the methodology set out in Chapter 3, which would reduce the amount of virgin material required to be won from the borrow pit search areas.

Flooding

11.6.41 The online SEPA flood risk map indicates that most of the site has no identified flood risk. A desk-based Stage 1 Flood Risk Assessment (FRA) has been undertaken to assess the local potential effects of the Proposed Development on fluvial and pluvial flooding at the site and this is presented in Appendix 11.3. The conclusion of the FRA is that risk of fluvial and pluvial flooding as a result of the Proposed Development is low. The banks of the Poniel Water to the north, and the banks of the Douglas Water to the south of the site are indicated to be at risk of fluvial flooding, and it is important to ensure that the Proposed Development will not exacerbate these risks. However, as described in Section 3.3 of this EIA Report, no site drainage will involve direct discharge to these watercourses; drainage and water crossings will be designed to mimic greenfield conditions.

11.6.42 A detailed drainage design will be undertaken and submitted to SEPA and the Local Authority for approval prior to construction. Therefore, the baseline sensitivity of this site to flooding is considered to be low.

Contaminated Land

11.6.43 Historically, the main body of the site has largely been undeveloped agricultural land, with the exception of the Existing Development in the northern area. There is considered to be limited potential for any ground contamination arising from these land uses.

11.6.44 An old rail line forms part of the proposed southern access; the rail line has been dismantled and the route is now a gravel track. A spoil heap containing materials from historical coal mining in the local area is situated adjacent to the old rail line at Douglas West, in the eastern part of the Proposed Development site boundary. These land uses represent potential localised contamination sources.

11.6.45 For the purposes of this assessment, the sensitivity of receiving watercourses to exposure to contaminative materials, and therefore their overall sensitivity, is considered to be high.

11.7 Potential Effects

11.7.1 The potential effects resulting from the Proposed Development are detailed below. Effects have been separated into those which occur during the construction, operation and decommissioning phases individually.

Construction

11.7.2 The construction phase includes all activities prior to the operation of Proposed Development, i.e. up to the point at which the turbines begin generating electricity. The following paragraphs outline the potential effects identified, with respect to geology, hydrology and hydrogeology during this phase.

Changes to Groundwater Flow

11.7.3 As discussed in Section 11.6, there is anticipated to be little groundwater at shallow depth beneath the site, limited to localised areas of till with higher proportions of sand and gravel content. Groundwater within the bedrock is anticipated to flow largely via fissures and other discontinuities.

11.7.4 Excavations will be required to form turbine foundations, and shallower excavations will be required to form platforms for the substation and energy storage compound, the temporary construction compounds, and the temporary laydown area. However, given the anticipated absence of substantial groundwater within the superficial deposits, any changes to groundwater flow would be highly localised.

11.7.5 There is therefore a potential low magnitude impact on a medium sensitivity receptor, resulting in a direct, temporary, short-term effect of **minor** adverse significance in the absence of mitigation.

Removal of and Impact on Peat

11.7.6 Three highly localised areas of deep peat (1.0 m to 1.5 m thickness) were identified within the Proposed Development footprint. The proposed infrastructure at these locations is limited to access tracks crossing each area (one being adjacent to the location of an existing track which will be retained, therefore no impact is anticipated at that location).

11.7.7 On the proposed access into the southern part of the site, an area of deep peat will require to be crossed. This area is limited to less than 50 m in length along the route of the proposed track; probes 50 m either side of the identified deep peat location recorded less than 50 cm of peat.

11.7.8 On the proposed access track between T1 and T2, another localised area of deep peat may require to be crossed. Again, this area is limited to less than 50 m in length along the route of the proposed track; probes 50 m either side of the identified deep peat location recorded less than 50 cm of peat.

11.7.9 Localised deep peat was identified adjacent to the eastern borrow pit search area, but not within the search area. Within the borrow pit search areas, peat probes identified peat depths less than 50 cm except at the far north of the eastern search area, where several probes identified peat to 50 cm to 100 cm depth.

11.7.10 In the absence of mitigation, there is a potential medium magnitude impact on a low sensitivity receptor, resulting in a direct, permanent effect of **minor** adverse significance in the absence of mitigation.

Impact on Downstream Fluvial Flood Risk

11.7.11 Construction of the Proposed Development has the potential to generate increased runoff through introduction of hardstanding areas, and to increase flood risk through creation of new water crossings. Downstream receptors include the Douglas Water and Poniel Water, both susceptible to fluvial flooding in localised zones along their banks. Therefore, in the absence of mitigation, there is potential for a medium magnitude impact on a high sensitivity receptor, resulting in an indirect, temporary, short-term effect of **major** adverse significance.

Pollution Impact from Sediment Runoff / Transport

11.7.12 Surface runoff containing silt and other sediments, particularly during and after rainfall events, has the potential to enter the watercourses and field drains on-site. Silt and sediment 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 in the absence of any mitigation.

11.7.13 The magnitude of change, prior to mitigation, is medium, on a high sensitivity receptor. Therefore, there is potential for 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

11.7.14 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.

11.7.15 The magnitude of change, prior to mitigation, is medium, on a high sensitivity receptor. Therefore, there is potential for a direct, temporary, medium-term effect of **major** adverse significance on watercourses prior to the implementation of mitigation measures.

Pollution Impact from Contaminated Land

11.7.16 The former rail line which forms part of the proposed access route to the southern site area represents a source of potential localised contamination associated with its historical use. However, no known sidings, goods sheds or other associated infrastructure, more likely to represent significant contamination sources, have been identified in close proximity to the site. Furthermore, although the old rail line will require upgrading to provide suitable access to the site, no extensive excavation work, which could mobilise localised contaminants, is envisaged.

11.7.17 The bing (coal mining spoil heap) adjacent to the proposed access track at Douglas West is proposed as a potential source of construction materials for the Proposed Development. The chemical characteristics of the bing materials are currently unknown, although anecdotal reports from SLC indicate the material to be inert. Use of contaminated materials in the construction process could result in leaching of contaminants into groundwater or surface water receptors. The magnitude of change, prior to detailed assessment and mitigation, is medium, on a high sensitivity receptor. Therefore, there is potential for a direct, temporary, medium-term effect of **major** adverse significance on watercourses prior to the implementation of mitigation measures.

Impact on the Integrity of Banking

11.7.18 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.

11.7.19 Permanent new watercourse crossings will be required at three locations. These include proposed installation of a pipe culvert at WC01, and a bottomless arch culverts at WC02 and WC03. The historic crossing at WC04 will also require upgrading/replacing as shown in Appendix 11.2.

11.7.20 There is potential for a high magnitude impact on high sensitivity receptors, therefore, there is potential for a direct, permanent effect of **major** adverse significance prior to the implementation of mitigation measures.

Direct Discharge of Untreated Foul Drainage

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

11.7.22 The magnitude of change, prior to mitigation, is medium, on a high sensitivity receptor. 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.

Operation

Surface Water Drainage

11.7.23 The access track and crane hardstandings for the wind turbines could result in an increased rate of surface water run-off from the site, increasing downstream flood risk and potentially resulting in soil erosion and silt-laden runoff, which could pollute watercourses, ditches and ponds.

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

Fluvial Geomorphology

11.7.25 If arch or pipe culverts for watercourse crossings are not designed properly to ensure continuous flows, this could potentially adversely affect the geomorphology of the streams by reducing heterogeneity.

11.7.26 The magnitude of change, prior to mitigation, is medium, on a high sensitivity receptor. Therefore, there is potential for a direct, permanent effect of **major** adverse significance prior to the implementation of mitigation measures.

Decommissioning

11.7.27 Potential effects of decommissioning the Proposed Development are similar to those encountered in the construction phase, however, generally with less magnitude as the level of site activity is lower.

11.7.28 Discussions will be held with SLC and the appropriate Regulatory Authorities prior to decommissioning to agree an appropriate Decommissioning Strategy.

11.8 Mitigation

Project Design

11.8.1 The assessment of baseline conditions at the site has identified that the surface watercourses at the site are the key sensitive receptors. 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 important that the design of the infrastructure helps to maintain or, if possible, improve the local hydrology. Poor design of wind farm infrastructure can result in adverse effects on the local hydrological environment with secondary effects on aspects such as ecology.

11.8.2 A 50 m buffer was implemented wherever feasible, for all watercourses considered to have continuous flow throughout the year in designing the project. These buffers are shown on Figures 11.2a and 11.2b. The section of track between proposed turbines T6 and T7 in the north-east part of the site slightly encroaches into the 50 m watercourse buffer applicable to the Windrow Burn. The route of the proposed track in this location has been designed to best work with the existing contours. This has resulted in the 50 m buffer being encroached for a length of approximately 360 m. At its nearest point, the proposed track is approximately 30 m from the Windrow Burn. Rigorous construction environmental management procedures will be implemented (see paragraph 11.8.9 below) to ensure appropriate protection of this and all other watercourses.

Pre-construction Site Investigations

11.8.3 In order to determine the ground and groundwater conditions across the site, pre-construction site investigations will be conducted. These investigations will focus on areas where construction is proposed to be undertaken and will allow the turbines and the associated infrastructure to be micro-sited away from unsuitable areas, such as areas of contamination or where there are significant groundwater flows.

11.8.4 The investigations will also include targeted monitoring and assessment of the groundwater levels and flows beneath the site. This will allow for micro-siting of the features of the Proposed Development and to assist in the detailed design of infrastructure and selection of appropriate materials for use during the construction process.

11.8.5 The material contained in the bing, proposed as a potential source of construction materials, will be subject to appropriate environmental and geotechnical testing as agreed with SLC and SEPA to confirm its suitability prior to excavation and use. Should elevated contaminant concentrations be identified, representing a risk to water environment receptors, the material will not be used.

Construction

Peat

11.8.6 The pre-construction site investigations noted above, and observations during construction, will inform micro-siting in areas where highly localised peat has been identified. If the identified small areas of deep peat can be entirely avoided through micro-siting, this will be the preferred option. Any peat identified in the borrow pit search areas will be avoided for actual borrow pit excavation.

11.8.7 Where it is not possible to avoid routing tracks over localised areas of peat, it is considered that the areas in question are so small (two identified locations each <50 m length of track) that floating tracks would be unwarranted. There may therefore be a requirement for localised excavation of peat at these locations, to be re-used on site as set out in the Outline Peat Management Plan (Appendix 11.1).

Water Quality

11.8.8 The appointed Contractor will undertake pre-construction baseline water quality sampling and analysis at the Smithy Burn, Windrow Burn and Podowrin Burn, and implement a programme of regular monitoring and analysis of the water quality of the watercourses throughout the construction period.

Pollution Impact from Silt-laden Runoff

11.8.9 With specific reference to the SEPA 'Guidelines for Water Pollution Prevention from Civil Engineering Contracts' and 'Special Requirements', the Contractor will produce a Construction Environmental Management Plan (CEMP) prior to the commencement of construction activities 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 (if required) away from watercourses;
- contingency planning and emergency procedures; and
- on-going monitoring of construction procedures to ensure management of risk is maintained.

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

11.8.11 All watercourse crossings and site discharges will be regulated under the CAR licensing regime and all necessary licences will be sought from SEPA prior to the commencement of any operations on site.

11.8.12 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 South Lanarkshire, 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 or suspend sensitive operations during adverse weather conditions.

11.8.13 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

11.8.14 All fuel and other chemicals will be stored in accordance with best practice procedures, including being kept within 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 CEMP. 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 bunded area.

11.8.15 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.

11.8.16 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.

11.8.17 Concrete batching will be undertaken at a designated area at the temporary construction compound in the south-east site area, more than 65 m from the nearest watercourse. The Contractor will develop a method statement to address the on-site batching of concrete and the transport, transfer, handling and pouring of liquid concrete at foundations. A limited amount of water abstraction will be required to facilitate the on-site batching process. A separate CAR licence application for any water abstractions required will be made to SEPA at the appropriate point prior to the commencement of construction.

11.8.18 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 water bodies.

11.8.19 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.

11.8.20 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 on Integrity of Banking

11.8.21 During the construction phase, construction staff will be instructed to maintain a sufficient distance from the burns located on site in order to ensure there is no incursion towards the burn.

11.8.22 Where the required bottomless arch culvert crossings are being constructed, foundations will be set back to prevent impact on the integrity of the banking of watercourses. Detailed design will be included within a Construction Method Statement to be agreed with SLC and SEPA and detailed watercourse crossing designs will be regulated under the CAR licensing regime.

Direct Discharge of Untreated Foul Drainage

11.8.23 Welfare facilities will either connect directly to self-contained storage tanks or to a septic tank, subject to approval from SEPA.

11.8.24 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.

Operation

Surface Water Drainage

11.8.25 The proposed track and hardstanding design principles for the Proposed Development are presented in Chapter 3.

11.8.26 Prior to construction, a detailed Drainage Strategy (DS) will be developed and agreed with SEPA and SLC. The DS will 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. The DS will also detail the dimensions and final design of proposed bottomless arch and pipe culverts for watercourse crossings which will be designed to maintain continuous flows.

Fluvial Geomorphology

11.8.27 The detailed design for the watercourse crossings, and the requirements for CAR authorisations or licences, will be agreed with SEPA prior to construction in order to ensure that any potential impacts are minimised.

11.9 Residual Effects

11.9.1 When the committed mitigation measures detailed in Section 11.8 are implemented with the appropriate management and monitoring, then no significant adverse residual effects (**minor** to **negligible** adverse effects) from the Proposed Development are predicted on hydrological, hydrogeological and geological resources.

11.10 Cumulative Assessment

11.10.1 This assessment has concluded that there will be no significant effects on geological resources associated with the Proposed Development. As such, no significant cumulative effects on geological resources associated with the Proposed Development, in combination with other similar local developments currently operational, consented or in planning, are predicted.

11.10.2 In terms of hydrology and hydrogeology, a number of operational and proposed wind energy projects in the vicinity lie partially within the catchments of the Poniel Water and/or Douglas Water.

11.10.3 A proportion of the drainage from these wind farms are likely to drain into the Poniel Water and Douglas Water, although flows are also likely to be distributed to other watercourses as well. All of these wind farms either have, or will be required to prepare their own drainage strategies to protect all receiving watercourses from pollution and increased runoff. Therefore, with no or negligible predicted residual effects on the Poniel Water and Douglas Water from the Proposed Development, it is considered that the combined effect on hydrology will be negligible and 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.

11.11 Summary

11.11.1 The Proposed Development site is located within the Clyde River catchment, with site drainage reaching the Clyde via the Douglas Water to the south of the site and the Poniel Water to the north. The Douglas Water and the on-site watercourses feeding the Douglas Water and Poniel Water are considered within the assessment to have good water quality.

11.11.2 The rock beneath the site is typically sedimentary, forming a low productivity aquifer (moderate productivity in the vicinity of the access road to the east of the main site area). Superficial deposits comprise till (typically low permeability) or are absent, with the exception of small, localised areas of peat.

11.11.3 A peat depth survey has identified minimal peat across the Proposed Development area, with most probes identifying no peat or <50 cm peat thickness. A peat slide risk assessment has identified negligible or low risks across the site.

11.11.4 Potential construction and operational effects include changes to the groundwater flow regime, the risk of pollution of watercourses resulting in adverse effects on water quality, effects on the integrity of watercourse banks, and localised impacts on peat.

11.11.5 The mitigation measures set out in this chapter will be drawn together into a Construction Environmental Management Plan prior to the commencement of construction activities. These mitigation measures are considered to be robust and implementable and will reduce the potential impacts on watercourses which have been identified as high and medium, to low. 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**.

Table 11.6 – Construction Summary Table

Description of Effect	Significance of Potential Effect		Mitigation Measure	Significance of Residual Effect		Comparison with the Existing Development
	Significance	Beneficial/ Adverse		Significance	Beneficial/ Adverse	
Changes to groundwater flow regime	Minor	Adverse	Pre-construction site investigation. CEMP and construction site management.	Negligible	Adverse	No change in significance as the groundwater regime is similar.
Removal of and impact on peat	Minor	Adverse	Pre-construction site investigation. Avoidance of peat for borrow pit excavations. Avoidance of deep peat where possible for access tracks (may be unavoidable over a small number of very short stretches).	Negligible	Adverse	No change in significance.
Impact on downstream fluvial flood risk	Major	Adverse	Detailed Drainage Strategy to be developed and agreed with SEPA and SLC. To detail drainage design to slow surface water flows and ensure that runoff from hard surfaces will be controlled. Appropriate design of water crossings to maintain continuous flows.	Negligible	Adverse	No change in significance.
Pollution from sediment run-off	Major	Adverse	50 m buffer around watercourses wherever feasible (minimum 30 m for a localised stretch of access track near the Windrow Burn). Water quality monitoring. CEMP and construction site management.	Minor	Adverse	Construction effects only therefore not relevant in terms of any current/ongoing effects from the Existing Development.
Pollution from chemical contaminated run-off	Major	Adverse		Minor	Adverse	
Mobilisation of historical contamination	Major	Adverse	Detailed ground investigations including testing of bing material for suitability prior to its use in construction.	Negligible	Adverse	
Loss of bank integrity	Major	Adverse	CEMP and construction site management.	Negligible	N/A	

Description of Effect	Significance of Potential Effect		Mitigation Measure	Significance of Residual Effect		Comparison with the Existing Development
	Significance	Beneficial/ Adverse		Significance	Beneficial/ Adverse	
Pollution from foul drainage	Major	Adverse	50 m buffer around watercourses wherever feasible (minimum 30 m for a localised stretch of access track near the Windrow Burn). Water quality monitoring. CEMP and construction site management.	Minor	Adverse	

Table 11.7 – Operation Summary Table

Description of Effect	Significance of Potential Effect		Mitigation Measure	Significance of Residual Effect		Comparison with the Existing Development
	Significance	Beneficial/ Adverse		Significance	Beneficial/ Adverse	
Surface water drainage including downstream flood risk	Major	Adverse	50 m buffer around watercourses wherever feasible (minimum 30 m for a localised stretch of access track near the Windrow Burn). Detailed Drainage Strategy to be developed and agreed with SEPA and SLC. To detail drainage design to slow surface water flows and ensure that runoff from hard surfaces will be controlled. Appropriate design of water crossings to maintain continuous flows.	Negligible	Adverse	No change in significance.
Alteration to fluvial geomorphology	Major	Adverse	Appropriately designed drainage and watercourse crossings.	Negligible	Adverse	No change in significance

11.12 References

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