11 Hydrology, Hydrogeology and Geology

Contents

This page is intentionally blank.

11 Hydrology, Hydrogeology & Geology

11.1 Executive Summary

11.1.1 This chapter considers the potential effects of 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 Hagshaw Burn and the Shiel Burn system, which themselves flow northward to the Poniel Water, ultimately draining into the River Clyde to the north-east of the site.

11.1.4 Two new water crossings will be required, where access tracks will need to traverse the Shiel Burn and a tributary. Additionally, there are four existing crossings of the Longhill Burn and Shiel Burn tributaries, two of which will be maintained and two which will be replaced.

11.1.5 Site geology comprises sedimentary bedrock sequences overlain by till. Some localised pockets of peat are recorded on published geological mapping. A peat depth survey has identified minimal peat across the Proposed Development area, with most probes identifying no peat. A peat slide risk assessment has identified negligible risks across the site.

11.1.6 Potential construction and operational effects arising from the Proposed Development (in the absence of mitigation) include changes to the groundwater flow regime, the risk of pollution of watercourses (including due to increased erosion following forestry felling) resulting in adverse effects on water quality, and effects on the integrity of watercourse banks.

11.1.7 Mitigation measures to avoid or reduce potential impacts, include developing and implementing a Construction Environmental Management Plan (CEMP), key-hole forestry felling and re-planting, felling works in accordance with good practice e.g. UK Forestry Standard, 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 run-off, 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.

11.2 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 Figure 11.2). 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 4.2 and 4.3.

Table 11.1 – Consultation Responses

Consultee - Date	Scoping/Other Consultation	Issue Raised	Response/Action Taken
SLC – 14 February 2019	Scoping	Peat depth assessment to be included.	A peat depth survey has been undertaken and is reported, together with a Peat Slide Hazard Risk Assessment and an outline Peat Management Plan, in Appendix 11.1.
SLC – 11 February 2019	Consultation	SLC was consulted for any information held on the presence of Private Water Supplies (PWS) in the vicinity of proposed turbines and the borrow pit search area. SLC confirmed that it holds no records of current or historical PWS in the area.	Efforts have been made to identify any potential PWS from OS mapping and site survey work. No PWS have been identified.
SEPA – 8 January 2019	Scoping	SEPA's Scoping response indicated that the following information should be provided in the EIA Report:	
		Map and assessment of engineering activities in or impacting on the water environment, flood risk assessment and info on CAR applications.	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.
		Map and assessment of impacts upon Groundwater Dependent Terrestrial Ecosystems (GWDTE) and buffers.	A map of potential GWDTE identified from an NVC survey is provided in Figure 7.3. Potential effects on GWDTE are discussed in paragraphs 11.6.21 to 11.6.27.
		Information on any water abstractions including proposed operating regime.	Arrangements for water abstractions are

Consultee - Date	Scoping/Other Consultation	Issue Raised	Response/Action Taken
			discussed in paragraph 11.8.16.
		Peat depth survey and table detailing re-use proposals.	A Peat Slide Hazard Risk Assessment and an outline Peat Management Plan are provided in Appendix 11.1.
		Information on borrow pits including management plan and pollution prevention measures.	Proposed borrow pits are discussed in Chapter 3 and paragraphs 11.6.39 to 11.6.41.
		Schedule of mitigation including pollution prevention measures.	Mitigation measures are set out in Section 11.8 and summarised in the schedule of mitigation in Chapter 18.
		Information on forest removal.	Proposed forest removal and forestry management is discussed in Chapter 16 and within this chapter as appropriate.
		Map of proposed waste water and surface water drainage layout.	Outline information on the proposed drainage strategy is provided in Chapter 3.
		Decommissioning statement.	Outline decommissioning proposals are provided in Chapter 3 and effects are assessed in this chapter as appropriate.
SEPA – 13 February 2019	Consultation	SEPA was consulted for any information held on the presence of PWS in the vicinity of proposed turbines and the borrow pit search area, however no information was available.	Efforts have been made to identify any potential PWS from OS mapping and site survey work. No PWS have been identified.
SNH – 31 January 2019	Scoping	SNH advises that detailed peat surveys of the site, measuring the peat deposit to full depth, should be undertaken in accordance with Scottish Government guidance. The results should also be used to inform a peat slide risk assessment.	A peat depth survey has been undertaken and is reported, together with a Peat Slide Hazard Risk Assessment and an outline Peat Management Plan, in Appendix 11.1.

Consultee - Date	Scoping/Other Consultation	Issue Raised	Response/Action Taken
The Coal Authority – 20 December 2018	Scoping	The Coal Authority reports that part of the site (the existing access road from the M74, and proposed access tracks north and east of the plantation forest) are within a Development High Risk area and a coal mining risk assessment should be provided.	A coal mining risk assessment is provided as Appendix 11.4.

11.5 Assessment Methodology and Significance Criteria

Consultation

11.5.1 As noted in Section 11.4, consultation has been undertaken with SEPA, SNH, the Coal Authority 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, SNH, the Coal Authority 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 25 January 2019. Field notes were taken on site, noting

ground constraints and details of ground conditions not apparent on available mapping. Peat depth probing was undertaken by a team of surveyors on 24 and 25 January, 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 17 January 2019.

11.5.7 A Phase 1 Habitat Survey and National Vegetation Classification (NVC) survey was undertaken by MacArthur Green on 20 to 23 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 and plus approximately 20 m from the turbine location to the north, south, east and west;
- Three probes at each proposed met mast location;
- Five probes at each proposed turbine hardstanding area (centre and four outside corners);
- Every 50 m along proposed access tracks, plus approximately 10 m either side of each probe, perpendicular to the route of the track, and additional probes as appropriate at proposed water crossing locations;
- Twenty probes at the location of the proposed substation, main temporary compound and temporary laydown area; and
- Probes on an approximately 50 m grid within the proposed borrow pit search area, where site observations indicated the potential presence of peat.

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.

Sensitivity	Description
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.

Magnitude of Change	Guidance Criteria
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 Carboniferous and Devonian sedimentary strata (sandstone, siltstone, mudstone) mainly of the Swanshaw Sandstone Formation, Kinnesswood Formation, Lawmuir Formation, and Glenbuck Group and Monks Water Group. The far northern site area is underlain by Lower Limestone Formation rocks. An igneous intrusion (microgabbro of the Mull Dyke Swarm) trends roughly north-east to south-west at the far western edge of the site.

11.6.2 Two faults trending roughly north-south are present in the far west and west-central site areas.

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

11.6.4 BGS mapping shows that bedrock across most of the site area, including the proposed southern access track, is overlain by till. In this area the till would typically be expected to comprise stiff to hard clay with variable inclusions of sand, gravel and boulders. Site observations support this, with exposures of till observed adjacent to the main access track in the southern site area (existing track, to be retained) and within the borrow pit search area (see Photographs 1 and 2).

Photograph 1: Exposed till adjacent to existing track in southern site area

Photograph 2: Exposed till adjacent to existing track in southern site area, showing forestry above

11.6.5 There are three localised areas of peat shown on BGS mapping at the west end of the site, only one of which coincides with any proposed infrastructure. This is an area of approximately 160 m by 230 m, between the two turbine pairings of T2 and T3 to the west, and T5 and T6 to the east. The proposed access track linking these turbines crosses this recorded area of peat. Peat depth surveys (see 11.6.12 to 11.6.19 below) identified very little peat at proposed infrastructure locations across the site, with no peat recorded along the proposed stretch of track where BGS mapping indicates peat to be present.

11.6.6 The other areas of peat shown on BGS mapping are further west, to the north and west of T2 and outside any proposed infrastructure footprint.

11.6.7 In respect of the soil resource across the site, it is noted that soils across the central and southern parts of the site are classified as organic soils, peaty pozols and peaty gleys. In particular, a swathe across the centre of the site is classified as peat (organic soils). Soils in the north and on the proposed southern access track are classified as non-calcareous gleys, brown forest soils, and some peaty gleys.

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

Mining

11.6.9 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 is within a mining risk area.

11.6.10 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

11.6.11 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 2.5 km away from any proposed new infrastructure.

11.6.12 However, given that BGS mapping shows some localised peat deposits at the site and soils mapping shows peat and peaty soils, a peat depth survey was undertaken as described in paragraph 11.58, broadly 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. It is noted that the peat depth survey undertaken employed a wider spacing than recommended in the above 2017 guidance, as a preliminary indicator of the presence and distribution of peat at the site. If deep or extensive peat had been identified then additional surveys based on a tighter spacing would have been undertaken to refine the findings and further information design iteration. However, as reported below and in Appendix 11.1, very little peat was recorded during the initial peat depth survey, and further survey work was considered to be unwarranted.

11.6.13 The locations and findings of the peat probes are illustrated on Figure 11.5.

11.6.14 *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.

11.6.15 The peat depth survey identified that the site is underlain by till, with localised peaty soils to shallow depth, and in some locations with rockhead near the surface. No deep peat was recorded.

11.6.16 Of 1,256 probes advanced during the peat depth survey, the peat depth was zero at 1,198 probes (95.4 %) and less than 0.5 m at all others (4.6 %), the latter defined as peaty or organo-mineral soil.

11.6.17 Only two probes recorded peat depths greater than 20 cm. These were probes taken at points 10 m west of the proposed access track south of T10, nearer to the watercourse than the proposed track itself. Probes along the proposed track route itself at these equivalent locations, and those 10 m to the east, recorded no peat.

11.6.18 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.

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

Hydrogeology

11.6.20 The groundwater body beneath most of the site area 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. The far north-west edge of the site is underlain by the Douglas Coalfield North groundwater body (ID 150545), with an overall status of poor, a quantitative status of good and a chemical status of poor.

11.6.21 Hydrogeology mapping data from the BGS shows the bedrock beneath most of the main site area to comprise a moderately productive aquifer in which flow is virtually all through fractures and other discontinuities. The far southern part of the site (where proposed T4 and T7 and the eastern part of the borrow pit search area are located) is shown to comprise a low productivity aquifer, in which flow is virtually all through fractures and other discontinuities.

11.6.22 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

11.6.23 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).

11.6.24 Within the site itself, habitats indicative of potential groundwater dependency were only identified along the banks of surface watercourses (namely the Hagshaw Burn and Shiel Burn), drains and valleys, forestry rides, and alongside existing tracks. Given the nature of the Proposed Development site as plantation woodland, and the pattern of wetland habitats identified, it is clear that the habitats are highly modified and likely to be mainly or entirely surface-water dependent, being located along surface watercourses and drainage routes.

11.6.25 Around the edges of the site, habitats indicative of potential groundwater dependency have also been identified from NVC survey work. These areas comprise low-lying land around the Poniel Water to the north of the site, and land sloping down from the hillsides, to the south of the site.

11.6.26 As noted above, superficial geology at the site largely comprises till. Highly localised areas of peat are shown on BGS mapping however only localised thin peaty soils were identified from site surveys, with no deep peat encountered. 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 moderately productivity aquifer with flow restricted to fissures and discontinuities, this would suggest there is little groundwater present near the surface across much of the site.

11.6.27 The areas in which habitats suggesting potential groundwater dependency have been identified are along watercourses and drainage features on the Proposed Development site, along the Poniel Water valley to the north of the site, and on the slopes of the hills to the south of the site. Given the nature of the on-site land use and associated modified habitats, as well as the site geology and anticipated absence of substantial groundwater, it is considered that surface water flow along water features and shedding from the hillsides is likely to be sustaining the habitats identified.

11.6.28 Based on the above considerations, it is concluded that on-site and adjacent habitats identified as being potentially groundwater dependent, are in fact fed largely or entirely by surface water.

11.6.29 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

11.6.30 SLC and SEPA were consulted regarding the presence of PWS in the vicinity of the proposed turbines and associated infrastructure. SLC confirmed that it holds no records of current or historical PWS in the vicinity, and SEPA was not able to provide any additional information.

11.6.31 No wells, springs or other features suggesting the potential presence of a PWS have been identified from a review of OS mapping, within the site boundary or within 500 m of any proposed turbines or the borrow pit search area. No evidence of potential PWS has been observed during site survey work. An assessment of effects on private water supplies is therefore not considered further within this chapter.

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

Watercourses

11.6.33 As shown on Figure 11.2, there are three main watercourses within the study area (1 km buffer around proposed new infrastructure):

- The Poniel Water flows roughly west to east to the north of the site, separating the on-site forestry from the former Dalquhandy Surface Mine to the north. On the north side of the Poniel Water are several ponds/lagoons formed from the historical mine workings.
- The Hagshaw Burn flows from south to north at the western edge of the site, draining into the Poniel Water to the north-west of the site.
- The Shiel Burn system comprises several tributaries rising in the southern part of the site and flowing northward, draining into a single watercourse (the Shiel Burn) which flows northward from the east-central site area to join the Poniel Water to the north of the site.

11.6.34 All site drainage is anticipated to flow to the Poniel Water, via the Hagshaw Burn or Shiel Burn system, or in the case of the far eastern site area, via the Longhill Burn (which drains to the Poniel Water to the north-east of the site). The Poniel Water flows into the River Clyde to the north-east of the site.

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

11.6.36 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.

11.6.37 Some of the proposed access tracks to turbines will require new watercourse crossings to be constructed, namely: an unnamed tributary of the Shiel Burn to the east of T4 in the southern site area; and the Shiel Burn itself between T9 and T10 in the north-central site area. The location of these proposed water crossings are shown on Figure 11.2, labelled WC03 and WC05. Indicative water crossing designs are included in Appendix 11.2.

11.6.38 Additionally, there are four existing water crossings (pipe culverts) beneath existing tracks. These have been inspected to determine their suitability for continued use given that the tracks will be retained for use within the Proposed Development. Two of these existing water crossings (WC01 and WC02) have been assessed as suitable to maintain in their current condition, with the existing HDPE pipe crossing being appropriate for maintaining greenfield run-off conditions. WC04 is an existing HDPE pipe crossing of the Shiel Burn, which is damaged and therefore will be replaced with a similar pipe together with slope repairs, to maintain greenfield run-off. WC06 is an existing HDPE pipe crossing of a ditch/tributary to the Shiel Burn, which is proposed to be replaced with a new pipe and concrete protection. The locations of these existing water crossings are shown on Figure 11.2 and further information each water crossing is provided and illustrated in Appendix 11.2. All final water crossing designs will be subject to authorisation under the CAR Licensing regime.

11.6.39 For the purposes of this assessment and taking account of the moderate status of the local watercourses, the sensitivity of baseline hydrological resources at this site is considered to be medium.

Borrow Pit Search Area

11.6.40 As shown on Figure 11.2, there is a borrow pit search area in the southern part of the site, on the sloping land rising from the existing track at this location. It is proposed that the actual borrow pit(s) would be located within this search area, however, would only require using a relatively small portion of the search area.

11.6.41 The borrow pit search area is immediately adjacent to the main access track (existing track proposed to be upgraded as required for continued use during construction and operation of the Proposed Development), thereby minimising haul distances.

11.6.42 The bedrock geology at the borrow pit search areas is Greywacke Conglomerate Formation in the west, and Glenbuck Group and Monks Water Group rocks (sandstone and conglomerate) in the east, all 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 area to be confirmed prior to commencement.

11.6.43 Following excavation, the borrow pit area(s) will be restored using site-won soils in accordance with relevant good practice guidance.

Flooding

11.6.44 The online SEPA flood risk map indicates no identified flood risk at the site. 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 (down-gradient) 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; site drainage and water crossings will be designed to mimic greenfield conditions.

11.6.45 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

11.6.46 Historically, the main body of the site has largely been undeveloped agricultural and forestry land. There is considered to be limited potential for any ground contamination arising from these land uses.

11.6.47 An old rail line is at the southern end of the existing 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, adjacent to the southern section of the existing southern access. These land uses represent potential localised contamination sources but will not be disturbed or altered by the Proposed Development. Therefore, contaminated land will not be considered further within this assessment.

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.

Pollution Impact from Sediment Run-off / Transport

11.7.3 Surface run-off 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 run-off is predicted to arise from excavations, exposed ground and any temporary stockpiles.

11.7.4 Silt and sediment laden run-off has the potential to impact on the water quality and hydrological and ecological function of receiving watercourses at and downstream of the works in the absence of any mitigation.

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

Pollution Impact from Forestry Felling

11.7.6 The on-site forestry will be felled as part of the normal plantation life-cycle and approved forest plan and/or a revised plan to allow areas of early harvesting where required to construct site infrastructure. Removal of mature trees may lead to direct impacts on the water environment through forestry material and brash entering local watercourse, and loss of structure of the underlying soils, with increased risk of erosion.

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

Changes to Groundwater Flow

11.7.8 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.

11.7.9 Excavations will be required to form turbine foundations and borrow pit workings, and shallower excavations will be required to form platforms for the substation and energy storage compound, the temporary construction compound, 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.

11.7.10 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

11.7.11 No deep peat was identified within the Proposed Development footprint, with the majority of the development area being directly underlain by till or bedrock, with no peat.

11.7.12 A limited thickness of peat (<20 cm) over till was identified at some proposed turbine locations, and slightly deeper peat (<50 cm) was identified at a highly localised area within 50 m of a proposed stretch of access track. Minor quantities of peat may therefore need to be excavated to allow construction of turbine foundations and a short stretch of track.

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

Impact on Downstream Fluvial Flood Risk

11.7.14 Construction of the Proposed Development has the potential to generate increased run-off through introduction of hardstanding areas, and to increase flood risk through creation of new water crossings. The Poniel Water, downstream of the site, is susceptible to fluvial flooding in localised zones along its 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 Chemical Contaminated Run-off

11.7.15 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.

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

Impact on the Integrity of Banking

11.7.17 Construction activities on or close to the sides of watercourses can detrimentally affect the structural integrity of 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.

11.7.18 Permanent new watercourse crossings will be required at two locations. These include proposed installation of a pipe culvert at WC03 and an arch culvert at WC05. Additionally, the existing crossings at WC01 and WC02 will be maintained, and the existing pipe crossings at WC04 and WC06 will be replaced. Further details are provided in Appendix 11.2.

11.7.19 There is potential for a high magnitude impact on medium 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

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

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

Operation

Surface Water Drainage

11.7.22 The access track and crane hardstandings for the wind turbines, and any un-restored areas of felling and borrow pit excavations, 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 run-off, which could pollute watercourses, ditches and ponds.

11.7.23 The magnitude of change, prior to mitigation, is high, on a medium 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

11.7.24 If watercourse crossings are not designed properly to ensure continuous flows, this could potentially adversely affect the geomorphology of the streams by reducing heterogeneity.

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

Decommissioning

11.7.26 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.

11.7.27 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 Wherever possible, a 50 m buffer was implemented for all watercourses considered to have continuous flow throughout the year in designing the project. These buffers are shown on Figure 11.2. There are three locations where Proposed Development infrastructure encroaches into the 50 m buffer:

- The edge of the crane pad and a short stretch of track alongside the crane pad associated with T4 are within approximately 25 m of the southern-most part of the Shiel Burn. The small watercourse at this location is within a valley and is physically separated from the proposed crane pad and track.
- The access track between T9 and the area west of T11 is within approximately 25 m (at its closest point) of the eastern-most branch of the Shiel Burn system. This is an existing track which may require upgrading but will not undergo major construction works such as excavation of a new track corridor. The watercourse at this location is within a valley, with the existing track above.
- The eastern edges of the proposed substation and temporary laydown area are within approximately 30 m of a small drain/tributary of the Longhill Burn. This small drain may not have continuous flow, and a buffer of 30 m is considered to be sufficient.

11.8.3 Rigorous construction environmental management procedures will be implemented (see paragraph 11.8.11 below) to ensure appropriate protection of the above-noted watercourses, and all other surface water receptors.

11.8.4 Additionally, the southern-most stretch of the Shiel Burn flows across the borrow pit search area. This small watercourse and a buffer of 50 m will be observed in selecting the actual borrow pit location(s) from within the search area.

11.8.5 The access track design makes use of existing access tracks wherever possible, in order to minimise the requirement for new track construction, and new water crossings.

11.8.6 Replanting of felled forestry will be key-holed i.e. areas left unplanted will be minimised to include only those areas required for turbine and infrastructure construction and suitable buffer areas.

Pre-construction Site Investigations

11.8.7 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 (unlikely) or where there are significant groundwater flows.

11.8.8 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.

Construction

Peat

11.8.9 The pre-construction site investigations noted above, and observations during construction, will inform micro-siting, if required and appropriate, in areas where localised peat has been identified

(though noting no deep peat has been recorded). Any peat identified in the borrow pit search areas will be avoided for actual borrow pit excavation.

11.8.10 There is likely to be a requirement for localised excavation of shallow peat at some turbine locations and potentially one short stretch of track. Any peat excavated will be re-used on site as set out in the Outline Peat Management Plan (Appendix 11.1).

Water Quality

11.8.11 The appointed Contractor will undertake pre-construction baseline water quality sampling and analysis at the Hagshaw Burn and Shiel 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 Run-off

11.8.12 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 felling, 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.

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

11.8.14 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.

11.8.15 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.

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

Pollution Impact from Forestry Felling

11.8.17 Felling works will be undertaken in accordance with good practice set out in the Forestry Commission's UK Forestry Standard (Forestry Commission, 2017). This includes appropriate buffering of watercourses and management of riparian zone vegetation, implementation of a suitable drainage plan, keeping watercourses and buffer areas clear of brash as far as practicable, removing any accidental blockages, and employing methods to minimise soil damage and

subsequent erosion. Stumps will be left in situ outwith the development footrpint. Further information on forestry management is provided in Chapter 16.

Pollution Impact from Chemical Contaminated Run-off

11.8.18 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.

11.8.19 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.

11.8.20 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.

11.8.21 Concrete batching will be undertaken at a designated area at the temporary construction compound at the main site entrance, over 100 m from the nearest watercourse (a small drain). 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.

11.8.22 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.

11.8.23 Any 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.

11.8.24 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

11.8.25 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.

11.8.26 Where the proposed bottomless arch culvert crossing is being constructed (WC05), 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

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

11.8.28 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

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

11.8.30 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 new access tracks, 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 run-off from hard surfaces will be controlled. The DS will also detail the dimensions and final design of proposed watercourse crossings which will be designed to maintain continuous flows.

Fluvial Geomorphology

11.8.31 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 catchment of the Poniel Water. A proportion of the drainage from these wind farms are likely to drain into the Poniel 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 run-off. Therefore, with no or negligible predicted residual effects on the Poniel 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 Poniel Water, which itself receives drainage from the on-site watercourses, the Hagshaw Burn and Shiel Burn system. The Poniel Water and the on-site watercourses are considered within the assessment to have moderate water quality.

11.11.2 The rock beneath the site is typically sedimentary, forming a moderate productivity aquifer (low productivity in the far southern area). Superficial deposits comprise till (typically low permeability) or are absent.

11.11.3 Small, localised areas of peat are identified on published geological mapping. However, a peat depth survey has identified minimal peat across the Proposed Development area, with most probes identifying no peat. A limited thickness of peat (<20 cm) was recorded at some proposed turbine

locations, and a slightly greater thickness (<50 cm) was identified within 50 m of a short stretch of proposed track. A peat slide risk assessment has identified negligible 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, and effects on the integrity of watercourse banks.

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	
	Significance	Beneficial/ Adverse		Significance	Beneficial/ Adverse
Pollution from sediment run-off	Moderate	Adverse	50 m buffer around watercourses wherever possible (minimum 25 to 30 m from small drains/watercourses in three localised instances, one being existing track). Water quality monitoring. CEMP and construction site management.	Minor	Adverse
Pollution from forestry felling	Major	Adverse	Key-hole felling and re-planting. Felling works in accordance with good practice e.g. UK Forestry Standard. Buffering of watercourses, management of riparian zone vegetation, drainage plan, brash control in watercourses and buffer areas, removing any accidental blockages, minimising soil damage, leaving stumps.	Minor	Adverse
Changes to groundwater flow regime	Minor	Adverse	Pre-construction site investigation. CEMP and construction site management.	Negligible	Adverse
Removal of and impact on peat	Negligible	Adverse	Pre-construction site investigation. Avoidance of peat for borrow pit excavations. Micro-siting infrastructure where required and appropriate, if unexpected deeper peat is identified.	Negligible	Adverse
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 run-off from hard surfaces will be controlled. Appropriate design of water crossings to maintain continuous flows.	Negligible	Adverse
Pollution from chemical contaminated run-off	Moderate	Adverse	50 m buffer around watercourses wherever possible (minimum 25 to 30 m from small drains/watercourses in three instances, one being existing track). Water quality monitoring. CEMP and construction site management.	Minor	Adverse

Description of Effect	Significance of Potential Effect		Mitigation Measure	Significance of Residual Effect	
	Significance	Beneficial/ Adverse		Significance	Beneficial/ Adverse
Loss of bank integrity	Major	Adverse	CEMP and construction site management.	Negligible	N/A
Pollution from foul drainage	Moderate	Adverse	50 m buffer around watercourses wherever possible (minimum 25 to 30 m from small drains/watercourses in three localised instances, one being existing track). 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	
	Significance	Beneficial/ Adverse		Significance	Beneficial/ Adverse
Surface water drainage including downstream flood risk	Major	Adverse	50 m buffer around watercourses wherever possible (minimum 25 to 30 m from small drains/watercourses in three localised instances, one being existing track). Detailed Drainage Strategy to be developed and agreed with SEPA and SLC. To detail drainage design to slow surface water flows and ensure that run-off from hard surfaces will be controlled. Appropriate design of water crossings to maintain continuous flows.	Negligible	Adverse
Alteration to fluvial geomorphology	Moderate	Adverse	Appropriately designed drainage and watercourse crossings.	Negligible	Adverse

11.12 References

The Forestry Commission (2017). *UK Forestry Standard.* Available at: https://www.forestry.gov.uk/pdf/FCFC001.pdf/$FILE/FCFC001.pdf

Scottish Renewables and SEPA (2014). *Developments on Peatland: Guidance on the assessment of peat volumes, reuse of excavated peat and the minimisation of waste.* Available at: https://www.gov.scot/Topics/Business-Industry/Energy/Energy-sources/19185/17852-1/CSavings/guidancepeatwaste

SEPA (2018). *Supporting Guidance (WAT-SG-75) – Sector Specific Guidance: Construction Sites.* Available at: https://www.sepa.org.uk/media/340359/wat-sg-75.pdf

SEPA (2017). *Land Use Planning System SEPA Guidance Note 4: Planning advice on windfarm developments* (LUPS-GU4). Available at: https://www.sepa.org.uk/media/136117/planning-guidance-on-on-shore-windfarms-developments.pdf

SEPA (2014). *Online Water Environment Hub*. Available at: https://www.sepa.org.uk/data-visualisation/water-environment-hub/

SNH & SEPA, (2015). *Good practice during wind farm construction, 3rd edition.* Available at: https://www.nature.scot/sites/default/files/2017-07/A1168678%20-%20Good%20Practice%20during%20Wind%20Farm%20construction%20-%20Sept%202015.pdf

SNH, SEPA & The James Hutton Institute (2014). *Guidance on Developments on Peatland - Site Surveys.* Available at: https://www.gov.scot/Topics/Business-Industry/Energy/Energy-sources/19185/17852-1/CSavings/PSG2011

NERC (2012) *Geology of Britain*. Available at:

http://mapapps.bgs.ac.uk/geologyofbritain/home.html

This page is intentionally blank.