7. HYDROLOGY AND GEOLOGY

7.1 General Introduction

This chapter identifies the likely impacts on hydrology, geology and soils and hydrogeological receptors associated with the construction and operation of the Proposed Development. The objectives of the chapter are to:

- describe the hydrology, geology and soils, and hydrogeology baseline;
- identify the potential direct and indirect impacts on hydrology, geology and soils, and hydrogeology receptors; and
- describe any mitigation measures proposed to address likely impacts.

This chapter is supported by the following Figures (**Volume 3a**) and Technical Annexes (**Volume 2**):

- **Technical Annex 7.1: Peat Depth Survey Results ;**
- **Technical Annex 7.2: Draft Peat Management Plan;**
- **Technical Annex 7.3: Peat Landslide Hazard Risk Assessment ;**
- **Figure 7.1: Surface Water Features ;**
- **Figure 7.2: Groundwater Dependent Terrestrial Ecosystems ;**
- **Figure 7.3: Hydrological Analysis of Groundwater Dependent Terrestrial Ecosystems ;**
- **Figure 7.4 Bedrock Geology ;**
- **Figure 7.5: Superficial Geology ;**
- **Figure 7.6: Soils Map of Scotland ; and**
- **TA Figure 7.3.3: Peat Depths .**

The hydrological assessment has been undertaken by Jo Thorp of Ramboll who has five years' experience in hydrological assessments, and Chris Day of Ramboll who has over ten years' experience in hydrological assessments across a variety of sectors, including the assessment of electrical transmission infrastructure. The geology, soils and peat assessment has been undertaken and reviewed by Jeff Turner, a Chartered Environmentalist and member of the Society for the Environment, Institute of Environmental Science, and Institute of Environmental Management and Assessment (CEnv, MIEnvSc, PIEMA, BSc (hons)). Jeff has over 22 years' experience in the co-ordination and management of Environmental Impact Assessments, including those for renewable energy developments. As part of this experience, Jeff has been responsible for managing the potential effects of electrical transmission infrastructure on peat and carbon rich soils, including the identification of suitable mitigation measures to minimise the effects from development.

7.2 Scope and Methodology

This chapter identifies and assesses the likely potential effects of the Proposed Development on surface water features and groundwater hydrology, geology, soils, and peat, through desk-based assessment supplemented by a field survey.

7.2.1 Study Area

Hydrological issues are typically considered at a catchment scale. The Hydrology Study Area therefore comprises a desk Study Area, that takes into account a 2 km buffer of the Site (**Figure 7.1, Volume 3a**), and watercourses with further downstream hydraulic connectivity to the Site which includes the downstream reaches of the River Aray. The Field Hydrology Study area includes the Site. The Field Hydrology Study area for geology, soils and peat also comprises the area within the Site (areas within the Red Line Boundary) as shown on **Figure 7.3.3, TA 7.3 (Volume 2)**.

7.2.2 Consultation

A summary of the key consultation comments and how they have been addressed is provided in **Table 1.1, Chapter 1 (Volume 1).**

7.2.3 Desk Study

The desk-based assessment was undertaken using opensource information including:

- Ordnance Survey (OS) 1:10,000 scale mapping;
- Scottish Environmental Protection Agency (SEPA) Flood Maps[1];
- SEPA River Basin Management Plan (RBMP) Water Environment Hub[2];
- British Geological Survey (BGS) Hydrogeological Maps of Scotland[3];
- NatureScot Site Link[4];
- Hutton Institute National Soil Map of Scotland 1:25,000 scale[5]; and
- Scotland's Soils Carbon and Peatland Map 2016[6].

7.2.4 Field Survey

In addition to the above opensource datasets a hydrology field survey in the area of the Site was undertaken by Ramboll on 10 May 2021, 3 November 2021 and 3 August 2022. Weather conditions prior to, and during, visits conducted in 2021 were wet with rain during and prior to the visit with saturated ground. Conditions during the 2022 surveying consisted of light rain. The purpose of the surveys was to photograph and document key parameters (stream width, stream depth, and bed substrate) of watercourses identified on the 1:10,000 scale OS mapping, as well as any additional waterbodies in connection with the proposed Creag Dhubh to Dalmally 275kV Overhead Line (OHL) , the proposed Creag Dhubh substation and the proposed Inveraray to Creag Dhubh 275kV OHL., within the immediate vicinity of the Site and downstream reach of the River Aray. Surveyed locations (A to F) are shown in **Figure 7.1** (**Volume 3a**). Photographs of selected survey points are in **Plates 1** and **2** of this chapter.

Four rounds of peat depth probing were undertaken within the Proposed Development area and as part of the adjacent projects comprising the proposed Creag Dhubh Substation, the Creag Dhubh to Dalmally 275 kV Overhead Line (OHL) and Inveraray to Creag Dhubh 275 kV OHL between March 2021 and April 2022. The peat probe locations included within the survey are stated in **Technical Annex (TA) 7.1** (**Volume 2**) and illustrated in **Figure 7.3.3, TA 7.3 (Volume 2)**. The peat depth probe survey was undertaken based on the design of the Proposed Development available at the time of the surveys, and was initially undertaken on a coarse grid, based on 100 m centres, followed by a more refined probe grid at approximately 20 m centres (subject to access and health and safety constraints, see limitations and assumptions).

In addition to the peat depths, a number of peat cores were taken using a Russian auger, with a sample volume of 0.5 l, and a number of field tests and observations were undertaken to identify:

- Depth of acrotelm;
- Water content;
- Degree of humification (using Hodgson, 1974), to establish amorphous, intermediate, fibrous and content; and
- Degree of humification using the Von Post classification.

[1] SEPA Flood Maps https://map.sepa.org.uk/floodmap/map.htm [Accessed: 17/11/21]
[2] SEPA Water Environment Hub https://www.sepa.org.uk/data-visualisation/water-environment-hub/ [Accessed: 17/11/21]
[3] British Geological Survey (BGS) Hydrogeological Maps of Scotland https://www.bgs.ac.uk/datasets/hydrogeological-maps-of-scotland/ [Accessed: 17/11/21]
[4] NatureScot Site Link https://sitelink.nature.scot/map [Accessed 17/11/21]
[5] Hutton Institute (2013), *National Soil Map of Scotland*. Available at http://map.environment.gov.scot/Soil_maps/?layer=1 [Accessed September 2022]
[6] Scottish Government (2016), *NatureScot Carbon and Peatland Map 2016*. Available at http://map.environment.gov.scot/Soil_maps/?layer=10 [Accessed September 2022]

Samples were subsequently submitted to a soils testing laboratory to analyse each sample for bulk density, loss on ignition (organic content), moisture content, and pH.

During each survey observations of peat instability or peat geomorphological conditions were recorded to inform this assessment.

7.2.5 Limitations and Assumptions

This assessment makes use of opensource and publicly available data resources, complimented by further surveys specific to the Site. The assessment of potential impacts within this chapter is reliant on the accuracy of the public data, which is considered robust and sufficient to enable this assessment to be completed.

Peat cores undertaken as part of the proposed Creag Dhubh Substation project have been used for the purpose of this assessment and are considered to be representative of peat baseline conditions based on their close proximity and similar morphology and topography.

Surveys were undertaken following access protocols and procedures to ensure the safety and wellbeing of the surveyors. This included limited access in some areas of dense forestry or soft ground, or crossing of burns and water features.

7.2.6 Appraisal of Potential Impacts

An appraisal has been undertaken of potential impacts to hydrology, geology and soils, and hydrogeology as a result of the Proposed Development during construction and operation.

The appraisal has been undertaken with reference to the following guidelines and technical guidance:

National Legislation and Policy

- Water Environment and Water Services (Scotland) Act 2003;
- Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended) (CAR);
- The Water Environment (Miscellaneous) (Scotland) Regulations 2017;
- Flood Risk Management (Scotland) Act 2009;
- The Water Intended for Human Consumption (Private Supplies) (Scotland) Regulations 2017;
- The Public and Private Water Supplies (Miscellaneous Amendments) (Scotland) Regulations 2015;
- The Public Water Supplies (Scotland) Regulations 2014 (as amended 2017); and
- The Water Environment (Drinking Water Protected Areas) (Scotland) Order 2013.

Guidance and Advice

- Pollution Prevention Guidelines (PPG) 1: Understanding your environmental responsibilities - good environmental practices (July 2013);
- Guidance for Pollution Prevention Guidelines (GPP) 2: Above ground oil storage tanks (January 2017);
- GPP 4: Treatment and disposal of wastewater where there is no connection to the public foul sewer (November 2017);
- GPP 5: Works and maintenance in or near water (January 2017);
- PPG 6: Working at construction and demolition sites (2012);
- GPP 13 Vehicle washing and cleaning (April 2017);
- GPP 21: Pollution incident response planning (July 2017);
- PPG 22: Incident response - dealing with spills (October 2017);
- Planning Advice Note (PAN) 79: Water and Drainage (September 2006);
- LUPS-DP-GU2a: Development Plan Guidance on Flood Risk (2017);

- LUPS-GU19: Planning advice on wastewater drainage (2011);
- LUPS-GU31: Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems, Version 3 (September 2017);
- WAT-SG-25: Good Practice Guide - River Crossings (November 2010) ;
- WAT-SG-26: Good Practice Guide - Sediment Management (September 2010);
- WAT-SG-29: Good Practice Guide - Temporary Construction Methods (March 2009);
- WAT-SG-75: Sector Specific Guidance: Construction Sites;
- WAT-PS-06-02: Culverting of Watercourses (June 2015);
- SEPA (2015), CAR - A Practical Guide, Version 7.4 (October 2019); and
- Scottish Government (2012) River Crossings and Migratory Fish.

7.2.7 Cumulative Effects

An appraisal has been undertaken of potential in-combination impacts with the following cumulative schemes identified in **Chapter 2: Environmental Appraisal Methodology and Scope (Volume 1)** and **Figure 2.2 (Volume 3a)** which fall within the desk Hydrology Study Areas:

- the proposed Creag Dhubh to Dalmally 275 kV Connection (ECU00002199, In-planning and forms part of the Argyll and Kintyre 275 kV Strategy);
- the proposed Creag Dhubh to Inveraray 275 kV OHL Connection Project (In-planning, and forms part of the Argyll and Kintyre 275 kV Strategy);
- the proposed Creag Dhubh Substation (22/00772/PP, In-planning and forms part of the Argyll and Kintyre 275 kV Strategy);
- Blarghour Wind Farm (ECU00005267; consented 29 October 2021);
- Blarghour Wind Farm OHL Connection (pre-planning, reasonably foreseeable, has been subject to public consultation and under SSEN Transmission's operating license, there is a legal obligation to connect energy generators));
- Commercial forestry schemes including the M23:Keppochan East and Keppochan Indicative Long Term Felling Plan (LTFP) within which the Site is located.

7.3 Baseline Conditions

7.3.1 Surface Hydrology

The Site is located within the River Aray catchment and the Site sits adjacent to the headwaters of the River Aray. The overall catchment area of the River Aray, upstream of its discharge to coastal waters at Loch Fyne, has been calculated using topographic data analyses using ArcPro GIS software tools, to extend to approximately 63 km^2. This has also been verified using the Flood Estimation Handbook web service[7].

The Site is crossed in the north by a small watercourse, the An Aodann (**Figure 7.1** (**Volume 3a**) and **Plate 1, A**), which flows north and discharges into another minor watercourse (**Figure 7.1 (Volume 3a**) and **Plate 1, B**) approximately 470 m north of the Proposed Development. An Aodann crosses the Proposed Development between diversion poles P5 and P6 and flows approximately 15 m north of the proposed permanent access track at its closest point. An Aodann discharges to a burn approximately 520 m north of the Proposed Development which changes direction to flow south joining the larger, deeper headwaters of the River Aray (**Figure 7.1** (**Volume 3a**) and **Plate 1, C**). As shown in **Figure 7.1 (Volume 3a)**, the River Aray flows approximately 200 m east of the Proposed Development at its closest point, at the new terminal tower 35b. An

7 Flood Estimation Handbook Web Service https://fehweb.ceh.ac.uk/GB/map [Accessed 26/11/21]

unnamed small watercourse is present approximately 30 m south of the Proposed Development .The proposed diversion pole P1 is the closest point of the Proposed Development to this unnamed watercourse.

Plate 1: Watercourses

		
A: An Aodann crossing the north of the Proposed Development looking upstream/ south-west.	**B:** Burn crossing the south of the Proposed Development looking downstream/ southeast.	**C:** Watercourse to the east of the Proposed Development looking upstream/ north.

7.3.2 Flood Risk

The Site is not indicated to be at risk of fluvial flooding according to the SEPA Flood Maps. However, SEPA flood mapping does not include watercourses with catchment areas <10 km². Therefore, due to their size, the watercourses bounding the Site have not been mapped for fluvial flood risk and, for such watercourses, pluvial flood risk mapping may present a better assessment of potential flood risk areas. There are areas of the Site indicated to be within the High probability surface water (pluvial) flood extent (1 in 10 year, or 10% Annual Probability (AP))[8] according to SEPA's online flood map service.

7.3.3 Water Quality

The Site, and the watercourses within it, do not fall within any Internationally or nationally designated areas such as Sites of Special Scientific Interest, Special Protection Areas or Special Areas of Conservation. The River Aray is classified within SEPAs RBMP as being in overall 'Good' condition[9], with the physical condition and water quality of the watercourse also classified as being 'Good'. The River Aray ultimately discharges into coastal waters at Loch Fyne, which is designated as a Shellfish Water under the Water Environment (Shellfish Water Protected Areas: Designation) (Scotland) Order, 2013[10].

The Site is not located within a Drinking Water Protected Area (DWPA)[11] and has no downstream connectivity with a DWPA.

Mapping of catchments vulnerable to acidification[12] is presented by Forest Research, a research agency of the Forestry Commission. No catchments in vicinity of the Site are shown to be vulnerable to acidification. There are five Nitrate Vulnerable Zones (NVZs) in Scotland as set out by the Agriculture and Rural Economy Directorate[13] and none of these are downstream of the Proposed Development. Therefore, these sensitivities are not relevant to the River Aray catchment.

8 SEPA Flood Maps: https://map.sepa.org.uk/floodmaps

9 Assessed under the Water Framework Directive classification scheme: https://www.sepa.org.uk/data-visualisation/water-classification-hub/

10 The Water Environment (Shellfish Water Protected Areas: Designation) (Scotland) Order, 2013 [Accessed: 06/12/21]

11 Scottish Government. Drinking water protected areas – Scotland river basin district: maps. https://www.gov.scot/publications/drinking-water-protected-areas-scotland-river-basin-district-maps/ [Accessed 06/12/21]

12 https://www.forestresearch.gov.uk/tools-and-resources/fthr/catchments-vulnerable-acidification

13 https://www.gov.scot/policies/agriculture-and-the-environment/nvz/

7.3.4 Groundwater Bodies

The Site is located within the Oban and Kintyre groundwater body which is classified as being in overall 'Good' condition.

The British Geological Survey (BGS) hydrogeological mapping indicates the Site is underlain by a low productivity aquifer where flow is virtually all through fractures and other discontinuities, and springs are rare.

7.3.5 Water Resource

Private Water Supply (PWS) information was requested from Argyll and Bute Council. There are no PWS's within 250 m, or in hydrological connectivity to the Proposed Development.

7.3.6 Groundwater Dependent Terrestrial Ecosystems

Chapter 4: Ecology and Ornithology (Volume 1) states National Vegetation Classification (NVC) results were used to determine the potential groundwater dependency of the habitats present in the ecology field survey area (a 100 m radius around the Site, capturing the Site and downstream locations along the River Aray).

An area of rush vegetation around the River Aray to the southeast of the Proposed Development was assessed to be in the M23 *Juncus effusus/ acutiflorus – Galium palustre* rush-pasture community, which has high potential to be a Groundwater Dependent Terrestrial Ecosystem (GWDTE) (**Figure 7.2, Volume 3a**).

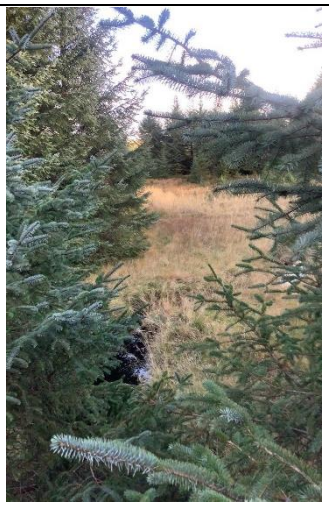
This area of habitat is located along the main trunk of the River Aray and several of its tributaries. During the field surveys, this area was observed to be saturated and contain areas of surface water accumulation. Given the direct connectivity to surface water features, and that the Site is underlain by a low productivity aquifer where groundwater flow will be limited to the weathered zone or secondary fractures, the potentially Highly GWDTEs are not considered to be groundwater dependent (**Figure 7.3. Volume 3a**). Surface water is instead likely to present a greater source of water input to the habitat than groundwater. Based on the cross reference of site-specific ecological and hydrological assessment with underlying hydrogeological conditions, the potential GWDTE is considered 'not sensitive' to alterations in groundwater supply, in the context of the Proposed Development.

7.3.7 Watercourse Crossings

There are a number of existing watercourse crossings along the access route to the Site (**Figure 7.1, Volume 3a**). including a crossing approximately 200 m east of the Proposed Development. This crossing is an approximately 1 m diameter concrete circular culvert (**Plate 2**). This culvert would be upgraded or replaced as part of the proposed access works for the proposed Creag Dhubh Substation (Planning Ref: 22/00772/PP).

Where crossing of small watercourses or areas of waterlogged ground present on the Site is required, this shall be carried out through the use of temporary trackways and bog mats. Therefore, no permanent or temporary crossing structures shall be required for the Proposed Development.

Plate 2: Existing Watercourse Crossing

		
View upstream (north) from the crossing.	View downstream (south) from the crossing.	Upstream face of the culvert.

7.3.8 Geology and Soils

The 1:50,000 and 1:625,000 scale geological mapping available from the British Geological Survey (BGS)[14] shows the bedrock geology beneath the Site to comprise bedrock deposits composed of basic lavas, some pillowed, with epiclastic volcanics, comprising pebbly rocks with detrital epidote and lava fragments associated with the Tayvallich Volcanic Formation, and Metalava and Metatuff from the Argyll Formation. This is shown on **Figure 7.3.6, TA 7.3, Volume 2**.

The BGS mapping shows the superficial geology of the Site to be underlain by hummocky (moundy) glacial till superficial deposits described as 'lithologically diverse and complex glacial deposits that have characteristic moundy topographic form. Composed of rock debris, clayey till and poorly to well stratified sand and gravel'. BGS mapping shows no peat deposits are located at the Site. This is shown on **Figure 7.3.7, TA 7.3, Volume 2**.

The National Soil Map of Scotland[6] including carbon-rich soils, deep peat and priority peatland habitat mapping shows the Site to be underlain by peaty gleys, and defined as 'Class 5' peat soil. Class 5 soils are not nationally significant but are defined as being 'carbon rich soils and deep peat with no peatland habitat'.

The survey results indicate that the peat depth is variable ranging between 0.0 m and 4.2 m thickness. Within the Proposed Development area the peat thickness was generally found to be between 0.0 m and 1.0 m thick in the western half, with some isolated pockets of peat extending to 2.0 m in thickness located to the north of P4. The deepest peat depth recorded within the Peat Study Area was 4.2 m thickness, located to the south of the proposed Creag Dhubh Substation. The probe depth and interpolated contours are shown on **Figure 7.3.3, TA 7.3, (Volume 2)**. The mean peat depth recorded across all the survey data was 0.71 m.

7.4 Future Baseline

In the absence of the Proposed Development watercourse morphology and the hydrological regime are likely to continue to be present in their current form.

It is assumed that forestry felling shall continue in line with the Long Term Felling Plans (LTFPs), shown in **TA 2.1: Woodland Report, (Volume 2**). The LTFPs seek to ensure that any felling within a three-year period represents 20% or less of a

14 British Geological Survey Online Viewer (2022) https://mapapps.bgs.ac.uk/geologyofbritain/home.html [Accessed September 2022]

catchment such that, as set out in the UK Forestry Standards Guidelines (UKFSG) (5th Ed), the effects of harvesting on receptors such as Public Drinking Water Supplies, Shellfish Waters Protected Areas, flood risk areas, acidification or nitrate sensitivity would be difficult to discern. Therefore, the felling would not be expected to change the hydrological baseline. Existing management proposals for forestry felling within the Hydrology Study Area have been taken into account in **TA 2.1: Woodland Report (Volume 2),** such that alteration to physio-chemical conditions of watercourses is avoided.

There is potential for climate change to impact on future baseline conditions. Climate change studies predict a decrease in summer precipitation and an increase in winter precipitation alongside slightly higher average temperatures. This suggests that there may be greater variability in the depth and availability of groundwater resources (including shallow groundwater held in superficial deposits).

However, summer storms are predicted to be of greater intensity. Therefore, peak fluvial flows associated with extreme storm events may also increase in volume and velocity. Such changes could lead to an expansion of areas assessed by SEPA to be at risk of flooding and increased surface water runoff rates. These climate change factors have been taken into account when considering the potential for likely significant effects.

7.5 Potential Impacts and Mitigation

7.5.1 Mitigation by Design[15]

The Proposed Development has been located outwith 30 m of all bounding watercourses, where possible. No new permanent or temporary watercourse crossing structures are required, and crossing of small watercourses shall be carried out through the use of temporary trackways and bog mats.

Approximately 700 m new permanent access track[16] shall be required, connecting to the existing access track to the southeast of the Proposed Development and upgrades to approximately 495 m of existing access track connecting to the access track to be upgraded for the proposed Creag Dhubh Substation (**Figure. 3.1b, Volume 3a**). The design of access tracks shall be carried out in line with best practice measures[17][18], and as detailed in the outline CEMP submitted with this application (**TA 3.2, Volume 2**) a CEMP to be prepared by the contractor such that access track construction shall not significantly alter habitat drainage regimes. Drainage measures incorporated into access track design would ensure the continued hydrological connectivity of habitats and prevent increases in surface water runoff rates from access track surfaces.

It should be noted that the layout of the Proposed Development, including tower locations, and hence access tracks, could be subject to micrositing within the Limits of Deviation (LOD)s as defined in **Chapter 3, Section 3.3.1**. Any micrositing changes would seek to maximise the buffer of the Proposed Development from watercourses. This will minimise the risk of alterations to surface and groundwater flow patterns, water pollution and increased sediment loading during both construction and operational phases.

7.5.2 Construction

Potential impacts during construction are detailed in **Table 7.2** below, which also details the relevant receptor and additional mitigation or control measures, where appropriate. For avoidance of doubt, embedded mitigation that has been relied upon for the purpose of this appraisal has also been referenced.

15 Mitigation by Design is the act of incorporating measures into the development of the design and thereby minimising the risks to the project and the local environment.

16 New tracks are located over shallow peat (<0.5 in depth), and therefore not likely to require floating.

17 Scottish Natural Heritage, 2015. Constructed tracks in the Scottish Uplands. 2nd Edition Updated September 2015

18 Forestry and Land Scotland (FLS) 2019 Forest Road Specification. Available online: https://forestryandland.gov.scot/ [last accessed August 2022].

Table 7.2: Potential Impacts to Hydrology, Hydrogeology and Geology and Soils during Construction and Relevant Mitigation/Control Measures

Potential Effect	Receptor	Mitigation Proposed	Responsibility/Timing of Mitigation Measure
Impacts to the quality of surface waters through: Release of sediment or pollutants generated during excavation, earth moving (including peat) and from temporary stockpiles. Accidental spills or release of pollutants to watercourses or the ground. Accidental discharge of untreated foul sewage from temporary welfare facilities to watercourses or to the ground.	All watercourses	No additional mitigation is required beyond the standard measures and embedded mitigation stated in **Chapter 3: Proposed Development and Alternatives (Volume 1)**, and summarised as follows: The location of the Proposed Development sought to achieve a 50 m buffer from all watercourses in accordance with typical SEPA requirements (although not specifically stated in policy). However, due to other environmental and engineering constraints this has not been possible. Therefore, based on professional judgement and experience on similar projects, the Proposed Development has been designed to be outwith 30 m of all bounding watercourses (**Figure 7.1, Volume 3a**) as it is believed this still allows sufficient space for mitigation and against downstream effects. Potential impacts of construction works for temporary diversion poles shall be minor and temporary, such that a 30 buffer from watercourses from proposed pole locations is sufficient space for mitigation and against downstream effects. A limited area of the northern extent of the proposed permanent access is approximately 15m from An Aodann and the use of silt fencing in this area would provide additional protection from the potential release of sediments. A site-specific Construction Environmental Management Plan (CEMP, based on the Outline CEMP presented in **TA 3.2, Volume 2**) would be written in accordance with the relevant best practice guidance on pollution prevention and mitigation. Namely, SEPA Guidance for Pollution Prevention (GPP[19]), The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended), Version 7.2 February 2017, and relevant construction and CIRIA guidance. All equipment, material and chemicals would be securely stored and bunded at least 50 m from watercourses. ECoW would audit storage	Principal Contractor/Forestry Contractor Forestry Operations and Construction

[19] SEPA GPP: Works and maintenance in or near water: GPP 5. Version 1.2. February 2017. https://www.netregs.org.uk/media/1417/gpp-5-works-and-maintenance-in-or-near-water.pdf?utm_source=website&utm_medium=social&utm_campaign=GPP5%2027112017 [Accessed 10/09/2021]

Table 7.2: Potential Impacts to Hydrology, Hydrogeology and Geology and Soils during Construction and Relevant Mitigation/Control Measures

Potential Effect	Receptor	Mitigation Proposed	Responsibility/Timing of Mitigation Measure
		areas during installation, as well as undertaking regular checks. Specific mitigation regarding peat to minimise impacts on watercourses have been included within the Draft Peat Management Plan (PMP) (**TA 7.2, Volume 2)**. The temporary diversion poles would be removed following completion of the construction works and excavations backfilled to match current baseline conditions. The CEMP would set out the environmental management requirements and responsibilities incumbent upon the appointed Contractor.	
Increased volumes and rates of surface runoff, and preferential routing of surface water flows due to an increase in impermeable surface areas within the Site boundary; discharge of any required dewatering activities; and surface water drainage measures for access tracks.	All watercourses	No additional mitigation is required beyond the standard measures and embedded mitigation stated in **Chapter 3: Proposed Development and Alternatives (Volume 1)**, and summarised as follows: Track drainage measures for the management of surface water runoff would be designed to minimise potential changes to the volume and rate of surface water runoff, such that it is limited to the pre-development greenfield rates in order to mimic the natural regime at this location whilst taking account of potential changes in rainfall as a result of climate change. Dewatering shall be carried out in accordance with the CEMP and SSEN Transmission's GEMPs (**TA 3.2: Outline CEMP, Volume 2)**. Dewatering of excavations must take place away from watercourses and silt-entrapment measures be used prior to discharge such that the magnitude of any impacts due to the dewatering of excavations would be minor on downstream receptors. Detailed drainage plans would be designed by the Contractor at later design stages and be detailed in the CEMP.	Principal Contractor / Forestry Operations and Construction
Impacts on morphology and sediment supply in watercourses as a result of excavations near surface water features.	All watercourses	No additional mitigation is required beyond the standard measures and embedded mitigation stated in **Chapter 3: Proposed Development and Alternatives (Volume 1)**, and summarised as follows: Any works taking place near watercourses would be undertaken in accordance with SEPA guidance and in line with the requirements of	Principal Contractor / Forestry Contractor Construction

Table 7.2: Potential Impacts to Hydrology, Hydrogeology and Geology and Soils during Construction and Relevant Mitigation/Control Measures

Potential Effect	Receptor	Mitigation Proposed	Responsibility/Timing of Mitigation Measure
		the Water Environment (Controlled Activities) (Scotland) Regulations[20] (CAR) to prevent or reduce adverse effects to the watercourse. Works would also be carried out in line with the final CEMP to be drafted by the Contractor and under the terms of the Construction Runoff Permit.	
Localised modification of groundwater flows and the formation of preferential flow path for sub-surface flows, or sub-surface draw down due to excavations and dewatering for footings.	Near-surface groundwater	No additional mitigation is required beyond the standard measures and embedded mitigation stated in **Chapter 3: Proposed Development and Alternatives (Volume 1)**, and summarised as follows: Implementation of dewatering control and distribution of surface water flows during construction; ensuring dewatering would be carried out in accordance with the CAR, as well as the CEMP **(TA 3.2: Outline CEMP, Volume 2**) and under the terms of the SEPA Construction Site Licence (CSL).	Principal Contractor / Construction
Impacts to GWDTEs through the alteration of surface water and groundwater flows.	GWDTE habitats	Potential GWDTE habitats identified through NVC surveying are not considered to be groundwater dependent (**Figure 7.3. Volume 3a**). Therefore, no additional mitigation is required beyond the standard measures and embedded mitigation stated in **Chapter 3: Proposed Development and Alternatives (Volume 1)**.	Principal Contractor / Construction
Potential for impacts on downstream receptors as a result of forestry felling: • Public drinking water supplies • Shellfish Waters Protected Areas • Flood Risk Areas • Catchments Sensitive to Acidification • Nitrate Sensitive Catchments	River Aray and Loch Fyne (Designated Shellfish Water)	As the River Aray discharges into a designated shellfish water, any felling which exceeds 20% of the overall catchment area within a three-year period could cause a discernable effect of the downstream receptor. The extent of the proposed forestry felling for the Proposed Development and associated infrastructure has been compared to the overall area of the River Aray catchment. The proposed felling (totaling 2.4 ha , see **TA 2.1: Woodland Report, Volume 2**) represents less than 0.5% of the overall catchment. Therefore, the proposed felling for the	N/A

[20] Secretary of State, 2011. The Water Environment (Controlled Activities) (Scotland) regulations 2011.

Table 7.2: Potential Impacts to Hydrology, Hydrogeology and Geology and Soils during Construction and Relevant Mitigation/Control Measures

Potential Effect	Receptor	Mitigation Proposed	Responsibility/Timing of Mitigation Measure
		Proposed Development would not lead to any noticeable change in the overall felling areas in this time period. The UK Forestry Standards Guidelines (UKFSG) (5th Ed) sets out that the effects of harvesting on the key receptors are only significant where the felling exceeds 20% of a catchment. Given the very low area of the River Aray catchment which would be subject to felling as a result of the Proposed Development, and as much of this felling is already proposed as part of the LTFP for Keppochan East and Keppochan, no significant impact is anticipated and no additional mitigation is required, outwith the standard measures stated within the CEMP. The River Aray catchment is not designated as a catchments sensitive to acidification or a nitrate sensitive catchments and no public drinking water protected areas have been identified downstream.	
Impacts to peat arising from the excavation and disturbance of peat from construction activities. Changes to local soils and peat habitats could occur as a result of: • Compaction of soils; • Potential for increased erosion of peat soils through disturbance, either through direct disturbance or localised drying caused by infrastructure; • Changes in soil hydrology; • Potential for peat slide caused by the construction of infrastucture which could affect human and environmental receptors; and • Loss of peatland habitats and carbon rich soils through excavations for infrastructure.	Class 5 and peat/ carbon rich soils	As discussed in **Chapter 3: Proposed Development and Alternatives (Volume 1),** the siting of the Proposed Development is defined by the location of the existing OHL and the position of the proposed Creag Dhubh substation. Measures have been undertaken to avoid areas of deep peat (where practicable) and also utilising existing tracks and construction methods to minimise disturbance of peat, and where this is not possible micrositing will be undertaken locally. An Outline PMP **(TA 7.2, Volume 2)** has been prepared for the Proposed Development which documents outline measures to mitigate potential impacts on peat and carbon rich soils through the construction phase. This is a live document that would be updated further as the project progresses through detailed design and operation. The PMP would seek to ensure that any impacts on peat and carbon rich soils are reduced particularly with regard to any areas of deeper peat. As the Proposed Development would result in the generation of approximately 22,275 m^3 of excavated peat, mitigation would be required to minimise surplus peat. This would be undertaken by	Applicant and Principal Contractor / Construction

Table 7.2: Potential Impacts to Hydrology, Hydrogeology and Geology and Soils during Construction and Relevant Mitigation/Control Measures

Potential Effect	Receptor	Mitigation Proposed	Responsibility/Timing of Mitigation Measure
		reusing peat to dress the shoulders and slopes of new access track and reinstate working areas used for the installation of towers. A Peat Landslide Hazard Risk Assessment (PLHRA) **(TA 7.3, Volume 2)** has been prepared which outlines the potential risks of the Proposed Development resulting in peat landslides as a result of construction activities. No risks have been identified and therefore no specific mitigation is required.	
Diversion or impoundment of natural surface water or near surface water flows due to track or construction compound footings.	Surface water flows, peat habitats	Cross drains will be installed at regular intervals along trackside drainage. Cross drains will be installed as pipe culverts under the track surface. The frequency of cross drains should increase in areas where higher flows are anticipated such as in areas of high surface flow (e.g. flushes or low-lying areas); where bank seepages are noted; and where historical or active drains are intercepted. Implementation of drainage measures as outlined in the CEMP. Geotechnical investigation shall be conducted to confirm the design and type of each tower to be installed. Where tower positions cannot be microsited to avoid sensitive habitats due to technical or operational restrictions, the option of a piled foundation would be considered to minimise the potential for adverse effects, particularly where peat is encountered at over 2 m depth.	Principal Contractor / Construction

7.5.3 Operation

Potential effects during operation are detailed in **Table 7.3** below, which also details the relevant receptor and mitigation or control measures, where appropriate.

Table 7.3: Potential Impacts to Hydrology, Hydrogeology and Geology and Soils during Operation and Relevant Mitigation/ Control Measures

Potential Effect	Receptor	Mitigation Proposed	Responsibility/ Timing of Mitigation Measure
Increased rates of surface water runoff and preferential routing of surface water flows due to an increase in impermeable surface area and surface water drainage measures for access tracks.	All watercourses	Ongoing maintenance of access track drainage would be required to ensure it remains fit-for-purpose. This would be secured through the implementation of the Operational Management Plan to be produced for the Proposed Development upon completion of construction. No additional mitigation measures are proposed.	Applicant / Operation
Impacts to water quality, such as from leakage of fuels from maintenance plant.	All watercourses	Access track drainage features would provide the required mitigation to prevent any increase in the sediment load of surface water runoff. Occasional maintenance works shall be carried out in line with SSEN Transmission's GEMPs and no plant laydown or storage of oils/fuels carried out during maintenance. Accordingly, no additional mitigation is proposed.	Applicant / Operation
Impacts to Peat	Class 5 and peat/ carbon rich soils	No operational phase mitigation has been identified.	N/A

7.6 Cumulative Effects

Of the cumulative developments identified in **Chapter 2: Environmental Appraisal Methodology and Scope** and shown in **Figure 2.2, Volume 3a**, the developments relevant to the cumulative assessment of effects on surface water, groundwater, geology, and soil receptors are set out in Section 7.2 of this Chapter.

7.6.1 Potential Cumulative Construction Effects

In the absence of mitigation, the construction of all cumulative schemes could have similar potential impacts to the water environment as outlined in **Table 7.2**. Construction programmes identified in Section **7.2.7** overlap, and therefore have the potential to result in in-combination impacts with the Proposed Development with regard to water quality, water flow and rate, and morphology and sedimentation within the desk Hydrology Study Area and downstream watercourses including the River Aray.

However, with implementation of the mitigation outlined in **Table 7.2** there is minimal potential for in-combination impacts to the water environment. This would include implementation of the CEMP which would adhere to GPP, CAR and CIRIA guidance, as well as the implementation of track drainage measures. Accordingly, no additional mitigation is required.

The OHLs (Section 7.2.7) would also result in forestry felling and the associated potential impacts to the water environment. However, the quantum of felling within the River Aray catchment is very small relative to the overall catchment area (the extent of the proposed forestry felling for the Proposed Development and associated infrastructure represents less than 1% of the overall catchment). Whilst some felling will be required for the ITE/ITW connection and the routing of the temporary OHL diversion, the majority of felling required would be completed as part of the Proposed Creag Dhubh Substation works. Therefore, the overall cumulative area of felling is likely to remain below the threshold at which effects could be realised (set out in guidance as felling equivalent to 20% the catchment area within a 3-year period). As discussed in Section 7.3, LTFPs also seek to ensure that any felling within a three-year period represents 20% or less of a catchment area. The indicative LTFP for the M23: Keppochan East and Keppochan indicative LTFP, within which the Site, is shown in **Figure 5 of TA 2.1: Woodland Report (Volume 2).** As shown in the indicative LTFP, the area proposed for felling in any 3-year period, including during the construction of the Proposed Development (shown in yellow), is also very small relative to the overall catchment area. Accordingly, the Proposed Development would not likely result in felling impacts in-combination with the above cumulative schemes.

7.6.2 Potential Cumulative Operational Effects

The potential for the operation of the nearby proposed OHLs and associated infrastructure identified in Section 7.2.7 (the proposed Creag Dhubh to Dalmally 275 kV Connection Creag Dhubh to Inveraray 275 kV OHL Connection and the proposed Creag Dhubh Substation) are assessed in separate applications and are considered highly unlikely to impact surface waters, and therefore the cumulative impact with the Proposed Development to the water environment is considered minor.

7.7 Conclusion

The primary receptors within the Site include a number of watercourses which form the headwaters of the River Aray and habitats which may rely on the continued quality and quantity of surface water supply. The River Aray does not fall within an internationally or nationally designated area. It is classified in SEPAs RBMP as being in overall 'Good' condition. The potential GWDTE habitats have been determined to not be groundwater dependent but are supported by surface water flows through the Site. The Site is underlain by varying thicknesses of peat and carbon rich soils.

Potential impacts to the water environment include changes to water quality and quantity, increased sedimentation, impacts to morphology, and increased flood risk. No impacts to the water environment during the construction and operation of the Proposed Development are anticipated following the implementation of standard mitigation measures through the CEMP, including pollution prevention measures, environmental management plans, use of track drainage measures, detailed design

of all watercourse crossings to meet CIRIA and CAR guidelines and as required under the Construction Run-off Permit. Impacts on peat can be mitigated through measures included within an Outline PMP (**TA 7.2, Volume 2**), including measures to re-use peat generated through construction of the Proposed Development.

No cumulative effects are anticipated.