Hydrology, Hydrogeology, Geology and Peat

Non-Technical Summary

13.1. The Proposed Development lies within the overall catchment of Loch Glascarnoch and the River Glascarnoch and is drained by a series of tributaries of Allt Giubhais Mor and Allt Giubhais Beag. The southernmost part of the Proposed Development boundary lies within the catchment of Loch Luichart, however no infrastructure is located within this catchment.

13.2. Two private water supplies were identified within 1 km of the Development boundary however, neither are within 1 km of proposed infrastructure and the effect of the Development on PWS has been assessed as negligible.

13.3. British Geological Survey mapping information on superficial soils indicates the majority of the site to be underlain by peat, with pockets of either glacial till or no superficial cover in the north, west and south respectively. Solid geology mapping indicates the majority of the Proposed Development to be Neoproterozoic aged Crom Psammite belonging to the Morar Group.

13.4. Peat probing was carried out within the Proposed Development site over several phases and recorded that peat depths to the east of the existing windfarm track were generally thicker in comparison to that of the western area, typically in line with topography. A maximum depth of 3.75 m recorded to the east although more generally the peat depths were between 1.0 m and 2.5 m. Peat depths in the western site area were generally less than 1.0 m, and more frequently, in the region of 0.5 m or less.

13.5. The assessment considered the effects of the Development on surface water runoff rates, potential for release of suspended solids to streams, potential for contamination of surface and groundwater from oil and chemical spills, effects on ground water dependent terrestrial ecosystems (GWDTEs) and impacts on soils and peat.

13.6. Two new watercourse crossings are proposed, for the access track to turbines eight, nine and ten. Watercourse crossings will be designed in detail at the construction phase and agreed with SEPA.

13.7. Peat probing at the turbine locations and proposed infrastructure confirmed the presence of deep peat in the eastern site area. This area was relatively flat lying, and with exception to localised hagging noted within the flatter topography in both the western and eastern site area. With limited deep peat across the remainder of the site and the deeper deposits existing in flatter topographic areas, no significant risk of peat instability was identified.

13.8. During construction, operation and decommissioning of the Development, a number of established good practice measures will be put in place to minimise peat disturbance, control surface and groundwater pollution and manage surface water run-off/drainage. These are designed to ensure the protection of the surface water, geology and hydrogeological regimes. These mitigation

measures will be included in the Construction Environmental Management Plan (CEMP) and a monitoring program will be supervised by an Ecological Clerk of Works (or equivalent).

13.9. With effective and well managed mitigation measures in place no significant residual effects of the Development on hydrology, water quality, water resources, hydrogeology and geology are predicted.

Introduction

13.10. This Chapter of the Environmental Impact Assessment Report (EIA Report) evaluates the effects of the proposed Lochluichart Wind Farm Extension II (the Proposed Development) on the hydrology, hydrogeology, geology and peat resources. This assessment was undertaken by Arcus Consultancy Services Limited (Arcus).

13.11. This Chapter is supported by the following Technical Appendix documents provided in Volume 4 of this EIA Report:

- Appendix 13.A: Construction Environmental Management Plan (CEMP);
- Appendix 13.B: Peat Slide Risk Assessment (PSRA);
- Appendix 13.C: Outline Peat Management Plan (oPMP);
- Appendix 13.D: Preliminary Borrow Pit Assessment; and
- Appendix 13.E: Flooding / Erosion Key Issues Report (Fairhurst 2017).

13.12. This Chapter is supported by the following figures:

- Figure 13.1: Hydrology Study Area;
- Figure 13.2: Hydrological Catchments;
- Figure 13.3: Superficial Soils Map;
- Figure 13.4: Bedrock Geology Map;
- Figure 13.5: Carbon and Peatland Map (SNH, 2016); and
- Figure 13.6: Peat Depth Interpolation.

13.13. This Chapter includes the following elements;

- Legislation, Policy and Guidance;
- Assessment Methodology and Significance Criteria;
- Baseline Conditions;
- Assessment of Potential Effects;
- Mitigation and Residual Effects;
- Cumulative Effect Assessment;
- Summary of Effects; and
- Statement of Significance.

Legislation, Policy and Guidance

13.14. The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations (2017)[i] (the EIA Regulations) establish in broad terms what is to be considered when determining the effects of development proposals on hydrology and hydrogeology. The following legislation, guidance and information sources have been considered in carrying out this assessment.

Legislative Background

13.15. The Water Framework Directive (WFD) (2000/60/EC)[ii] establishes a framework for the protection, improvement and sustainable use of all water environments. It is transposed within Scotland by the Water Environment and Water Services (Scotland) Act 2003[iii] and subsidiary Regulations.

13.16. Other relevant legislation includes:

- The Salmon and Freshwater Fisheries (Consolidation) (Scotland) Act 2003[iv];
- The Private Water Supplies (Scotland) Regulations 2006[v];
- The Water Intended for Human Consumption (Private Supplies) (Scotland) Regulations 2017[vi]; and
- The Public and Private Water Supplies (Miscellaneous Amendments) (Scotland) Regulations 2015.

Scottish Planning Policy and Guidance

Scottish Planning Policy 2014 (SPP)

13.17. The Scottish Planning Policy (SPP)[vii] was published in 2014, and replaces the previous SPP (published in 2010). SPP is a non-statutory document which sets out the Scottish Government's policy on how nationally important land use planning matters should be addressed.

13.18. In paragraphs 255 to 268, the SPP sets out guidance for development within areas of flood risk, including the responsibilities of planning authorities in regulating and controlling development in such areas, in order to prevent increased risk of flooding in the future. SPP emphasises the need to apply sustainability principles to the prevention of flooding and the control of future development.

13.19. In relation to peat and organic soils, paragraph 205 from SPP states that where peat and other carbon rich soils are present, applicants should assess the likely effects of development on carbon dioxide (CO_2) emissions. Where peatland is drained or otherwise disturbed, there is liable to be a release of CO_2 to the atmosphere. Developments should aim to minimise this release.

Pollution Prevention Guidelines (PPGs) and Guidance for Pollution Prevention (GPPs)

13.20. Produced by the Scottish Environment Protection Agency (SEPA), PPGs and GPPs[viii] give advice on statutory responsibilities and good environmental practice. Each PPG and GPP addresses a specific industrial sector or activity, SEPA are in the process of replacing the PPGs with GPPs however, this process is ongoing. The following are of relevance principally to surface water, however as surface water has the potential to affect groundwater, they are also of relevance to the assessment of groundwater:

- PPG1: General guide to the prevention of water pollution (July 2013);
- GPP2: Above ground oil storage tanks (January 2017);
- GPP4: Treatment and disposal of wastewater where there is no connection to the public foul sewer (October 2017);
- GPP5: Works and maintenance in or near water (January 2017);
- PPG6: Working at construction and demolition sites (2012);
- GPP8: Safe storage and disposal of used oils (July 2017);
- PPG18: Managing fire water and major spillages (June 2000);
- GPP21: Pollution incident response planning (July 2017); and
- GPP22: Dealing with spills (October 2018).

Other Guidance

13.21. Other relevant guidance comprises the following:

- The Scottish Government (2001), PAN 61: Planning and Sustainable Urban Drainage Systems[ix];
- Scottish Water (2015), Sewers for Scotland, 3rd Edition[x];
- Conservation (Natural Habitats, & c.) Regulations 1994 (as amended 2012);
- SEPA (2010), Engineering in the water environment: good practice guide: River crossings[xi];
- SEPA (2013), Aquifer and Vulnerability Maps[xii];
- SEPA and Scotland and Northern Ireland Forum for Environmental Research (SNIFFER) (2004) Groundwater Vulnerability Maps;
- SEPA (2006) Culverting of Watercourses: Policy Statement and Supporting Guidance[xiii];
- SEPA (2014), Land Use Planning System Guidance Note 31, Version 2, (LUPS-GN31)[xiv];
- SEPA (2002), Managing River Habitats for Fisheries[xv];
- The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (the CAR Regulations)[xvi];
- SEPA (2015), CAR - A Practical Guide, Version 7.2[xvii];
- The Water Environment (Drinking Water Protected Areas) (Scotland) Order 2013[xviii];
- SEPA (2009), River Basin Management Plan[xix];

- Scottish Natural Heritage (SNH) (2015), Good Practice During Wind Farm Construction[xx];
- The Scottish Government (2017), Peat Landslide Hazard and Risk Assessments - Best Practice Guide for Proposed Electricity Generation Developments[xxi];
- The Scottish Government (2009), The Scottish Soil Framework[xxii];
- The Construction Industry Research and Information Association (CIRIA) (2015), Environmental Good Practice on Site (C741)[xxiii];
- CIRIA (2001), Control of Water Pollution from Construction Sites (C532)[xxiv]; and
- CIRIA (2015), The SuDS Manual. (C753).

Assessment Methodology and Significance Criteria

13.22. This assessment has involved the following elements, further details of which are provided in the sections:

- Consultation with relevant statutory and non-statutory bodies;
- Desk study, including review of available maps and published information;
- Site walkover;
- Phase 1 and 2 Peat Probing;
- Peat Slide Risk Assessment;
- Input to design process to minimise effects;
- Identification and evaluation of potential effects;
- Evaluation of the significance of these effects;
- Identification of measures to avoid and mitigate potential effects;
- Assessment of residual effects;
- Evaluation of potential cumulative effects;
- Proposed monitoring; and
- Statement of significance.

Scoping Responses and Consultations

13.23. Information has been provided by a range of organisations during the assessment, and this is summarised in Table 13.1. The response to each point raised by consultees is also presented within the table, demonstrating where the design of the Proposed Development has changed in response to specific issues indicated by SEPA, SNH and The Highland Council (THC).

Table 13.1 Consultation Responses

Consultee	Type and Date	Summary of Consultation Response	Response to Consultee
SEPA	Scoping Response 11th May 2017	SEPA made the following comments of relevance to Hydrology and Hydrogeology, Geology and Peat:	N/A

Consultee	Type and Date	Summary of Consultation Response	Response to Consultee
		2.1 The Proposed Development layout must be designed to avoid impacts on the water environment. Where activities such as watercourse crossings, watercourse diversions or other engineering activities in the water environment cannot be avoided then the submission must include a map showing the following: a) All proposed temporary or permanent infrastructure overlain with all lochs and watercourses. b) A minimum buffer of 50 m around each loch or watercourse. If this minimum buffer cannot be achieved each breach must be numbered on a plan with an associated photograph of the location, dimensions of the loch or watercourse, drawings of what is proposed in terms of engineering works. c) Detailed layout of all proposed mitigation including all cut off drains, location, number and size of settlement ponds.	2.1 – The Proposed Development has been designed to avoid impacts on the water environment. A map of the Proposed Development infrastructure is provided as Figure 13.1 of this Chapter. A 50 m buffer of watercourses has been incorporated into the design of the Proposed Development. Measures within the CEMP, provided as Technical Appendix 13.A, will safeguard watercourses and subsurface water. The principles of CEMP are set out in within the Technical Appendix 13.A.
		2.2 If water abstractions or dewatering are proposed, a table of volumes and timings of groundwater abstractions and related mitigation measures must be provided.	No groundwater abstraction is planned as part of the Proposed Development. There may be a requirement to abstract surface water for use for concrete mixing. Abstraction will be undertaken in line with the Controlled Activities Regulations (CAR) and it is possible an authorisation may be required. The level of authorisation will depend on the quantities of water required. Proposed abstractions, timings and volumes will be provided as part of application for SEPA authorisation. Measures within the CEMP will address how dewatering will be undertaken.

Consultee	Type and Date	Summary of Consultation Response	Response to Consultee
		2.4 Refer to Appendix 2 of our Standing Advice for advice on flood risk. Watercourse crossings must be designed to accommodate the 0.5% Annual Exceedance Probability (AEP) flows, or information provided to justify smaller structures. If it is thought that the Proposed Development could result in an increased risk of flooding to a nearby receptor then a Flood Risk Assessment must be submitted in support of the planning application. Our Technical flood risk guidance for stakeholders outlines the information we require to be submitted as part of a Flood Risk Assessment.	Measures within the CEMP, provided as Technical Appendix 13.A, will ensure flows are managed and released at greenfield rates and mitigate flood risk. Findings from a report into flood damage at the Lochluichart estate during 2017, provided as Technical Appendix 13.E, have been considered in the assessment of increase in runoff and flood risk.
		3.1 Scottish Planning Policy states (Paragraph 205) that "Where peat and other carbon rich soils are present, applicants must assess the likely effects of development on carbon dioxide (CO_2) emissions. Where peatland is drained or otherwise disturbed, there is liable to be a release of CO_2 to the atmosphere. Developments must aim to minimise this release."	Carbon Balance assessment has been completed as part of the EIA submission. Further details on this are included in Chapter 5 Climate Change.
		3.2 The planning submission must: a) demonstrate how the layout has been designed to minimise disturbance of peat and consequential release of CO_2 and b) outline the preventative/mitigation measures to avoid significant drying or oxidation of peat through, for example, the construction of access tracks, drainage channels, cable trenches, or the storage and re-use of excavated peat.	Peat constraints were provided for the site layout design evolution and has been avoided where possible. An outline peat management plan is provided as a Technical Appendix 13.C detailing peat management best practice measures.
		3.3 The submission must include: a) A detailed map of peat depths (this must be to full depth and follow the survey requirement of the Scottish	Phase 1 Peat probing has been undertaken on the basis of Development on Peatland: Site Surveys and Best Practice. A peat

Consultee	Type and Date	Summary of Consultation Response	Response to Consultee
		Government's Developments on peatland: Site surveys and best practice) with all the built elements (including peat storage areas) overlain to demonstrate how the development avoids areas of deep peat and other sensitive receptors such as Groundwater Dependent Terrestrial Ecosystems (GWDTEs). b) A table which details the quantities of acrotelmic, catotelmic and amorphous peat which will be excavated for each element and where it will be re-used during reinstatement. Details of the proposed widths and depths of peat to be re-used and how it will be kept wet permanently must be included.	interpolation map is illustrated in Figure 13.3. Further Phase 2 stage probing was undertaken following the design layout is fixed. An outline peat management plan is provided in accordance with Guidance on the Assessment of Peat Volumes, Reuse of Excavated Peat and Minimisation of Waste and the Regulatory Position Statement – Developments on Peat, including tabulated quantities and best practice measures for peat management. This is presented in Appendix 13.C.
		4.1 GWDTE are protected under the Water Framework Directive and therefore the layout and design of the development must avoid impact on such areas. The following information must be included in the submission: a) A map demonstrating that all GWDTE are outwith a 100 m radius of all excavations shallower than 1 m and outwith 250 m of all excavations deeper than 1 m and proposed groundwater abstractions. If micro-siting is to be considered as a mitigation measure the distance of survey needs to be extended by the proposed maximum extent of micro-siting. The survey needs to extend beyond the Proposed Development boundary where the distances require it. b) If the minimum buffers above cannot be achieved, a detailed site specific qualitative and/or quantitative risk assessment will be required. We are likely to seek conditions securing appropriate mitigation for all GWDTE affected.	A Phase 1 NVC survey has been undertaken and is detailed within Chapter 11 Ecology. An assessment of the potential hydrological and hydrogeological effects arising from the Proposed Development on habitats and ecological communities (such as GWDTEs) is provided in paragraphs 13.98 of this Chapter. No groundwater abstractions are proposed as part of the Proposed Development.

Consultee	Type and Date	Summary of Consultation Response	Response to Consultee
		5.1 Excavations and other construction works can disrupt groundwater flow and impact on existing groundwater abstractions. The submission must include: a) A map demonstrating that all existing groundwater abstractions are outwith a 100 m radius of all excavations shallower than 1m and outwith 250 m of all excavations deeper than 1 m and proposed groundwater abstractions. If micro-siting is to be considered as a mitigation measure the distance of survey needs to be extended by the proposed maximum extent of micro-siting. The survey needs to extend beyond the Proposed Development boundary where the distances require it. b) If the minimum buffers above cannot be achieved, a detailed site specific qualitative and/or quantitative risk assessment will be required. We are likely to seek conditions securing appropriate mitigation for all existing groundwater abstractions affected.	Details of groundwater abstractions and the distances to the Proposed Development are presented in paragraphs 1.88 to 1.90 and Table 13.7. No groundwater abstractions exist within 250 m of Proposed Development infrastructure and no groundwater abstractions are proposed as part of the Proposed Development.
		8.2 A schedule of mitigation supported by the above site-specific maps and plans must be submitted. These must include reference to best practice pollution prevention and construction techniques, regulatory requirements, the daily responsibilities of Ecological Clerk of Works (ECoWs), how site inspections will be recorded and acted upon and proposals for a planning monitoring enforcement officer. Please refer to the Pollution prevention guidelines.	Potential effects of the hydrological and hydrogeological environment from all aspects of the Proposed Development are assessed within this Chapter. Measures within the CEMP, provided as Technical Appendix 13.A, will safeguard watercourses and subsurface water and are based on good practice and industry guidance.
SNH	Scoping Response 11th May 2017	4 Carbon rich soils, deep peat and priority peatland habitat has been identified in Scottish Planning Policy as a nationally important mapped resource we therefore support the proposal in	Phase 1 Peat probing has been undertaken on the basis of Development on Peatland: Site Surveys and Best Practice. A peat interpolation map is

Consultee	Type and Date	Summary of Consultation Response	Response to Consultee
		the scoping report to assess the impacts on peat.	illustrated in Figure 13.3. Further Phase 2 stage probing be undertaken following the design layout being fixed.
THC	Scoping Response 5th June 2017	THC made the following comments of relevance to Hydrology and Hydrogeology:	N/A
		Hydrology and ground conditions As part of the water environment assessment the developer requires to ensure that Private Water Supplies (PWS) are taken into account as part of the baseline survey and that suitable mitigation measures are identified, where necessary, to protect them.	THC Environmental Health Department were consulted to identify Private Water Supplies
THC Environmental Health Department	Response to PWS information request	2 PWS's were identified.	Private Water Supplies were visited during site surveys and are detailed in Table 13.7.

Study Area

13.24. The hydrology and hydrogeology Study Area is defined by the Proposed Development application boundary, a wider study area of 10 km from the proposed wind turbine locations has also been considered to assess potential impacts on the downstream water environment (the Wider Study Area). Both study areas are shown in Figure 13.1. At distances greater than 10 km within upland catchments, it is considered that schemes are unlikely to contribute to a hydrological impact, in terms of chemical or sedimentation impacts, due to dilution over distance of potentially polluting chemicals.

13.25. A smaller 1 km study area is used to assess private water supplies (the PWS study area).

Scope of Assessment

13.26. The key issues for the assessment of potential effects on the hydrological and hydrogeological resources relating to the Proposed Development include:

- Potential chemical pollution effects on the hydrological environment;
- Potential erosion and sedimentation effects on the hydrological environment;
- Potential impediments to stream flow;
- Potential effects on private water supplies;

- Potential changes in soil and peat interflow patterns;
- Potential for the compaction of soils;
- Potential effects on the hydrological function of GWDTEs;
- Potential for peat destabilisation and disturbance; and
- Potential for an increase in runoff and flood risk.

13.27. Effects during construction, operation and decommissioning have been assessed, as well as potential cumulative effects.

Elements Scoped Out of Assessment

13.28. The SEPA Waste Map and consultation with THC has not identified any areas of contaminated land within the Core Study Area and no effects are anticipated. Should potentially contaminated land be encountered during excavations, however, this would be tested and appropriate action taken in accordance with The Environmental Protection Act 1990. Potential effects arising from contaminated land have, therefore, been scoped out of this assessment.

Baseline Survey Methodology

Desk Study

13.29. The desk study included:

- Identification of underlying geology and hydrogeology;
- Collation of data provided through consultations;
- Identification of groundwater vulnerability;
- Assessment of topography and slope characteristics;
- Identification of catchments, watercourses, springs and water features;
- Collation of data provided through consultations; and
- Collation of flood plain information and water quality data.

13.30. Reference was also made to the following sources of information:

- The Ordnance Survey (OS) 1:50,000 Landranger Map (Sheet 20);
- OS 1:25,000 Map (Digital);
- National River Flow Archive (NRFA)[xxv];
- SEPA Flood Map 2014[xxvi];
- Meteorological Office Rainfall Data[xxvii]; and
- The British Geological Survey (BGS) Geology Map (Digital)[xxviii].

Site Walkover

13.31. A site walkover was undertaken on the 30th and 31st May 2017 and the 18th and 19th October 2017 to visually inspect surface water features and to obtain an understanding of the local topography and hydrological regime. The site walkover covered the areas surrounding the proposed turbine locations on the slopes of Meallan Teth, Meallan Caoruinn and Socach Allt Giubhais. Water quality measurements were also taken using a hand-held water quality meter

at the Allt Giubhas Beag at British National Grid (BNG) reference 235193, 870372 and the Allt na Beinne Leithe Bige at BNG reference 233095, 869270.

13.32. Weather conditions were dry during the site visits during both May and October 2017.

Peat Probing and Peat Slide Risk Assessment

13.33. The methodology employed for the Peat Slide Hazard and Risk Assessment (PSHRA) is in accordance with Energy Consents Unit (ECU) Scottish Government guidance Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments (Second Edition)[xxix]. Using experience from other windfarm projects, the assessment endeavours to assess the effects on geology and soils either affected directly or indirectly by construction or operation of the Development.

Methodology for the Assessment of Effects

13.34. The methodology outlined in paragraphs 13.26 to 13.36 has been developed by Arcus in consultation with SEPA, SNH, Marine Scotland and the Scottish Government. The assessment is based on a source-pathway-receptor methodology, where the sensitivity of the receptors and the magnitude of potential change upon those receptors identified within the study areas.

Sensitivity

13.35. The sensitivity of the receiving environment is defined as its ability to absorb an effect without perceptible change and can be classified as high, moderate or low. These classifications are dependent on factors such as the quality of the subsurface water within the receptor, their purpose (e.g. whether used for drinking, fisheries, *etc.*) and existing influences, such as land-use.

13.36. These criteria are outlined in Table 13.2 and are based on professional judgement and experience.

Table 13.2 Receptor Sensitivity Criteria

Receptor Sensitivity	Sensitivity Description
High	▪ A large, medium or small waterbody with a SEPA water quality classification of 'High' or 'Good'. ▪ The hydrological receptor and downstream environment has limited capacity to attenuate natural fluctuations in hydrochemistry and cannot absorb further changes without fundamentally altering its baseline characteristics / natural processes. ▪ The hydrological receptor is of high environmental importance or is designated as national or international importance, such as a Special Area of Conservation (SAC) or a Site of Special Scientific Interest (SSSI). ▪ The receptor acts as an active floodplain or other flood defence. ▪ The receptor is located within an active flood plain, in accordance with SPP 2014.

Receptor Sensitivity	Sensitivity Description
	▪ GWDTEs which are classified by SEPA as "highly groundwater dependent" have no functional impairment by man-made influence (such as drainage or forestry). ▪ The hydrological receptor will support abstractions for public water supply or private water abstractions for more than 25 people. ▪ Abstractions used for the production of mass produced food and drinks. ▪ Areas containing geological or geomorphological features considered to be of national importance (e.g. geological SSSIs). ▪ Local groundwater constitutes a valuable resource because of its high quality and yield. Aquifer(s) of local or regional value. Statutorily designated nature conservation sites (e.g. SACs and SSSIs) dependent on groundwater. ▪ Soil type and associated land use are highly sensitive (e.g. peat/blanket bog) ▪ Class 1 or 2 priority peatland, carbon-rich and peaty soils) and covers >20% of the Development Area ▪ Receptor contains areas of regionally important economic mineral deposits
Moderate	▪ A large, medium or small waterbody with a SEPA water quality classification of 'Moderate'. ▪ The hydrological receptor and downstream environment will have some capacity to attenuate natural fluctuations in hydrochemistry but cannot absorb certain changes without fundamentally altering its baseline characteristics / natural processes. ▪ The hydrological receptor is of regional environmental importance (such as Local Nature Reserves), as defined by SEPA. ▪ The hydrological receptor does not act as an active floodplain or other flood defence. ▪ The hydrological receptor supports abstractions for public water supply or private water abstractions for up to 25 people. ▪ GWDTEs which are classified by SEPA as "highly groundwater dependent" but have functional impairment by man-made influence (such as drainage or forestry). ▪ GWDTEs which are classified by SEPA as "moderately groundwater dependent" have no functional impairment by man-made influence (such as drainage or forestry). ▪ Areas containing geological features of designated regional importance including Regionally Important Geological/geomorphological Sites (RIGS), considered worthy of protection for their historic or aesthetic importance. ▪ Aquifer of limited value (less than local) as water quality does not allow potable or other quality sensitive uses. Exploitation of local groundwater is not far-reaching. Local areas of nature conservation known to be sensitive to groundwater effects. ▪ Soil type and associated land use are moderately sensitive (e.g. commercial forestry) ▪ Class 1 or 2 priority peatland, carbon-rich and peaty soils cover <20% of the Development Area, or Class 3 and 5 peatland areas, carbon rich and peaty soils

Receptor Sensitivity	Sensitivity Description
	▪ Receptor contains areas of locally important economic mineral deposits
Low	▪ A large, medium or small waterbody with a SEPA water quality classification of 'Poor' or 'Bad'. ▪ The hydrological receptor and downstream environment will have capacity to attenuate natural fluctuations in hydrochemistry but can absorb any changes without fundamentally altering its baseline characteristics / natural processes. ▪ The hydrological receptor is not of regional, national or international environmental importance. ▪ The hydrological receptor is not designated for supporting freshwater ecological interest. ▪ GWDTEs which are classified by SEPA as "moderately groundwater dependent" but have functional impairment by man-made influence (such as drainage or forestry). ▪ GWDTEs which are classified by SEPA as "highly or moderately groundwater dependent" but are ombrotrophic. ▪ The hydrological receptor does not act as an active floodplain or other flood defence. ▪ The hydrological receptor is not used for recreational use. ▪ The hydrological receptor does not support abstractions for public water supply or private water abstractions. ▪ Geological features or geology not protected and not considered worthy of specific protection. ▪ Poor groundwater quality and / or very low permeability make exploitation of groundwater unfeasible. Changes to groundwater not expected to affect local ecology. ▪ Soil type and associated land use not sensitive to change in hydrological regime (e.g. intensive grazing) ▪ Receptor contains Class -2, -1, 0, and 4 non-peatland areas, with no carbon-rich and/or peaty soils

Magnitude

13.37. The magnitude is determined by the timing, scale, size and duration of the potential effect resulting from the Proposed Development. The magnitude of potential effects can be classified as major, moderate, minor or negligible, as outlined in Table 13.3.

Table 13.3 Criteria for Determining Magnitude

Magnitude of Effect	Magnitude Description
High	▪ A short or long-term major shift in hydrochemistry or hydrological conditions sufficient to negatively change the ecology of the receptor. This change will equate to a downgrading of a SEPA water quality classification by two classes e.g. from 'High' to 'Moderate'. ▪ A sufficient material increase in the probability of flooding onsite and offsite, adding to the area of land which requires protection by

Magnitude of Effect	Magnitude Description
	flood prevention measures or affecting the ability of the functional flood plain to attenuate the effects of flooding by storing flood water (in accordance with SPP). ▪ A major (greater than 50 %) or total loss of a geological receptor or peat habitat site, or where there will be complete severance of a site such as to fundamentally affect the integrity of the site (e.g. blocking hydrological connectivity). ▪ A major loss of (greater than 50 % of study area) or total loss of highly dependent and high value GWDTE, or where there will be complete hydrological severance which will fundamentally affect the integrity of the feature. ▪ A major permanent or long-term negative change to groundwater quality or available yield. ▪ A major permanent or long-term negative change to geological receptor, such as the alteration of pH or drying out of peat. ▪ Changes to groundwater quality or water table level that will negatively alter local ecology or will lead to a groundwater flooding issue. ▪ Major or total loss of or alteration to peatland resource such that post development characteristics or quality will be fundamentally or irreversibly changed ▪ Long term /permanent change to baseline resource ▪ Major or total loss of a geological site or mineral deposit, where the value of the site would be severely affected
Moderate	▪ A short or long term non-fundamental change to the hydrochemistry or hydrological environment, resulting in a change in ecological status. This change will equate to a downgrading of a SEPA water quality classification by one class e.g. from 'High' to 'Good.' ▪ A moderate increase in the probability of flooding onsite and offsite, adding to the area of land which requires protection by flood prevention measures or affecting the ability of the functional flood plain to attenuate the effects of flooding by storing flood water (in accordance with SPP). ▪ A loss of part (approximately 5 % to 50 %) of a geological receptor or peat habitat site, major severance, major effects to its integrity as a feature, or disturbance such that the value of the site will be affected, but could still function. ▪ A loss of part (approximately 10 % to 50 % of study area) of a moderately dependent and moderate value GWDTE – significant hydrological severance affects the integrity of the feature, but it could still function. ▪ Changes to the local groundwater regime that may slightly affect the use of the receptor. ▪ The yield of existing supplies may be reduced or quality slightly deteriorated. ▪ Fundamental negative changes to local habitats may occur, resulting in impaired functionality. ▪ Loss of, or alteration to the baseline resource such that post development characteristics or quality will be partially changed ▪ Mid-term /permanent change to baseline resource

Magnitude of Effect	Magnitude Description
	▪ Partial loss of a geological site or mineral deposit, with major effects to the settings, or where the value of the site would be affected
Low	▪ A detectable non-detrimental change to the baseline hydrochemistry or hydrological environment. This change will not result in a downgrading of the SEPA water quality classification. ▪ A marginal increase in the probability of flooding onsite and offsite, adding to the area of land which requires protection by flood prevention measures or affecting the ability of the functional flood plain to attenuate the effects of flooding by storing flood water (in accordance with SPP). ▪ A detectable but non-material effect on the receptor (up to 5 %) or a moderate effect on its integrity as a feature or where there will be a minor severance or disturbance such that the functionality of the receptor will not be affected. ▪ A detectable effect on a GWDTE (loss of between 5 % - 10 % of study area) or a minor effect on a GWDTE's integrity as a feature or where there will be a minor severance or disturbance such that the functionality of the receptor will not be affected. ▪ Changes to groundwater quality, levels or yields do not represent a risk to existing baseline conditions or ecology. ▪ Small loss of soils or peatland, or where soils will be disturbed but the value not impacted ▪ Short-term change to baseline resource ▪ Small effect on a geological site or mineral deposit, such that the value of the site would not be affected
Negligible	▪ No perceptible changes to the baseline hydrochemistry or hydrological environment. ▪ No change to the SEPA water quality classification. ▪ No increase in the probability of flooding onsite and offsite. ▪ A slight or negligible change from baseline condition of geological resources. ▪ Change hardly discernible, approximating to a 'no change' in geological condition. ▪ Minimal detectable effect on a GWDTE (between to 0.1 % - 5 % of study area) or no discernible effect on its integrity as a feature or its functionality. ▪ Minimal or no change to soils or peatland deposits ▪ A very slight change from the baseline conditions. The change is barely distinguishable, and approximates to the 'no-change' situation ▪ Minimal or no change to a geological site or mineral deposit

Significance

The predicted significance of the effect is determined through a standard method of assessment and based on professional judgement, considering both the sensitivity of receptor and the magnitude of the potential effect as defined

in Table 13.4. Effects of moderate significance or greater are considered significant in terms of the EIA Regulations.

Table 13.4 Significance Matrix

Magnitude of Effect	Sensitivity of Resource or Receptor		
	High	**Moderate**	**Low**
High	Major	Major	Minor
Moderate	Major	Moderate	Minor
Low	Moderate	Minor	Negligible
Negligible	Negligible	Negligible	Negligible

13.38. The relevant catchments for potential effects on the designated areas of Loch Glascarnoch, the River Glascarnoch, the Allt Coire Mhuilidh and Loch Luichart are considered to be the catchments of the Allt Giubhais Mor, Allt Giubhais Beag and the Allt Coire Mhuilidh. All Proposed Development infrastructure is located within these catchments, therefore this Chapter focuses on potential effects within the catchments of these watercourses.

Cumulative Assessment Methodology

13.39. A cumulative effect is considered to be an additional effect on hydrological resources arising from the Proposed Development in combination with other proposed developments (either under construction, consented but not built or at application stage) likely to affect the hydrological environment. At distances greater than 10 km, it is considered that schemes are unlikely to contribute to a cumulative hydrological effect due to attenuation and dilution over distance of potentially polluting chemicals. Therefore, for the purposes of the assessment of potential cumulative effects on the immediate catchment and hydrological regime, only proposed developments within approximately 10 km of the Proposed Development have been considered. These developments have been identified through consultation with the relevant local authorities and statutory consultees, and are discussed in more detail in paragraphs 13.187 to 13.188.

13.40. The methodology followed to assess the cumulative effects is the same as that used for the Proposed Development in isolation.

13.41. Geology and peat are considered as a site-specific consideration and it is not considered that there will be cumulative effects.

Assessment Limitations

13.42. All data considered necessary to identify and assess the potential significant effects resulting from the Proposed Development was available and was used in the assessment reported in this Chapter.

Embedded Mitigation

13.43. Embedded mitigation measures are set out within the CEMP (provided as Technical Appendix 13.A) which sets out specific mitigation which relates to this Proposed Development. They comprise good practice methods and works that are established and effective measures to which the Applicant will be committed through the planning consent. Although the CEMP is draft and will evolve to take account of consultee feedback and detailed design, there is sufficient confidence in the effectiveness of the measures set out in the CEMP for them to be treated as part of the Proposed Development for the purposes of this assessment. Measures and procedures outlined in the CEMP will be adopted and incorporated into a single working document to be agreed with statutory consultees and the planning authority following consent by way of an appropriately worded planning condition. For ease of reference through this Chapter, reference to specific sections in the CEMP, detailing the appropriate embedded mitigation measures, are provided.

13.44. Accordingly, the identification of likely significant effects from the Proposed Development is considered following implementation of the measures in Technical Appendix 13.A.

13.45. A buffer zone distance of 50 m has been established for turbine bases and ancillary structures / infrastructure around the minor watercourses (natural) at the Proposed Development.

13.46. The existing network of access tracks which serve the Lochluichart, Lochluichart Extension (thereafter known as the 'Operational Schemes') and Corriemoillie wind farms have been utilised, where possible, limiting the requirement to disturb peaty soils to access the Proposed Development. Where new access tracks are required they have been designed to avoid crossing watercourses, where possible. Further description of this is provided in Chapter 3: Project Description.

13.47. The CEMP describes water management measures to control surface water run-off and drain hardstandings and other structures during the construction and operation of the Proposed Development. This will form part of a Pollution Prevention Plan (PPP) to be implemented for the Proposed Development.

13.48. The 50 m watercourse buffer zone in conjunction with the measures set out in the CEMP will be sufficient to avoid potential effects on the hydrological and hydrogeological resource, as their effectiveness has been demonstrated on several wind farm construction sites for which Arcus have provided technical advice for.

13.49. The measures discussed in the CEMP are inherently part of all wind farm development design and should be treated as embedded mitigation. The Arcus hydrology team has provided services for a large number of onshore wind farm developments and have worked closely with statutory agencies such as the SEPA, SNH and Local Councils to develop appropriate survey and assessment methods.

13.50. This approach has withstood legal review on all hydrology EIA work undertaken by Arcus and has received positive comments from consultees for proposing appropriate embedded mitigation on a project specific basis.

13.51. Conclusions, therefore, state whether the residual significance will be major, moderate, minor or negligible, once appropriate mitigation (beyond that specified in the CEMP) has been implemented. This assessment relies on professional judgment to ensure that the effects are appropriately assessed.

13.52. A residual effect is considered to be a likely significant effect in accordance with the EIA Regulations if assessed as moderate or major following the preceding methodology.

Good Practice

13.53. Good practice will be followed in all aspects of construction, operation and decommissioning, specifically through a PPP, which will be incorporated into a full CEMP, to be agreed with SEPA prior to the construction phase.

13.54. The PPP will set out measures to be employed to avoid or mitigate potential effects for all phases of the Proposed Development, and will also include an Incident Plan to be followed should a pollution event occur. This plan will be produced following consultation and agreement with SEPA and all appropriate personnel working on the construction site will be trained in its use. The Construction Project Manager will have specific responsibility for implementation of the PPP.

13.55. Method statements will also be applied, which will follow the principles laid out in relevant SEPA Pollution Prevention Guidelines.

Baseline Conditions

Topography and Land Use

13.56. The Proposed Development occupies an undulating upland location with areas of peat across the site. The Proposed Development rises from approximately 270 m above ordnance datum (AOD, approximately equivalent to sea level) at the Proposed Development entrance (in the northern section of the Proposed Development) to 500 m at Meallan Caoruinn (in the southern section of the Proposed Development).

13.57. The Proposed Development is bounded by open moorland with steep slopes to the west and east. Loch Glascarnoch bounds the Proposed Development to the immediate north and Corriemoillie wind farm is located immediately to the east of the Proposed Development.

13.58. There are a number of existing tracks within the Core Study Area associated with the Operational Schemes and the neighbouring Corriemoillie wind farm.

Surface Hydrology

13.59. The Core Study Area lies within the catchment of Loch Glascarnoch and Glascarnoch River, approximately 1 km north of the Proposed Development boundary, and is drained by a series of tributaries of Allt Giubhais Mor and Allt Giubhais Beag. The southernmost section of the Proposed Development, south of Turbine 6, is in the catchment of Loch Luichart, approximately 4 km south of the Proposed Development boundary. Areas to the south of the Proposed Development are drained by the Allt Coire Mhuilidh and its tributaries, however no infrastructure is located within this catchment.

13.60. The central and western area of the Core Study Area is drained by the Allt Giubhais Mor. A number of tributaries drain into this watercourse, including the Allt Beinne, which flows from west to east from outwith the Core Study Area, discharging into Allt Giubhais Mor.

13.61. Allt Giubhais Mor rises within the Core Study Area and flows into Loch Glascarnoch at the northern boundary of the Proposed Development.

13.62. The eastern area of the Core Study Area is drained by the Allt Giubhais Beag, which rises on the southeastern boundary of the Core Study Area and flows southeast into the Allt Giubhis Beag along the Proposed Development's eastern boundary before flowing into the River Glascarnoch.

13.63. Morphology of these watercourses is typical of upland watercourses with steep gradients, fast flows and rocky beds.

13.64. Loch Glascarnoch is classed by SEPA as having 'Moderate' overall status while the Glascarnoch River is classed as having 'Bad' overall status. There are no statutory designations associated with watercourses within the Proposed Development, Loch Glascarnoch or Glascarnoch River.

13.65. Lochluichart and he Allt Coire Mhuilidh are classified by SEPA as having 'Moderate' overall status.

13.66. Baseline hydrochemistry data was obtained from the Allt na Beinne at NGR 233108, 868979 and from the Allt Giubhais Beag at NGR 235193, 870353, as outlined in Table 13.5.

Table 13.5 Water Quality Monitoring

Location	Temp°C	pH	Dissolved Oxygen %	Electrical Conductivity µS/cm	Total Dissolved Solids ppm	Salinity PSU	Turbidity NTU
Allt na Beinne	8.1	8.87	101.8	19.2	18.2	0.01	0.97
Allt Giubhais Mor	9.4	8.3	100.5	22.6	20.8	0.01	1.12

13.67. The data suggests these watercourses are typical of upland rural areas i.e. of good water quality with parameters within the expected ranges.

13.68. Watercourses and their catchments are shown in Figure 13.2.

Climate

13.69. The National River Flow Archive (NRFA) reports Average Annual Rainfall (AAR 1961 - 1990) on the Blackwater at Garve, approximately 8.47 km southeast of the Proposed Development, as 1672 mm.

13.70. As monthly long-term climate data is not freely available from the NRFA, long term average rainfall data (1981 to 2000) obtained by the Meteorological Office at the Loch Glascarnoch gauging station, located to the immediate north of the Proposed Development, are presented in Table 13.6.

Table 13.6 Long term average rainfall data (1981 – 2000), Loch Glascarnoch

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall (mm)	236.3	164.0	175.3	94.0	87.7	85.7	98.2	103.5	150.3	199.5	191.8	180.5

Geology and Soils

Superficial Soils

13.71. Available British Geological Survey mapping information on superficial soils indicates the majority of the site to be underlain by peat, with pockets of either glacial till or no superficial cover in the north and west, and south respectively. The peat deposits are shown dominate the eastern and central site areas. Given the rural upland location, a thin covering of peaty soil is anticipated across the majority of the site overlying the peat and glacial till. Figure 13.3 illustrates the Superficial Soils map.

Bedrock Geology

13.72. BGS mapping information on solid geology indicates the majority of the Proposed Development and Neoproterozoic aged Psammite belonging to the Morar Group. A north to south intrusion of Semipelite and Pelite, of same and group was also present in the central of the Proposed Development. Figure 13.4 illustrates the Bedrock Geology map.

National Soils of Scotland

13.73. The following information is a summary of the information on soil units within Scotland's Soils, Scotland's Environment website[xxx].

13.74. The Soil Survey of Scotland at a scale of 1:250,000 (Macaulay Institute for Soil Research, 1981) indicates that the site is underlain by a mix of mainly blanket peat, gleys soils and podzols. This is supported by soil carbon mapping which suggests the site is underlain by a mix of two main categories:

- All vegetation cover is priority peatland habitats + All soils are carbon-rich soils and deep peat; and
- Soil information takes precedence over vegetation data + No peatland habitat recorded. May also show bare soil. + All soils are carbon-rich soil and deep peat.

13.75. A brief description of the characteristics and formation of component soil groupings is detailed below, as described by Scotland's Soils Map, although these do not include information on depths or engineering properties:

- Blanket Peat: Poorly drained upland soil with an organic surface layer generally greater than 50 cm thick, unconfined and 'blankets' the landscape;
- Podzols: Podzols are acid soils with a grey leached layer just below the surface and bright orangey-brown coloured subsoils and/or dark brown to black, organic rich subsoils; and
- Gleys: Gleys are soils that are periodically or permanently waterlogged;

Carbon-rich Soils, Deep Peat and Priority Peatland Habitats

13.76. The Carbon and Peatland Map (SNH, 2016) indicates the Carbon-rich soils and peatland importance to be categories 1,2 and 5, although mainly 1 across the majority of the site. These categories are indicative of areas of carbon-rich soils and deep peat and priority peatland habitat. The small area of category 5 recorded in the west indicates an area where soil information takes precedence over vegetation data, however, no peatland habitat anticipated. Figure 13.5 illustrates the Carbon and Peatland Map (SNH, 2016).

13.77. A summary of the peat survey is summarised below and the details are included in Appendix 13.C. The Technical Appendix provides site-specific peat depth information which has informed the design of the layout of the Proposed Development and the subsequent assessment of effects.

13.78. Peat is a sedimentary material, which is dark brown or black in colour and comprises partially decomposed remains of plants and organic materials preserved in anaerobic conditions, essentially within a waterlogged environment. There are two principal types of peat:

- Acrotelm is the upper layer, quite fibrous and contains plant roots. Acrotelmic peat is relatively dry, generally lying above the groundwater table and has some tensile strength; and
- Catotelm is the lower layer of peat, highly amorphous and has a very high water content, generally lying below the ground water table and has a very low tensile strength.

Phase 1 Peat Probing

13.79. Peat probing was undertaken across the Proposed Development in accordance with the Scottish Government (2017), Peat Landslide Hazard and Risk Assessments - Best Practice Guide for Proposed Electricity Generation Developments.

13.80. Arcus carried out initial phase 1 peat probing in April 2017 to inform the development constraints as part of the EIA for the Proposed Development. This covered the Proposed Development utilising a 100 m grid centre approach. During the works a total of 171 peat probes were sunk.

13.81. The maximum peat depth recorded was 3.75 m in the eastern area of the Proposed Development in a topographically low-lying area between Meallan Caoruinn and Socach Allt Giubhais. Generally, peat depths did not exceed 0.5 m, which is anticipated with steep topography and in rocky outcrop areas.

13.82. Peat varied between 1.0 m to 2.0 m depth west of Meallan Caoruinn in the vicinity of Caochan Ban and Allt na Beinne Leithe Bige watercourses. This area was noted to be occupied by hummocky ground and there was evidence of localised 'peat creep' and local surface drainage features were abundant.

13.83. Following a review of development constraints, a re-scope of turbine locations led to the requirement for further phase 1 peat probing. Adopting the same methodology as previous visit, a further 137 peat probes were sunk. The area covered was situated north of initial peat probing works. There were two defined areas, the western area being steep topography and rolling hillside while the east of the existing wind farm was slightly undulating topography, but generally flatter.

13.84. Localised low-level peat hagging was recorded in flat lying areas, both in the eastern and western site areas. Some minor peat collapse was noted as shown Plates 1 and 2. In addition. During the site visits, pooling was observed in the south-eastern area of the development site, as shown Plate 3.

Plate 1. Localised peat failure in hag, eastern site area.

Plate 2. Peat hags, western site area.

Phase 2 Peat Probing

13.85. Phase 2 peat probing was undertaken in June 2018 comprising 50 metre (m) intervals along proposed tracks. Probes were sunk 25 m perpendicular to the track centre line on both sides for micro-siting purposes. In addition to the probing at the proposed tracks, a 10 m interval grid was adopted at turbines 3, 4 and 5 where deep peat has previously been recorded during Phase 1 surveys in April 2017 and August 2017, while 10 m centre cross hair probing was undertaken at the remaining turbine locations. T1 was not re-visited due to restrictions on foot traffic in this part of the site.

13.86. Peat recorded to the east of the existing windfarm track was generally thicker than the western area, with a maximum depth of 3.75 m recorded approximately 100m east of the proposed T5. Across this area, peat was generally greater than 1.0 m although, within the vicinity of T1 and T2, peat did not exceed 1.0 m. Proposed tracks sections between T3 and T4 were situated in peat up to 3.5m but more generally in the region of 2.0 m to 2.5 m thick. Peat Depth Interpolation mapping across the proposed infrastructure is illustrated on Figure 13.5.

Hydrogeology

13.87. Data on hydrogeology was obtained from the SEPA and SNIFFER Groundwater Vulnerability Map. The Vulnerability Map represents the strata overlying the aquifer ('vertical pathway'). These maps provide show that the vulnerability class for the Core Study Area is variable (5 to 4b).

13.88. Vulnerability classes range from 1 to 5, with 5 being most vulnerable. Class 4 is subdivided into 4a and 4b. It is the hydrogeological characteristics within the pathway rather than the 'importance' of a particular aquifer that results in the final vulnerability classification. The methodology behind the classification assumes that where contaminants move through unsaturated fractured bedrock, no attenuation of pollutants can take place. Large parts of Scotland show areas of Classes 4 and 5, reflecting the widespread occurrence of rocks dominated by fracture flow located exposed at the surface where the potential for attenuation of contaminants, from overlying strata, in the pathway is very limited.

13.89. The Hydrogeological Map of Scotland, 1:625,000 Series indicated the region to be underlain by low productivity aquifer with small amounts of groundwater in the near surface weathered zone and secondary fractures.

13.90. Within the wider Study Area, aquifer vulnerability is similar to that underlying the Proposed Development, showing areas of Classes 5 to 4b.

13.91. The SEPA River Basin Management Plan (RBMP) map classes the groundwater body underlying the Proposed Development (Conon, Northern Highlands) as having a 'Good' chemistry status and 'Good' quantitative class.

Site Drainage

13.92. The majority of the Core Study Area is open peatland with extensive hags and is drained initially by overland flow and small incised streams. Drainage across the non-forested areas of the Core Study Area is characterised by channels in the peaty soils and very occasional flushes within eroded peat / soil channels.

13.93. Existing trackside drainage associated with the Operational Schemes runs parallel to the tracks before discharging to watercourses onsite.

13.94. Forested areas in the centre of the Core Study Area are drained by existing forestry ditches which run parallel and discharge into watercourses.

13.95. Peaty deposits may act as a store of water and release rainwater for a considerable time after significant rainfall. Observations made during the site walkover noted that the central and eastern areas of the Proposed Development (centred on BNG reference 233758, 869596) were heavily saturated during the site visit as shown in Plate 3. This is due to the gently sloping topography of this area of the Core Study Area and poorly drained peaty soils.

Plate 3. BNG 232250, 869155 looking towards proposed location of Turbine 3

Hydrological Regime and Surface Water Morphology

13.96. Morphology is typical of upland watercourses, which (as described in paragraphs 1.49 to 1.56) are generally evenly dispersed through flat boggy ground from their upper reaches, becoming increasingly steep and faster flowing as they progress downstream to the primary rivers.

13.97. Site observations from the Core Study Area indicate that morphology is relatively typical of dendritic drainage network watercourses, which are steeper in their upper reaches and become increasingly flatter as they progress down slope.

Groundwater Dependent Terrestrial Ecosystems (GWDTEs)

13.98. In accordance with SEPA guidance a Phase 1 habitat survey was undertaken to identify wetland habitats occurring within the Core Study Area. Wetland habitats were identified in line with the criteria outlined in 'A Functional Wetland Typology for Scotland' (SNIFFER, 2009) where wetland habitats were confirmed through Phase 1 survey, further detailed habitat assessment was undertaken, with identification of National Vegetation Classification (NVC) communities. The survey methods employed for this assessment are outlined in Chapter 11: Ecology.

13.99. Extensive areas of Wet Heath (M15) are located across the Core Study Area. Both borrow pit locations, turbine 6, turbine 7 and access tracks are located within areas of Wet Heath habitat as shown in Figure 11.2 of this EIA Report. Wet heath is classed as having the potential for moderate groundwater dependency as outlined in Appendix 4 of the SEPA Guidance Note 31.

13.100. The habitats with potential for groundwater dependency are located across a wide area and are likely to have some degree of groundwater dependency.

13.101. The wet heath habitat identified in the southern section of the Core Study Area is located on a fairly steep upland slope ranging from approximately 500 m AOD to 360 m AOD, over a distance of approximately 550 m. The location and topography in which the heath habitats are situated strongly suggests that the heath communities are ombrogenous in nature, being dependent on surface water run-off and precipitation, rather than groundwater.

13.102. Similarly the northern section of the Core Study Area, in proximity to T11, is on a slope with a gradient greater than 30 degrees.

13.103. As shown in Figures 13.4 and 13.5, the underlying geology in proximity to T7 and T6 is dominated by psammite (sandstones) and glacial till, which also supports the conclusion that the identified habitats are not connected with groundwater and having limited potential to interact with the groundwater.

13.104. The M15 in the northern section of the Core Study Area has been heavily modified by linear man-made drainage and forestry.

13.105. As discussed, the limited potential for wet heath to actively interact with the underlying groundwater in the upper layers of the psammite bedrock, along with the topography and underlying geology; strongly suggests that the habitats are not groundwater dependent, but ombrogenous. It is therefore concluded that the M15 communities within the Core Study Area are not groundwater dependent.

13.106. Although not considered as GWDTEs, the sensitivity of the identified wetland habitats is acknowledged, with further consideration of the potential for effects on the hydrological function of the identified wetland habitats provided in paragraphs 13.167 to 13.175. Potential for effects on all identified wetland habitats in relation to their ecological and nature conservation value, are also discussed in Chapter 11: Ecology.

Flooding

13.107. The Flood Map (2014) produced by SEPA shows the areas of Scotland with a 0.5% (1:200) or greater chance of flooding, identified as medium to high risk areas for flooding. No turbines, transformers, control building, battery storage array, temporary construction compounds or borrow pits are located in areas classed as a medium to high risk for flooding from pluvial, fluvial or groundwater sources.

A minor area either side of the Allt Giubhais Beag on the Core Study Area is classified as having a high risk of fluvial flooding. The lower reaches of the Allt Ghuibais Mor are classified as high risk from fluvial flooding between the existing access track and Loch Glascarnoch. The existing access track is culverted over Allt Ghuibais Mor as shown in Plate 4.

Plate 4: Existing access track and arched culvert over Allt Ghuibais Mor

13.108. Flooding and associated erosional issues were observed during 25th August 2017 during heavy rainfall events, which damaged access tracks to the adjacent Corriemoillie wind farm and the Operational Schemes[xxxi] and damaged transport infrastructure, Loch Luichart Estate infrastructure, properties and water supplies; although this has since been repaired.

13.109. None of the infrastructure of the Proposed Development is located within the catchment affected by this flooding incident. The flooding described in the report provided as Technical Appendix 13.E refers to damage caused by high levels during storm conditions in an unnamed watercourse which flows into Loch Luichart and has its headwaters near the southern boundary of the Operational Schemes.

13.110. Any subsequent application by the District Network Operator, as a result of a consent for the Proposed Development, will consider the experience of this flooding event and consider appropriate mitigation measure in any forthcoming s37 application as required.

Public and Private Water Supplies

13.111. The Private Water Supplies (Scotland) Regulations 2006 defines supplies as either:

- Type A – Supplies providing 10 m^3 of water a day or serving 50 or more persons; and supplies to commercial or public activities irrespective of their size; or

- Type B – Supplies serving only domestic premises with less than 50 persons supplied.

13.112. Scottish Water confirmed that there are no Scottish Water drinking water catchments or water abstraction sources, which are designated as Drinking Water Protected Areas under the Water Framework Directive, in the area that may be affected by the Proposed Development.

13.113. During consultation at the scoping stage, THC identified two Type A abstractions for private water supply within 1 km of the Proposed Development boundary.

Table 13.7 Private Water Supplies

Receptor	Source of Supply	In/outwith Proposed Development Catchment	Distance from Proposed Development Infrastructure	Comments
Viach Power Station	Surface Water Body	Unknown	1.3 km	Unoccupied
Aultguish Inn	Surface Water	In catchment – Abstraction from Allt Giubhais Beag	1.5 km	Confirmed by resident

Designations and Fisheries

There are two statutory designated sites relating to water within the wider 10 km Study Area, identified through the use of SNH[xxxii] and SEPA[xxxiii] GIS datasets, as shown in Table 13.8.

Table 13.8 Statutory Designated Sites

Designation	Distance from Proposed Development	Qualifying Interest	Hydrologically Linked to Proposed Development
Fannich Hills SSSI and SAC	6 km west	Blanket bog, clear water lakes or lochs with aquatic vegetation and heath.	No – outwith surface water catchment.
Beinn Dearg SSSI, SAC and SPA	6 km north	Upland habitats including blanket bog.	No – hydrologically separated by Loch Glascarnoch.

13.114. The hydrological designations are considered to be hydrologically disconnected from the Core Study Area (in terms of surface and sub-surface water effects), as development is proposed in areas that are hydrologically disconnected by Loch Glascarnoch or the designations are hydrologically up gradient.

Information Gaps

13.115. All data considered necessary to identify and assess the potential significant effects resulting from the Proposed Development were available and used in the assessment reported in this Chapter.

Sensitivity of Receptors

13.116. The sensitivities of the identified receptors, and their relationship to the potential effects from the construction of the Proposed Development, are outlined in Table 13.9.

Table 13.9 Sensitivity of Hydrological Receptors

Receptor	Potential Effects	Sensitivity	Comment
Watercourses	Increased run-off, erosion and sedimentation, stream flow impediments and pollution as a result of construction groundworks and chemical handling / storage.	Moderate	Considered Moderate sensitivity as the main watercourses on site discharge into Loch Glascarnoch and the Glascarnoch River. While Loch Glascarnoch is classified by SEPA as having 'Good' ecological potential it is not noted as a fisheries resource and is not used for drinking water. Glascarnoch River is classified by SEPA as having 'Bad' ecological potential and is not designated as a hydrology resource.
Groundwater	Pollution as a result of erosion and sedimentation from construction activities and uncontained spills from chemical handling / storage.	High	Considered High sensitivity as hydrocarbon pollution in bedrock fissures has a lengthy attenuation period. Groundwater vulnerability is classified as 5 to 4b (high). The groundwater body underlying the Proposed Development (Northern Highlands) has a 'Good' chemistry status and a 'Good' quantitative class.
Private Water Supplies	Pollution as a result of erosion and sedimentation from construction activities and uncontained spills	High	Considered as High sensitivity as the hydrological receptor (Aultguish Inn) supports abstractions for over 25 people (during summer occupancy) as outlined in Table 13.2.

Receptor	Potential Effects	Sensitivity	Comment
	from chemical handling / storage.		
Near-surface Water	Diversion of near-surface flow as a result of track construction and the installation of turbine foundations / hardstanding.	Moderate	Considered Moderate sensitivity as near-surface water supplies flow to the watercourses within the Core Study Area, which in turn discharge into Loch Glascarnoch, Glascarnoch River and Lochluichart.
Soils / Superficial geology (excluding peat)	Pollution as a result of track construction and chemical handling / storage.	Moderate	Considered Moderate sensitivity as the receptor has some capacity to filter and attenuate most potentially polluting chemicals and sediment over time.
Peat	Disturbance of peat and carbon rich soils.	Moderate	Considered Moderate sensitivity as the receptor has class 1 soils on site (blanket peat) across parts of the site proposed for infrastructure.
Solid Geology (bedrock)	Loss of strata as a result off stone winning from borrow pits or turbine excavations.	Low	Considered Low sensitivity as the receptor is not designated or of limited resource across Scotland and can function normally throughout all phases of the Proposed Development.
GWDTEs	Pollution as a result of track construction and uncontained spills from chemical handling / storage. Drying out or changes to groundwater interflow patterns as a result of construction.	Moderate	Considered Moderate sensitivity as the GWDTE communities identified within the Core Study Area are classed as moderately groundwater dependant, however are ombrotrophic in nature or have been modified by forestry and man-made drainage and access tracks.

Assessment of Potential Effects

13.117. The effect of the Proposed Development on hydrological receptors has been considered for the construction, operation and decommissioning phases of the Proposed Development. Effects occurring during construction and decommissioning are considered to be short term effects, with those occurring as a result of the operational phase of the Proposed Development being considered to be long term effects.

Potential Construction Effects

13.118. The nature and magnitude of effects that could result from construction activities, as described in Chapter 3: Project Description, are assessed in the following paragraphs, which includes:

- The potential upgrade of access tracks at the Operational Schemes for the construction of the Proposed Development;
- New borrow pits for the construction of the Proposed Development. A search area of two locations has been identified; and
- Construction of new access tracks, turbines and associated infrastructure, hardstandings and temporary construction compounds for the Proposed Development.

Chemical Pollution

13.119. Potential effects involved with the management of construction are more a risk management issue, with the effects being assessed should the risk be realised. Should the Proposed Development proceed as described in Chapter 3: Infrastructure *i.e.* with no spills, there would be no effects.

13.120. Potential risks include the spillage or leakage of chemicals, fresh concrete, foul water, fuel or oil, during use or storage onsite. These pollutants have the potential to adversely affect soils, subsurface water quality, peat, surface water quality, and groundwater, and hence effects on the biodiversity of receiving watercourses.

Surface Hydrology

13.121. Watercourses could be at risk from a pollution incident during construction. All surface watercourses and surface water bodies are considered to be of moderate sensitivity.

13.122. Buffer distances between proposed construction works and watercourses have been maximised to reduce the potential for chemical pollutants to be transferred to the water environment.

13.123. Measures such as absorbent spill pads / kits and other measures highlighted within Sections the CEMP found in Technical Appendix 13.A will effectively limit the uncontained release of chemicals to minor fugitive releases. These would be minimised through best practice construction methods such as vehicle speed limits and regular vehicle and machine maintenance.

13.124. Therefore, effects on these watercourses and lochs, of Moderate sensitivity, have the potential to be of negligible magnitude and therefore (in accordance with Table 13.4.) of negligible significance. This is not significant in terms of the EIA Regulations.

Groundwater, Near-Surface Water and Bedrock

13.125. Pollutants coming into contact with bedrock also have the potential to indirectly alter the pH of the groundwater resource. pH and chemical

alterations to bedrock are difficult to rectify due to the fractured nature of the rock and the lengthy attenuation and dispersal of chemicals.

13.126. As noted previously, due to the underlying hydrogeology consisting of low productivity aquifer with small amounts of groundwater in the near surface weathered zone and secondary fractures, groundwater is unlikely to be present near the surface, meaning there is limited potential for pollutants to come into contact with groundwater.

13.127. Measures such as spill pads, impermeable geotextile membranes and measures described within the CEMP Appendix 13.A will effectively limit the uncontained release of chemicals to minor fugitive releases. Therefore, effects on bedrock and groundwater have the potential to be of negligible magnitude for receptors of High (groundwater), Moderate (near-surface water) and Low (bedrock) sensitivity and therefore (in accordance with Table 13.4) of negligible significance. This is not significant in terms of the EIA Regulations.

Private Water Supplies

13.128. PWS could be at risk from a pollution incident during construction. PWS within the catchment of the Proposed Development infrastructure are considered to be of High sensitivity.

13.129. None of the PWS within the catchment of Proposed Development infrastructure, as outlined in Table 13.6, are within 250 m of Proposed Development infrastructure and as such fall out with the recommended buffer to excavations greater than 1 m in depth as detailed in the SEPA guidance on assessing the impact of developments on groundwater abstractions.

13.130. Measures such as absorbent spill pads / kits and other measures highlighted within Sections the CEMP found in Appendix 13.A will effectively limit the uncontained release of chemicals to minor fugitive releases. These would be minimised through best practice construction methods such as vehicle speed limits and regular vehicle and machine maintenance.

13.131. Given the potential for attenuation and dilution as a result of the distance between PWS and Proposed Development infrastructure as well as the best practice measures described in Appendix 13.A, there is limited potential for chemical pollution of PWS.

13.132. Therefore, effects on PWS, of High sensitivity, have the potential to be of negligible magnitude and therefore (in accordance with Table 13.4) of negligible significance. This is not significant in terms of the EIA Regulations.

<u>Erosion and Sedimentation</u>

Surface Hydrology

13.133. Erosion and sedimentation can occur from excavations, stone winning, ground disturbance and overburden stockpiling. Sediment entering watercourses has the potential to affect water quality, ecology and flood storage capacity.

13.134. Given the overland distance between construction areas and watercourses, any silt or other materials carried by overland flow as a result of construction are likely to be entrained in vegetation and existing drainage ditches (in the absence of intervening good practice measures) before reaching watercourses.

13.135. Measures such as check dams, silt traps, settlement lagoons and buffer strips will minimise sedimentation and erosion; further details of these measures are outlined in the CEMP.

13.136. Other Sustainable Drainage System (SuDS) measures, such as the use of settlement lagoons, swales and interception bunds, will effectively prevent sediment entering watercourses via drainage ditches adjacent to access tracks. As such, there will be limited potential for sediment or erosion effects on watercourses in the Core Study Area, including the hydrology and water quality of onsite watercourses.

13.137. For these reasons, the magnitude of this effect will be negligible. Given the Moderate sensitivity of the watercourses and negligible magnitude of effects, the significance of effects associated with erosion and sedimentation is assessed as being negligible. This is not significant in terms of the EIA Regulations.

Groundwater and Near Surface Water

13.138. Sediment also has the potential to change near-surface water flow in superficial geology deposits and peaty soil characteristics by creating a physical barrier within naturally occurring drainage micropores. Sediment entering near-surface water in superficial deposits also has the potential to impact on groundwater quality within bedrock deposits / fissures.

13.139. Measures described in Technical Appendix 13.A, such as impermeable ground membrane layers and bunded areas, will effectively prevent sediment entering sub-surface water in superficial deposits (and groundwater) and peat. For these reasons, the magnitude of this effect will be negligible. Given the Moderate sensitivity of near-surface water and High sensitivity of groundwater and negligible magnitude of effect, the significance of the effect associated with erosion and sedimentation is considered to be negligible. This is not significant in terms of the EIA Regulations.

Private Water Supplies

13.140. The quality of PWS could be affected by sediment mobilisation. PWS within the catchment of Proposed Development infrastructure are considered to be of High sensitivity.

13.141. Given the distance between the receptors and the Proposed Development, any sediment generated is likely to drop out of suspension before reaching the PWS, even in the absence of embedded design measures.

13.142. Measures detailed in the CEMP and in paragraphs 13.114 and 13.115 combined with monitoring as detailed in the CEMP will limit the potential for the mobilisation of sediment.

13.143. Therefore, effects on PWS, of High sensitivity, have the potential to be of negligible magnitude and therefore (in accordance with Table 13.4) of negligible significance. This is not significant in terms of the EIA Regulations.

Impediments to Flow

13.144. The access tracks will require the installation of 2 new watercourse crossings across all sections of the Proposed Development. Additionally, the use of the existing access track which has existing watercourse crossings, which serves the Operational Schemes and Corriemoillie Wind Farm, has removed the requirement to upgrade the existing watercourse crossings, therefore minimising the potential for impediment to flow.

13.145. The minimisation of the number of proposed watercourse crossings and the re-use of the existing watercourse crossings reduces one of the main activities that could give rise to impediment of flows. The indicative culvert design is outlined in the CEMP, detailed design will be carried out at the construction phase and will be agreed with SEPA.

13.146. In addition to watercourse crossings, felling of trees can increase surface water run-off and cause impediments to river flow through accumulation and transfer of brash. Brash build up within watercourses has the potential to impede the passage of waterborne ecology and divert / concentrate flow to river banks. In the long-term, however, it is generally accepted that, the removal of plantation forestry in proximity to watercourses can improve surface water conditions due to increased growth of bankside vegetation, improved ground level lighting and reduced potential for the introduction of impediments to flow.

13.147. Measures described in the CEMP, such as brash matting, not stockpiling brash and not allowing brash to block drainage ditches or enter watercourses, verified by visual inspections, further reduce the potential for this effect to occur.

13.148. Therefore, the effects on watercourses of Moderate sensitivity are considered to be of negligible magnitude and, therefore of negligible significance. This is not significant in terms of the EIA Regulations.

Changes in Groundwater and Peaty Soil Interflow Patterns

13.149. Some turbine base excavations may need temporary sub-surface water controls, such as physical cut-offs or de-watering. These temporarily divert flows away from the excavation, and temporarily lower the local water table and sub-surface water levels in peat. Localised temporary changes to soil and peat interflow patterns may therefore arise. Turbine foundations and crane hardstandings also have the potential to change sub-surface water flow by creating physical barriers within naturally occurring drainage macropores in soil or peat.

13.150. The drying out of peaty soil can result from alterations to the natural drainage regime. Measures set out in the Section 8 of Technical Appendix 13.A, such as the rewetting of peat through controlled irrigation techniques, are considered sufficient, and sufficiently reliable, to avoid substantial alterations to the

natural drainage regime. As a result, peat is not expected to dry out, beyond what would be the case in the baseline scenario. No substantial impediments to near-surface water flow will be created as the detailed site drainage design will consider any severance of saturated areas to ensure hydrological connectivity is maintained, in accordance with SEPA / SNH 'Good practice during wind farm construction'.

13.151. Consequently, effects on soil (Moderate sensitivity receptor) are considered to be of negligible magnitude and therefore negligible significance. This is not significant in terms of the EIA Regulations.

Compaction of Soils

13.152. Construction of access tracks and movement of construction traffic, in the absence of construction good practice, can lead to compaction of the soil. This can reduce soil permeability, potentially leading to increased run-off and increased erosion. The superficial geology underlying the Proposed Development is generally of low permeability, so the effects of compaction would not result in a significant increase in runoff from existing conditions. Access tracks for the Proposed Development should be designed to avoid impinging on areas of heavily saturated ground.

13.153. In order to maintain the current level or improve the drainage, it is necessary to ensure that construction methods do not seriously disrupt the established drainage and that no areas are saturated, either by water discharge or spoil blocking pathways.

13.154. Maintenance of existing drainage is critical to avoid compaction of soils, therefore all existing drainage network channels, such as those draining the existing wind farms adjacent to the Proposed Development, will be maintained and where necessary, channelled below the proposed road construction, as described in Section 6 of Technical Appendix 13.A. Drainage ditches on the upslope of the road are likely to be required on side-long ground. If required, the ditches will be constructed with small dams and cross drains where necessary in order for water to drain below the road at regular intervals and that concentrated discharges to soil / peat on the down slope side of the road are avoided, as outlined in Section 6 and 8 of Technical Appendix 13.A.

13.155. Existing access tracks have been used in the design where practicable, further reducing the potential for soil compaction. Furthermore, the percentage of the Core Study Area proposed for the construction of new infrastructure is small.

13.156. For these reasons, the magnitude of this effect will be negligible. Given the Moderate sensitivity of soils and negligible magnitude of effect, the significance of effects associated with the compaction of soils is considered to be negligible. This is not significant in terms of the EIA Regulations.

Peat Disturbance

13.157. The turbines and associated infrastructure affected by the deep peat are T3 and T4 and track sections between T5, T4 and T3, where peat up to depths of

1.1 m, 2.75 m and up to 3.5 m were recorded respectively. The areas of peat recorded were consistent with the National Soils of Scotland Mapping, which classified the eastern site area to be blanket peat and the Carbon and Peatland 2016 mapping indicating Class 5 soils across the majority of the eastern site area.

13.158. The assessment of peat disturbance has highlighted localised areas of peat at risk from the Proposed Development, in particular the eastern part of the site indicative of a Medium risk of disturbance to Class 1 or 2 priority peatland (carbon-rich and peaty soils which cover <20% of the Development Area), or Class 3 and 5 peatland areas, carbon rich and peaty soils. The magnitude of effect is considered to be Moderate due to loss of, or alteration to the baseline resource such that post development characteristics or quality will be partially changed and a mid-term /permanent change to the baseline resource.

13.159. On this basis, in the absence of mitigation, the Proposed Development is considered to result in a potential effect of moderate significance on a receptor of Moderate sensitivity. This is considered a significant effect in terms of the EIA Regulations.

13.160. Peat Stability

13.161. Peat instability is generally the result of a combination of causative factors. Several construction activities have the potential to increase the likelihood of peat slides in areas where peat is present at a sufficient depth and where gradients are sufficiently steep to result in a peat slide event.

13.162. Construction activities that have the potential to increase the likelihood of peat slides include locating proposed infrastructure including track networks on sloping ground which often involves removal of surface vegetation and excavation of peat and other soils.

13.163. Due to the presence of peat, a Peat Slide Risk Assessment was undertaken and is included in Appendix 13.B. This PSRA was carried out in accordance with the Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments, 2017, which is a requirement for projects with a generating capacity of 50MW or above, falling under Section 36 of the Electricity Act 1989.

13.164. Peat slides can affect soils and local sensitive habitats and have the potential to affect surface water systems from soil inundation, leading to sedimentation. This can have an effect by reducing water quality and/or modify drainage patterns. Receptors identified across the Proposed Development area are:

- Existing forestry tracks and paths
- Existing minor watercourses
- Proposed Wind Farm Infrastructure

13.165. Peat depths are typically shallow, generally less than 1.0 m across the wider site area, particularly the western and central site areas, with areas of deeper peat in the eastern area. Potential peat stability issues were identified as localised and are generally on slopes with shallow peat or non-peat soils.

13.166. Within the Proposed Development footprint, the assessment concluded only localised low risk zones within a wider generally negligible hazard rank. Two isolated medium risk points were identified, at two single peat probe locations, the result of thin peat (0.1 m) over very steep slopes, close to proposed infrastructure. Localised pockets were highlighted as low risk, in the vicinity of T2, T8 and T9 and a 200 m section of track between T4 and T5 resulting from deep peat being located within non-flat areas, just greater than 2 degrees. The remainder of the infrastructure lies within areas of negligible risk from peat slide.

13.167. On this basis, in the absence of mitigation, the Proposed Development is considered to result in a potential effect of minor significance and would therefore not be significant, in accordance with the EIA Regulations.

Good practice measures are embedded in the design principles and adoption of further best practices, will reduce the effect of peat instability.

Effects on the Hydrological Function of Wetland Habitats

13.168. Wetland habitats supporting heath communities are present within the Core Study Area with potential for hydrological impact from the Development.

13.169. An area of M15 is located on the eastern slope of Meallan Caoruinn, occurring within the footprint of the proposed southern borrow pit, T6 and T7. Excavations for access tracks are likely to be less than 1 m in depth and restricted to the footprint of the access track, while the footprint of the proposed turbines where excavations may reach up to 3 m in depth with potential for direct impact (i.e. habitat loss) to wetland habitats in these areas. Indirect impacts of disturbance to surrounding wetland habitats may also occur. Near-surface water through superficial deposits may be disrupted by the cut and fill access track to T6 and T7, as the installation of aggregate may cause a physical blockage to water flow in micro and macropores within the M15 community, where the access track runs perpendicular to natural flow.

13.170. Approximately 338.2 ha of M15 exists within the Core Study Area. Approximately 5.82 ha of M15 will be directly lost as a result of infrastructure at the Development being located within this community. Therefore, approximately 1.7 % of this community will be directly lost as a result of the Development. As such, direct hydrological effects will equate to a 'minimal detectable effect on a GWDTE (between to 0.1 % - 5 % of study area) or no discernible effect on its integrity as a feature or its functionality' in accordance with Table 13.3. Therefore the magnitude of the loss M15 will result in a negligible effect. Given the moderate sensitivity (as set out in Table 13.9) and negligible magnitude of effect, the significance of effects associated with the loss of M15 is negligible. This is not significant in terms of the EIA Regulations.

13.171. Some infiltration of surface water through the access tracks is expected in this habitat, but the majority of the water will enter the surface water drainage system and will be discharged downslope of the access track at specified points. It is also likely that there will be temporary localised lowering of the

water levels within the soil layers downslope of the access track and turbine foundations immediately after construction, due to a reduction in the quantity of near-surface water into this area. It is anticipated that this will replenish with rainwater.

1.171.1. Indirect effects could also occur in the west of the Core Study Area in proximity to T8 and T9. However the turbine locations are downgradient of the M15 community with a fall of between 10 m and 30 m suggesting that turbine foundations will not cause an obstruction to near-surface water flow feeding the habitat.

13.172. Regardless, the embedded design measures outlined in Section 8.2 of Technical Appendix 13.A will also minimise the indirect effects on wetland habitats. As such, indirect hydrological effects will equate to a 'slight or negligible change from baseline condition of geological resources. Change hardly discernible, approximating to a 'no change' in geological condition' in accordance with Table 13.3.

13.173. Good practice design and construction (outlined in paragraph 13.43 to 13.55) and measures outlined in Section 8.2 of Technical Appendix 13.A will minimise potential indirect effects of the Development on wetland habitats, particularly marshy grassland and mesotrophic grassland.

13.174. Prior to access track construction, site operatives will identify flush areas, depressions or zones which may concentrate water flow. These sections will be spanned with plastic pipes or drainage matting to ensure hydraulic conductivity under the road, and reduce water flow over the road surface during heavy precipitation.

13.175. Additionally, the following design measures will ensure that effects on wetland habitats are minimised:

- A PPP is implemented to ensure good practice working methods are followed throughout construction works.
- Silt traps will be deployed to trap and filter sediment-laden run-off throughout the construction phase of the Development.
- Settlement lagoons will be constructed and actively managed to control water levels and ensure that any run-off is contained, especially during times of rainfall.
- Turbine foundations are constructed in holes in the ground that will be de-watered, and hence water flow is typically into the foundation area. This will prevent concrete leaching into groundwater or surface water in the event of shutter collapse.
- All excavations will be sufficiently dewatered before concrete pours begin and that dewatering continues while the concrete cures. However, construction good practice will be followed to ensure that fresh concrete is isolated from the dewatering system.
- If required turbine foundations may be dewatered, temporarily lowering water levels in the superficial deposits and near-surface groundwater. The dewatering process would involve the treatment of any extracted water to remove any sediment and redistributing the water onto a

vegetated surface in proximity to the excavation. This process would not involve any net loss of water from the hydrological system and would ensure that the water being treated is of the same (or similar) quality to what was extracted. Hence, there would not be an unacceptable effect on groundwater or near-surface water supplying GWDTEs.

13.176. In accordance with Table 13.9, wetland habitats are defined as Moderate sensitivity. The magnitude of indirect effects is considered to be negligible. As such, there will be negligible predicted significance on the hydrological function of GWDTEs. This is not significant in terms of the EIA Regulations.

Bedrock Excavation

13.177. A volume of excavated material required for the Proposed Development will be obtained from excavations for new access tracks, hardstandings and blade laydown areas, for the substation, and from onsite borrow pits. Two borrow pit search areas have been identified for the Proposed Development.

13.178. Two new borrow pits areas will be considered during the site investigation stage. The total proposed area of the borrow pits will be a small percentage of the larger bedrock area underlying the Core Study Area.

13.179. In the context of the geological resource, the extraction volumes are small.

13.180. For this reason, the magnitude of the loss of bedrock will be a negligible effect. Given the low sensitivity (as set out in Table 13.4) and negligible magnitude of effect, the significance of effects associated with the loss of bedrock is negligible. This is not significant in terms of the EIA Regulations.

Acidification of Watercourses

13.181. Felling of forestry and the storage of brash could potentially result in a short-term increase in the acidity of watercourses within the immediate catchment of forested areas and have an effect on water quality and ecology. This can result from two possible processes:

- Nitrate leaching of stockpiled brash, if stored close to watercourses; and
- Disturbance of the ground due to felling activities very close to watercourses could lead to flushing of acid from groundwater, if measures to prevent run-off from entering the watercourses directly are not achieved.

13.182. Felling will also involve the movement of heavy machinery across a soft ground surface, and hence will lead to soil disturbance which could have the potential to lead to acidification and sedimentation.

13.183. Forestry good practice measures are set out in the Technical Appendix 13.A, including specific measures for felling and for forestry activities within 50 m of a watercourse. These measures will be implemented and maintained, and this will be carried out during the construction phase under supervision of an ECoW, whose role is described in Technical Appendix 13.A.

13.184. It is proposed in the Felling Plan that 4.09 ha of stocked woodland would be removed for the Proposed Development as outlined in Section 16.7 of Chapter 16: Forestry. This comprises 1.4 % of the forested area.

13.185. The adoption of these measures combined with the small area of felling would mean that the magnitude and significance of resulting effects would be negligible. Given the Moderate sensitivity of watercourses the residual significance is negligible. This is not significant in terms of the EIA Regulations.

Increase in Runoff and Flood Risk

13.186. The increase in hardstanding area associated with construction and operation of the Proposed Development could increase the volume and rate of localised surface run-off, although a large proportion of the proposed infrastructure hardstanding, including access tracks and crane hardstandings, would be permeable to some extent. The impermeable nature of the thin soils onsite and the underlying geology, however, means that, in the baseline scenario, there will be relatively low infiltration and relatively high run-off rates, and hence the addition of the Proposed Development would have minimal effect on the existing run-off scenario.

13.187. The design of the Proposed Development layout has incorporated a buffer zone between watercourses and turbine bases of 50 m to watercourses.

13.188. Measures, including SuDS, to attenuate run-off and intercept sediment prior to run-off entering watercourses are described in Section 2 of Technical Appendix 13.A and are embedded as part of the Proposed Development design. Furthermore, the area of new hardstanding is small, in terms of the percentage of the relevant catchments that may be affected.

13.189. The flooding report provided as Technical Appendix 13.E describes flood damage in a separate catchment to the Proposed Development, therefore the Proposed Development will not exacerbate flooding issues or overwhelm any remedial measures that have been put in place.

13.190. No turbines, construction compounds, substations or meteorological masts are located within areas described as having a 0.5 % or greater annual risk of flooding. However, one small area of existing access track (approximately 60 m in length) from the A835 is located adjacent to an area described as having a 0.5 % or greater annual risk of flooding. As the track is existing and is culverted using a recently installed bottomless arched structure, these elements do not require upgrading and will not alter the baseline flooding scenario.

13.191. For these reasons, effects on watercourses of Moderate sensitivity are considered to be of negligible magnitude and therefore negligible significance. This is not significant in terms of the EIA Regulations.

Potential Operational Effects

13.192. Potential effects associated with the operation of the Proposed Development are:

- Increased run-off rates and volume;
- Continued erosion and sedimentation from runoff from areas of hardstanding;
- Alterations to natural flow pathways from runoff from areas of hardstanding; and
- A risk of a pollution event from minor spills from maintenance vehicles.

13.193. The nature of these effects has been discussed in relation to the construction phase. As there would be substantially less activity during operation, and as there is unlikely to be any significant ground disturbance during operation, the magnitude of these effects is similarly reduced.

13.194. There would be minimal or no impacts upon peat and soils during the operational phase, and significant effects are not anticipated.

13.195. There will be a minor reduction in the potential for increased surface water run-off during the operational phase due to the reduction in hardstanding areas used during the construction phase, such as the removal of the construction compounds.

13.196. Whilst alterations to natural flow pathways will not be introduced during the operational phase, any changes during construction will continue through operation, as the majority of infrastructure will remain in place. Alterations to natural flow pathways will be reduced through adopting good practice design and construction, as set out in the CEMP, such as cross drainage, use of shallow drainage ditches and prevention of blockages.

13.197. As a result, the magnitude and significance of all effects associated with operation of the Proposed Development are assessed as being negligible, and not significant in terms of the EIA Regulations.

Potential Decommissioning Effects

13.198. Potential effects of decommissioning the Proposed Development are similar in nature to those during construction, as some ground-work would be required to remove turbine foundations and hardstandings to 1 m below ground level. These effects would be substantially lesser in magnitude than during construction, and would be controlled by a PPP, as discussed previously. Where infrastructure would be left in place, drainage features would also be left in place, where this is compatible with the PPP.

13.199. During decommissioning, the bases would be broken out to below ground level. All cables would be cut off below ground level, de-energised, and left in the ground. Access tracks would be left for use by the landowner. No stone would be removed from the Site. The decommissioning works are estimated to last six months. This approach is considered to be less environmentally damaging than seeking to remove foundations, cables and roads entirely. Therefore, it is considered that decommissioning, activities would be less intrusive and would not disturb peat, therefore no significant effects are anticipated.

13.200. As a result, the magnitude and significance of all effects associated with decommissioning are assessed as being negligible, and not significant in terms of the EIA Regulations.

Mitigation and Residual Effects

13.201. Embedded design and construction good practice measures are included in Technical Appendix 13.A. The embedded design and construction good practice measures are based on experience of providing detailed site design for several wind farm developments across Scotland, in consultation with SEPA.

13.202. Micro-siting of turbines located in deep peat within micro-siting buffers and the use of floating track construction methods in areas where peat is consistently 1.0 m or greater will reduce peat disturbance. With the embedded design measures described in Technical Appendix 13.A and PPP in place and adoption of best practice measures for peat avoidance and management as described in Technical Appendix 13.C outline Peat Management Plan, all identified potential effects have been assessed as being of negligible significance. The embedded design measures proposed are established measures that are widely used in construction projects and which Infinergy and its contractors are well used to undertaking. Given the levels of certainty in the success of application of the mitigation measures and their effectiveness it is appropriate that the mitigation measures are considered and assumed to be fully effective in the determination of this application.

13.203. No residual effects are predicted for all phases of Proposed Development, and are therefore not significant in terms of the EIA Regulations.

Cumulative Effect Assessment

13.204. The methodology followed to assess the cumulative impacts is the same as that used for the Proposed Development in isolation.

13.205. A cumulative effect is considered to be an additional effect on hydrological resources (within the same hydrological catchment) arising from the Proposed Development in addition to the combination of other developments likely to affect the hydrological environment. At distances greater than 10 km, it is considered that schemes are unlikely to contribute to a cumulative

hydrological effect due to attenuation and dilution over distance of potentially polluting chemicals. Therefore, for the purposes of the assessment of potential cumulative effects on the immediate catchment and hydrological regime, only proposed developments, which require large scale construction / excavation, within approximately 10 km of the Proposed Development have been considered.

13.206. Peat is considered as a site-specific consideration and it is not considered that there will be cumulative effects.

Cumulative Developments within 10 km (consented or under construction)

13.207. There are no developments that have been consented or are under construction within 10 km of the Proposed Development.

13.208. Operational wind farms are considered to form part of the baseline for the purposes of cumulative assessment.

Predicted Cumulative Effects

13.209. There are no cumulative effects predicted during the construction and operational phased of the Proposed Development, similarly no residual cumulative effects are predicted.

Summary of Effects

13.210. This Chapter identified no likely significant effects, following the embedded measures (outlined in Technical Appendix 13.A) in the design of the Proposed Development.

13.211. Table 13.10 summarises the predicted effects of the Proposed Development on the hydrology and hydrogeology resources.

Table 13.10 Summary of Effects

Receptor	Potential Effect	Significance of Effect	Mitigation Proposed	Residual Significance
Construction				
Watercourses, Near-surface water and PWS	Chemical Pollution	Negligible	None	Negligible
Watercourses, Near-surface water and PWS	Erosion and Sedimentation	Negligible	None	Negligible
Watercourses	Impediments to Flow	Negligible	None	Negligible
Soils and near-surface water	Changes in Soil Interflow Patterns	Negligible	None	Negligible

Receptor	Potential Effect	Significance of Effect	Mitigation Proposed	Residual Significance
Soils	Compaction of Soil	Negligible	None	Negligible
Peat	Disturbance	Moderate	Micro-siting of turbines located in deep peat within micro-siting buffer to reduce peat disturbance. Floating tracks in areas where peat is consistently 1.0m or greater. Best Practice Measures for avoiding peat and the management of peat and peaty soils.	Low
Peat	Peat Stability	Low	Micro-siting of turbines located in deep peat within micro-siting buffer to reduce peat disturbance. Floating tracks in areas where peat is consistently 1.0m or greater. Best Practice Measures for avoiding peat and the management of peat and peaty soils.	Negligible
GWDTE	Effects on the Hydrological Function of GWDTEs	Negligible	None	Negligible
Watercourses and Near-surface water	Migration of Pollutants from Contaminated Land	Negligible	None	Negligible
Watercourses	Acidification of Watercourses	Negligible	None	Negligible
Watercourses	Increase in Run-off	Negligible	None	Negligible
Operation				
Watercourses and Near-surface water	Increased Run-off Rates / Volume	Negligible	None	Negligible

Receptor	Potential Effect	Significance of Effect	Mitigation Proposed	Residual Significance
Watercourses, Near-surface water and PWS	Erosion and Sedimentation	Negligible	None	Negligible
Soils and near-surface water	Alterations to natural flow pathways	Negligible	None	Negligible
Peat	Disturbance	Negligible	None	Negligible
Peat	Peat Stability	Negligible	None	Negligible
Decommissioning				
Watercourses, Near-surface water and PWS	Chemical Pollution	Negligible	None	Negligible
Watercourses, Near-surface water and PWS	Erosion and Sedimentation	Negligible	None	Negligible
Soils and near-surface water	Changes in Soil Interflow Patterns	Negligible	None	Negligible
Soils	Compaction of Soil	Negligible	None	Negligible
Peat	Disturbance	Negligible	None	Negligible
Peat	Peat Stability	Negligible	None	Negligible
GWDTE	Effects on the Hydrological Function of GWDTEs	Negligible	None	Negligible

Statement of Significance

13.212. This Chapter has assessed the likely significance of effects of the Proposed Development on hydrology, hydrogeology, geology and peat. The Proposed Development has been assessed as having the potential to result in effects of negligible significance and effects of low significance for peat.

13.213. Given that only effects of moderate significance or greater are considered significant in terms of the EIA Regulations, the potential effects on hydrology and hydrogeology and are considered to be not significant.

[i] Scottish Government (2017) the Town and Country Planning (EIA) (Scotland) Regulations 2017 [Online] Available at: http://www.legislation.gov.uk/ssi/2017/102/contents/made (Accessed 02/03/18)

[ii] European Commission (2000) The Water Framework Directive (2000/60/EC) [Online] Available at: http://ec.europa.eu/environment/water/water-framework/index_en.html (Accessed 08/01/2018)
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