VOLUME 2: CHAPTER 11 – HYDROLOGY AND HYDROGEOLOGY

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11. HYDROLOGY AND HYDROGEOLOGY

11.1 Introduction

This Chapter of the EIA Report evaluates the likely significant effects of the proposed Carnaig Substation (the Development) on the Hydrological resources. This assessment was undertaken by ERM.

This Chapter of the EIA Report is supported by the following Chapters:

- Chapter 10: Geology and Soils;
- Chapter 7: Ecology and Nature Conservation;
- Technical Appendix 2.1: GEMPs and SPPs; and
- Technical Appendix 2.2: Construction Environmental Management Plan.

This Chapter is structured as follows:

- 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.

11.2 Assessment Methodology and Significance Criteria

11.2.1 Scope of the Assessment

Legislation, Policy and Guidance

The following guidance, legislation and information sources have been considered in carrying out this assessment.

Legislation

- The Water Framework Directive (2000/60/EC)[1] (as implemented in Scotland via the Water Environment and Water Services (Scotland) Act 2003[2]);
- The Water Environment (Controlled Activities) (Scotland) Regulations 2011[3] Pollution Prevention and Control (Scotland) Regulations 2012;
- Industrial Emissions Directive (IED)[4]
- The Water Environment (Drinking Water Protected Areas) (Scotland) Order 2013[5]; and
- The Water Intended for Human Consumption (Private Supplies) (Scotland) Regulations 2017[6] Policy.

[1] European Parliament (2000) Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy ("The Water Framework Directive"). Available online at: http://ec.europa.eu/environment/water/water-framework/index_en.html

[2] Scottish Government (2003). Water Environment and Water Services (Scotland) Act 2003. Available online at: https://www.legislation.gov.uk/asp/2003/3/contents

[3] Scottish Government (2011). The Water Environment (Controlled Activities) (Scotland) Regulations 2011. Available online at: https://www.legislation.gov.uk/ssi/2011/209/contents/made

[4] Scottish Government (2012). The Pollution Prevention and Control (Scotland) Regulations 2012. Available online at: https://www.legislation.gov.uk/ssi/2012/360/contents/made

[5] Scottish Government (2013). The Water Environment (Drinking Water Protected Areas) (Scotland) Order 2013. Available online at: https://www.legislation.gov.uk/ssi/2013/29/made

[6] Scottish Government (2017) the Water Intended for Human Consumption (Private Supplies) (Scotland) Regulations 2017 Available online at: https://www.legislation.gov.uk/ssi/2017/282/note/made

Policy

- The Highland Wide Local Development Plan[7] (Policy 63 Water Environment, Policy 64 Flood Risk and Policy 66 Surface Water Drainage) and
- The National Planning Framework 4[8].

Guidance

- Planning Advice Note 61: Planning and Sustainable Urban Drainage Systems[9];
- Construction Industry Research and Information Association (CIRIA) Control of Water Pollution from Construction Sites (C532)[10];
- CIRIA Development and flood risk: guidance to the construction industry, C624D[11];
- Planning Advice Note 79: Water and Drainage[12];
- British Standard Code of Practice for Earthworks BS 6031 200928[13];
- Scottish Environment Protection Agency (SEPA) Engineering in the Water Environment Good Practice Guide: River Crossings[14];
- Wind farm developments on peat land: planning advice[15];
- SEPA Land Use Planning System guidance Note 31, Version 2. Guidance on Assessing the Impacts of Windfarm Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems[16];
- SEPA Controlled Activities Regulations (CAR) – A Practice Guide, Version 7.2[17];
- CIRIA The SuDS Manual (C753)[18];
- CIRIA Environmental Good Practice on Site (C741)[19];
- The Highland Council Onshore Wind Energy Supplementary Guidance[20];
- Nature Scot Good Practice During Wind Farm Construction[21];

[7] The Highland Council (2012). Highland Wide Local Development Plan. Available online at: https://www.highland.gov.uk/info/178/development_plans/199/highland-wide_local_development_plan

[8] Scottish Government (2023). National Planning Framework 4. Available online at: https://www.gov.scot/publications/national-planning-framework-4/

[9] Scottish Government (2001). Planning Advice Note 61: Sustainable urban drainage systems. Available online at: https://www.gov.scot/publications/pan-61-sustainable-urban-drainage-systems/

[10] CIRIA (2001). Control of water pollution from construction sites. Guidance for consultants and contractors (C532). Available online at: https://www.ciria.org/CIRIA/CIRIA/Item_Detail.aspx?iProductCode=C532&Category=BOOK

[11] CIRIA (2004). Development and flood risk – guidance for the construction industry (C624D). Available online at: https://www.ciria.org/CIRIA/CIRIA/Item_Detail.aspx?iProductCode=C624&Category=BOOK

[12] Scottish Government (2006). Planning Advice Note 79: Water and Drainage. Available online at: https://www.gov.scot/publications/planning-advice-note-pan-79-water-drainage/

[13] The British Standards Institute (BSI) (2009). BS 6031:2009 Code of Practice for Earthworks. Available online at: https://knowledge.bsigroup.com/products/code-of-practice-for-earthworks/standard

[14] SEPA and Natural Scotland (2010). Engineering in the Water Environment Good Practice Guide: River Crossings, Second edition. Available online at: https://www.sepa.org.uk/media/151036/wat-sg-25.pdf

[15] Scottish Government (2013). Wind farm developments on peat land: planning advice. Available online at: https://www.gov.scot/publications/wind-farm-developments-on-peat-land-planning-advice/

[16] SEPA (2014). Land Use Planning System Guidance Note 31. Guidance on Assessing the Impacts of Windfarm Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems . Version 2. Available online at: https://www.sepa.org.uk/media/143868/lupsgu31_planning_guidance_on_groundwater_abstractions.pdf

[17] SEPA (2015). Controlled Activities Regulations - A Practical Guide, Version 7.2. Available online at: http://www.sepa.org.uk/media/34761/car_a_practical_guide.pdf

[18] CIRIA (2015). The SuDS Manual (C753). Available at: https://www.susdrain.org/resources/SuDS_Manual.html

[19] CIRIA (2015). C741 Environmental good practice on site guide. 4th edition. Available online at: https://www.ciria.org/CIRIA/CIRIA/Item_Detail.aspx?iProductcode=C741&Category=BOOK

[20] The Highland Council (2016). Onshore wind energy: supplementary guidance. Available online at: https://www.highland.gov.uk/downloads/file/18793/onshore_wind_energy_supplementary_guidance_november_2016

[21] Nature Scot (2019). Good Practice During Wind Farm Construction. Available online at: https://www.nature.scot/doc/guidance-good-practice-during-wind-farm-construction

- Highways Agency's Design Manual for Roads and Bridges (DMRB) LA 113 – Road drainage and the water environment, formerly HD45/09, Revision 1, 2020[22];
- SEPA Supporting Guidance (WAT-SG-75) Sector Specific Guidance: Water Runoff from Construction Sites[23]; and
- SEPA Guidance for Pollution Prevention[24].

Summary of Scope

The key issues for the assessment of potential hydrological effects relating to the Proposed Development include short-term (construction) and long-term (operation).

The potential short-term effects arising from the construction phase which have the potential to result in hydrological effects are as follows:

- Chemical pollution (including accidental pollution) of surface water, near-surface water, and groundwater because of construction works;
- Erosion and sedimentation of surface water, near-surface water and groundwater as a result of construction works, including access track water crossings;
- Increased risk of erosion and sedimentation of surface water, near-surface water and groundwater in areas of cutting earthworks at trackside and crane hardstanding;
- Increased run-off and flood risk from increased area of impermeable hardstanding including access tracks;
- Acidification of watercourses as a result of construction works and related tree felling;
- Potential effects on the hydrological function of GWDTEs; and
- Potential effects on designated sites in terms of decrease in condition of qualifying interests.

Long-term effects arising from operational phase which have the potential to result in a hydrological effect could include:

- Increased run-off and flood risk from increased impermeable hard standing, including permanent access tracks;
- Alterations to natural flow pathways from runoff from areas of hard standing, with potential effects on the hydrological function of GWDTEs; and
- Contamination of surface water and groundwater through the release of contaminated fire suppressant water during a fire at the Proposed Development.
- Contamination of surface water and groundwater from pollution incidents from contaminants, oils and fuels stored at the Proposed Development.

Potential effects relating to peat, soils and geology are detailed and assessed in **Volume 2 Chapter 10** Geology and Peat and are therefore not included in this chapter.

11.2.2 Extent of the Study Area

The following study areas will be considered as part of the hydrological and hydrogeological assessment:

- Core Study Area: outlined by the Proposal of Application Notice (PAN) Boundary;
- Wider Study Area: a 10 km buffer zone around the PAN Boundary. The Proposed Development is not expected to impact the hydrological or hydrogeological environment outside of the Wider Study Area due to dilution and attenuation of potential pollutants; and

[22] Highways Agency (2020). Design Manual for Roads and Bridges (DMRB) LA 113 – Road drainage and the water environment, formerly HD45/09, Revision 1. Available online at: https://www.standardsforhighways.co.uk/dmrb/search/d6388f5f-2694-4986-ac46-b17b62c21727.
[23] SEPA (2021). Supporting Guidance (WAT-SG-75) Sector Specific Guidance: Water Runoff from Construction Sites. Available online at: https://www.sepa.org.uk/media/340359/wat-sg-75.pdf
[24] SEPA (various). Available online at: https://www.netregs.org.uk/environmental-topics/guidance-for-pollution-prevention-gpp-documents/

- Private Water Supply (PWS) Study area: PWS will be identified within 2 km of the PAN Boundary. Beyond 2 km it is considered that potential for hydrological connectivity with PWS is limited.

11.2.3 Consultation Undertaken To Date

Consultation responses are summarised in **Table 11.1**. The response to each point raised by consultees is also presented within the table, demonstrating where the design of the Proposed Development has addressed the response to specific issues identified.

Consultation was undertaken with the organisations shown in **Table 11.1**. Only organisations that were consulted and that had inputs regarding the Hydrology and Hydrogeology are listed in **Table 11.1**.

Table 11.1 Scoping and Consultation Responses

Consultee	Type and Date	Summary of Consultation Response	Response to Consultee
The Highland Council	Scoping Opinion 09/05/2024	The EIAR needs to address the nature of the hydrology and hydrogeology of the site, and of the potential impacts on water courses, water supplies including private supplies, water quality, water quantity and on aquatic flora and fauna. Impacts on watercourses, lochs, groundwater, other water features and sensitive receptors, such as water supplies, need to be assessed.	Nature of the hydrological and hydrogeological resources are identified and discussed throughout **Section 4**. Potential impacts on these resources that are hydrologically connected to the site are discussed throughout **Section 5**.
		Measures to prevent erosion, sedimentation or discolouration will be required, along with monitoring proposals and contingency plans. Assessment will need to recognise periods of high rainfall which will impact on any calculations of run-off, high flow in watercourses and hydrogeological matters. In this respect, you are directed to the detail of SEPA's consultation response on the Scoping Report.	Measures to prevent erosion, sedimentation or discolouration are incorporated in **Volume 4 Appendix 2.1** GEMPs (Oil Storage and Refuelling, Working in or Near Water and Watercourse Crossings) and will be secured through **Volume 4 Appendix 2.2** CEMP.
SEPA, via The Highland Council	Scoping Opinion 09/05/2024	SEPA drew attention to their comments in the major pre application response, 23/04004/PREMAJ. SEPA confirms that their comments and requirements still apply	Impacts relating to peat are assessed in **Volume 2 Chapter 10** Geology and Peat.

Consultee	Type and Date	Summary of Consultation Response	Response to Consultee
		with regards to peat, protection of the water environment, GWDTE, PWS, pollution prevention and forest waste.	Impacts relating to forestry are assessed in **Volume 2 Chapter 9** Forestry. Impacts relating to protecting the water environment, GWDTE, PWS and pollution prevention are assessed in **Section 5** of this chapter.
		The applicant will require to carry out an investigation to identify any private water supplies, including pipework, which may be adversely affected by the development and to submit details of the measures proposed to prevent contamination or physical disruption. Highland Council has some information on known supplies but it is not definitive. An on-site survey will be required.	Details of any Private Water Supply networks recorded on the site walkover and informed by the baseline conditions established in **Section 4**.

Method of Baseline Data Collation

Desk-based Study

A desk-based study and consultation have been conducted to inform the hydrology and hydrogeology assessment.

The desk-based study included:

- Identification of watercourses, surface water catchments and springs;
- Identification of underlying geology and hydrogeology and connectivity to the Proposed Development;
- Assessment of topography and slope to inform drainage patterns;
- Collation of data provided through consultation, including details on private water supplies and their sources; and
- Assessment of flood risk data and mapping.

The following sources of information were used to inform the desk-based study:

- The Ordnance Survey (OS) 1:50,000 (Digital);
- OS 1:25,000 Map (Digital);
- LiDAR for Scotland DTM[25];
- National River Flow Archive (NRFA)[26];

[25] Scottish Government, LiDAR for Scotland DTM. Available online at: https://remotesensingdata.gov.scot/data#/map
[26] Centre for Ecology and Hydrology (n.d.) *National River Flow Archive* [online] available at: http://nrfa.ceh.ac.uk/

- SEPA Flood Map 2022[27];
- Meteorological Office Rainfall Data[28];
- Scotland's Environment web-based maps[29]; and
- British Geological Survey (BGS) GeoIndex onshore geology viewer[30].

Site Walkover

A site walkover was conducted on 4th June 2024 to visually inspect surface water features, obtain an understanding of the local topography and drainage patterns and to ground-truth the information reviewed and collated in the desk-based study.

The site walkover covered the Core Study Area, as shown in **Volume 3a Figure 11.1** Hydrology Study Areas. This included a walkover of the key surface watercourses, associated tributaries and areas of potential GWDTEs.

11.2.4 Methodology for the Assessment of Effects

The significance of the potential effects of the Proposed Development has been classified by professional consideration of the sensitivity of the receptor and the magnitude of the potential effect.

Methodologies have been developed by ERM in consultation with SEPA, NatureScot (formerly Scottish Natural Heritage (SNH)), Forestry and Land Scotland (FLS) and various Councils across Scotland. 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.

11.2.5 Determining Magnitude of Change and Sensitivity of Receptors

Sensitivity of Receptors

Receptor sensitivity is determined using professional judgement making use of environmental designations and quantifiable data from reputable sources (e.g., regulatory bodies and research organisations) where available. The criteria which are used to determine receptors sensitivity is detailed in **Table 11.2**.

Table 11.2 Framework for Determining Sensitivity of Receptors

Sensitivity	Description	Example
High	An attribute of high quality and rarity with little potential for substitution which is highly sensitive to change.	Water Framework Directive (WFD) designated watercourse with a High or Good ecological potential. A protected site under EU or UK wildlife legislation (SSSI, SAC). Species and / or habitat protected under EU or UK wildlife legislation (GWDTE). Public or private water supply and associated sources supplying areas at a regional to local scale.
Medium	An attribute of medium quality and rarity with limited potential for substitution which is somewhat tolerant to change.	WFD designated watercourse with a moderate ecological potential.
Low	An attribute of low quality and rarity with some potential for substitution which is tolerant to change.	WFD designated watercourse with a poor ecological potential.

27 SEPA ($_{2022}$) *Flood Hazard and Flood Risk Information* [o_{nline}] available at: https://map.sepa.org.uk/floodmaps
28 Met Office (2022) *Climate Data* [o_{nline}] $a_{vailable}$ at: http://www.metoffice.gov.uk/public/weather/climate ($_{Accessed\ 29/0}$$_{9/2023}$)
29 Scotland's Environment (n.d.) [o_{nline}] $a_{vailable}$ at: https://www.environment.gov.scot/maps/scotlands-environment-map/
30 BGS (2019) *GeoIndex Onshore* [o_{nline}] $a_{vailable}$ at: https://mapapps2.bgs.ac.uk/geoindex/home.html

Sensitivity	Description	Example
		Unlicensed potable surface water abstraction e.g., private water supply.
Negligible	The receptor is resistant to change and is of little environmental value.	A non-WFD designated watercourse not associated with any downstream WFD watercourse / waterbody. Unlicensed non-potable surface water abstraction e.g., livestock supply.

Magnitude of Effect

The magnitude of effect is established by assessing the potential extent and degree of the impact relative to the extent of the Proposed Development, considering the sensitivity of the receptor, longevity of the effect and hazards arising from direct and secondary effects of the impact. The criteria used to define the magnitude of impact is show in **Table 11.3**.

Table 11.3 Framework for Determining Magnitude of Effects

Magnitude of Effects	Description	Example
Major	Results in a fundamental long term or permanent change to the baseline of a receptor which results in wholesale impacts on the integrity or loss of the receptor.	Permanent loss of water supply. Long term or permanent changes in the quality of surface water leading to a change in WFD status or prevention of attaining a target status. Floodplain loss due to construction within identified flood risk areas / zones. Major deterioration or total loss of designated geological, hydrogeological, or hydrological designated sites.
Moderate	Results in a material short to medium term change to the baseline of a receptor which results in partial impacts on the integrity or partial loss of the receptor.	Temporary loss of water supply. Temporary medium-term changes in the quality of surface water leading to a change in WFD status or prevention of attaining a target status. Increase in impermeable surfaces which can increase surface water runoff. Moderate deterioration or partial loss of designated geological, hydrogeological, or hydrological designated sites.
Minor	Results in a non-material transitory change to the baseline of a receptor which has minor impacts on the use or integrity of the receptor.	Short term changes in the quality of surface water leading to a change in WFD status or prevention of attaining a target status. Increase in impermeable surfaces which can increase surface water runoff.

Magnitude of Effects	Description	Example
		Small deterioration or loss of designated geological, hydrogeological, or hydrological designated sites.
Negligible	Results in an imperceptible change to the baseline of a receptor which is of insufficient magnitude to affects its use or integrity.	Negligible change to surface water quality with no detectable impact on ecological value. Minor changes in impermeable surfaces resulting in negligible variations in surface water runoff. Undetectable or no deterioration or loss of designated geological, hydrogeological, or hydrological designated sites.

Significance of Effects

The sensitivity of the asset and the magnitude of the predicted effects will be used as a guide, in addition to professional judgement, to predict the significance of the likely effects based on the matrix detailed in **Table 11.4**.

Table 11.4 Framework for Assessment of The Significance of Effects

		Sensitivity of Receptor / Receiving Environment to Change / Effect			
		High	**Medium**	**Low**	**Negligible**
Magnitude of Change / Effect	**High**	Major	Major	Moderate	Negligible
	Medium	Major	Moderate	Minor	Negligible
	Low	Moderate	Minor	Minor	Negligible
	Negligible	Negligible	Negligible	Negligible	Negligible

11.3 Sensitive Receptors

The key sensitive receptors in the assessment are as follows:

- Four WFD designated watercourses are hydrologically connected to the Proposed Development with a sensitivity of High.
- Two designated receptors are located within the Core Study Area with a sensitivity of High.
- PWSs are of High sensitivity due to the supply of potable water to properties and businesses.
- Five GWDTEs which are designated to be highly to moderately groundwater dependent are within the Core Study Area with a sensitivity of High.
- The Proposed Development is located within the Northern Highlands groundwater body catchment, which has a WFD quality status of Good and a sensitivity of High.

11.4 Baseline Conditions

11.4.1 Surface Hydrology

The Proposed Development is located within the Scotland WFD River Basin District (RBD), in the catchment of the River Fleet to the north and the Dornoch Coastal to the south, and four nested catchments as outlined below:

- River Fleet – Loch Fleet to Rogart river catchment;

- Abhainn an t-sratha Charnaig river catchment;
- Loch Buidhe lake catchment; and
- Allt Garbh-airigh river catchment.

The WFD designated surface water bodies which are hydrologically connected to the Proposed Development are:

- Allt Garbh-airigh (SEPA ID: 20073) located approximately 75 m to the north of the Core Study Area and approximately 570 m to the north of the Proposed Development has an overall WFD waterbody classification of “Good”. Allt Garbh-airigh is a tributary of Loch Buidhe;
- Loch Buidhe (SEPA ID: 100096) is located adjacent to the northern boundary of the Core Study Area and approximately 600 m to the north east of the Proposed Development and has an overall WFD waterbody classification of ‘High”. Loch Buidhe covers an area of 60 ha, receives an inflow via several watercourses to the north, west and south east and outflows to the River Fleet via Abhainn an t-sratha Charnaig; and
- Abhainn an t-sratha Charnaig (SEPA ID: 20072) is located approximately 2 km to the north east of the Proposed Development, downstream of Loch Buidhe, and has an overall WFD waterbody classification of “Good”. Abhainn an t-sratha Charnaig drains in an overall easterly direction for approximately 18.4 km before discharging into the River Fleet.

The River Fleet (Loch Fleet to Rogart) (SEPA ID: 23390) and Loch Fleet are downstream of the Proposed Development, located approximately 10.7 km and 11.3 km to the east of the Proposed Development, respectively. The River Fleet has an overall WFD waterbody classification of “Moderate”, whilst Loch Fleet has an overall WFD waterbody classification of “Good”. However, due to the distance between these waterbodies and the Proposed Development, they have been scoped out of further assessment.

Based on a review of OS data and information contained within the UK Centre for Ecology & Hydrology (UKCEH) Flood Estimate Handbook (FEH) web service mapping[31], further non-WFD surface water features have been identified within the Wider Study Area, with those hydrologically connected to the Proposed Development listed below:

- Unnamed Watercourse A is a drainage channel located within the PAN Boundary. Originally, this watercourse drained in a north westerly direction across the north eastern area of the Proposed Development. However, commercial forestry practices across this area are thought to have modified the upstream course of this watercourse. Aerial imagery indicates that Unnamed Watercourse A now drains along the boundary between the existing forestry line and area of cleared forestry. To the north of the Proposed Development, this watercourse enters a culvert, draining under the access road of the existing 275 kV Loch Buidhe Substation, before continuing in a north westerly direction, under Lochbuie Road, and towards Allt Garbh-airigh. Originally, Unnamed Watercourse A would likely have drained in a northerly direction across land to the north of Lochbuie Road, however, satellite imagery suggests this watercourse now drains west and then north but ultimately still discharges into Allt Garbh-airigh;
- Unnamed Watercourse B is a roadside ditch located within the Core Study Area, adjacent to eastern side of Lochbuie Road. Satellite imagery suggests that there are two culverted outfalls from this drainage ditch, both under Lochbuie Road, one to the north which outfalls to Unnamed Watercourse C, and a second to the south which outfalls to Alltan Dubh; and
- Alltan Dubh is located within the western area of the Core Study Area, on the other side of Lochbuie Road, and is a tributary of Allt Garbh-airigh.

The surrounding surface watercourses are shown in **Volume 3a Figure 11.2**: Surface Hydrology Baseline.

[31] UK Centre for Ecology & Hydrology (2023) Flood Estimation Handbook Web Service [online] Available at: https://fehweb.ceh.ac.uk/Map

11.4.2 Hydrogeology

The groundwater body underlying the PAN Boundary is identified by Scotland's Environment mapping service as Northern Highlands[32] groundwater body (SEPA ID: 150701). The groundwater body has a SEPA overall status of 'Good'[32].

BGS groundwater vulnerability[33] classes range from 1 to 5, with 5 being most vulnerable. Class 4 is subdivided into 4a and 4b. The BGS groundwater vulnerability for the site ranges between 4a to 5 defining the underlying rocks as vulnerable to pollutants not readily absorbed.

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. Rocks which are not exposed at the surface and are overlain by superficial deposits have a reduced potential for attenuation of contaminants.

11.4.3 Groundwater Dependent Terrestrial Ecosystems

In accordance with SEPA guidance, a Habitat Survey was undertaken to identify wetland habitats present within the Core Study Area. The Habitat Survey and corresponding NVC Survey identified areas of Low, Moderate and High potential for GWDTE. Areas of Moderate potential are associated with the rides through the existing forestry, whilst areas of High potential are associated with land between the existing forestry within the PAN Boundary and Unnamed Watercourse A.

Where wetland habitats were identified, a further detailed habitat assessment was undertaken, with identification of NVC communities. The survey methods employed for this assessment are outlined in **Volume 2 Chapter 9** Ecology and Nature Conservation and the report from the NVC surveyor attached in **Volume 4 Appendix 9.1** Habitat and Protected Species Survey Report.

The potential GWDTEs were recorded within the PAN Boundary in areas of woodland, grassland and wetland habitats. The NVC communities that have the potential to be moderately or highly groundwater dependent based on SEPA guidance are outlined in **Table 11.5**, with GWDTEs shown in **Volume 3a Figure 7.2b** UK Habitat GWDTE.

Table 11.5 Potential GWDTE Communities

Phase 1 Habitat	Recorded NVC Community	SEPA Groundwater Dependency Potential (LUPS-GU31)	Location within the Core Study Area
M15	*Tricophorum cespitosum* – *Erica tetralix* wet heath	Moderate - High	West of the Core Study Area in the location of the proposed access track from the west and south and construction compound.
M16	*Erica tetralix* – *Sphagnum compactum* wet heath	Moderate	West of the Core Study Area in the location of the proposed access track from the west and SuDS pond.

[32] SEPA (n.d.) Water Classification Hub [online] available at: https://www.sepa.org.uk/data-visualisation/water-classification-hub/ (Accessed 18/09/2023)
[33] BGS (2015) *User Guide: Groundwater Vulnerability (Scotland) GIS dataset, Version 2. Revised Report.* [online] available at: https://nora.nerc.ac.uk/id/eprint/509618/1/OR15002.pdf (Accessed 19/09/2023)

Phase 1 Habitat	Recorded NVC Community	SEPA Groundwater Dependency Potential (LUPS-GU31)	Location within the Core Study Area
M23	*Juncus effusus / acutiflorus – Galium palustre* rush-pasture	Moderate	East of the Core Study Area on the eastern side of the existing road which the proposed access tracks link to.
MG10	*Holcus lanatus – Juncus effusus* rush-pasture	Moderate	Located in isolated parcel to the north and east of the Core Study Area, with no infrastructure.

11.4.4 Private and Public Water Supplies

Private Water Supplies

Publicly available mapping provided by THC indicates three known PWSs within 2 km of the Core Study Area as shown in **Volume 3a Figure 11.3** Private Water Supplies. Information for each of these is provided in **Table 11.6**.

Table 11.6 Private Water Supplies

PWS Name	PWS ID	Easting	Northing	Type	Source	PWS Distance from Proposed Development*
PWS Sleasdaraidh	43293	264473	896616	Domestic	Spring	550 m
PWS Reidbreac	31134	263579	896423	Domestic	Groundwater – spring	1,250 m
PWS Craigton Farm	31358	262697	896110	Domestic	Borehole	2,100 m

*This is the distance from the nearest element of infrastructure that makes up the Proposed Development

Public Water Supplies

Consultation with Scottish Water confirmed that the Proposed Development is not located in a catchment which may impact Scottish Water public drinking water catchments or abstraction points.

11.4.5 Designated Hydrological Receptors

The statutory designated sites related to water within the wider study area were identified using NatureScot and SEPA GIS datasets[34]. The statutory designations that are considered hydrologically connected to the Development are listed in **Table 11.7**.

[34] NatureScot (2024) Nature Scot Spatial Data Hub [online] Available at: https://opendata.nature.scot/search?groupIds=9828d34c7aee46919f28ccc859e76108

Table 11.7 Designated Receptors

Designated Receptor	Distance from the Development	Qualifying Interest
Strath Carnaig and Strath Fleet Moors	Within the Core Study Area.	Hen harrier (Circus cyaneua), breeding
Strath Carnaig and Strath Fleet Moors	Within the Core Study Area.	Hen harrier, breeding

11.4.6 Flood Risk

Volume 4 Appendix 11.2 Flood Risk Statement provides identified flood risk impacts and sets out recommended mitigation measures and recommendations based on engineering judgement. The Flood Risk Statement concludes that the Site has a moderate to high risk of surface water flooding, a low risk of groundwater flooding and a negligible risk of flooding from other sources.

The Indicative SEPA Flood Map[35] shows areas of Scotland with a 0.1% Annual Exceedance Probability (AEP) or greater chance of flooding. The indicated flood extents are classified into areas of river, surface water and coastal flooding with a risk rating of low (0.1% AEP) to high (10% AEP) applied. This mapping also shows areas which could have a 0.5% AEP chance of flooding from either rivers or the sea by the 2080s.

The SEPA Flood Map shows that the Proposed Development is not at risk of coastal flooding or river flooding now or in the future, with a less than 0.1% AEP chance of flooding from the sea in any given year. Loch Buidhe, Alltan Dubh, Allt Garbh-airigh, and Loch an Lagain are shown to have a high risk (10% AEP) of river flooding, however, this is not shown to impact the Proposed Development.

Most of the Proposed Development is also shown to remain free from surface water flooding, with no surface water flood flow paths indicated within the PAN Boundary. Areas of increased surface water flooding are associated with the existing forest rides, whereby linear trackways designed for access have been included between areas of forestry plantation. Surface water flood risk within these areas is likely indicative of artificial drainage channels used to manage surface water within the area of commercial forestry.

11.5 Issues Scoped Out

For the reasons outlined in the Scoping Report there are unlikely to be any significant effects and therefore the following potential hydrological effects are not assessed further:

- Migration of pollutants from contaminated land;
- Impacts relating to public water supplies;
- Impacts relating to peat stability (which are assessed in **Volume 2 Chapter 10** Geology and Soils);
- Impacts to Water Framework Directive watercourses and waterbodies; and
- Modifications to groundwater levels and GWDTEs.

As part of the consultation for the Proposed Development THC raised a question on the potential impacts fire suppressant water might having on the receiving water environment in an event where firefighting is required, and fire suppressant water drains into receiving watercourses. The Proposed Development will develop a Fire Strategy which will confirm the approach for fire management. In a fire event firefighting with water shall not be permitted and this will be secured within the Fire Strategy; firefighting will comprise passive fire suppression and the use of firefighting foam (i.e., no fire suppressant water will be directly aimed at the fire, instead suppressant fire water will be sprayed around the perimeter of a fire to prevent spreading). The drainage system will include a penstock / shut off valve before discharging into a watercourse to allow the system to be

[35] SEPA (2022) SEPA Scottish Flood Hazard and Risk Information [online] available at: https://map.sepa.org.uk/floodmaps (Accessed 28/08/2023)

isolated from the watercourse if required. As such the potential impact of contamination of waterbodies from fire suppressant water is unlikely to be significant and is not assessed further in this chapter.

11.6 Assessment of Effects, Mitigation and Residual Effects

11.6.1 Mitigation by Design

The Proposed Development has been designed to reduce potential impacts as far as reasonably practicable. This includes mitigation that is embedded into the design of the Proposed Development in accordance with industry standard methods and procedures, which will reduce impacts from construction and operation. The following mitigation measures relating to the hydrological environment are embedded into the design and construction where practicable of the Proposed Development:

- 50 m watercourse buffers for construction works, except for watercourse crossings along access tracks; and
- The Proposed Development will utilise much of the existing access track already in place at this location where possible, this will help to minimise ground disturbance and requirement for watercourse crossings; and,
- A surface water drainage system will be implemented which will prevent any increases in surface water runoff and protect the receiving water environment from sedimentation and contamination.

11.6.2 Construction Phase

Vehicular access will be required during construction to enable the construction works. Existing access tracks would be used where feasible and as required. Construction methodologies are detailed in **Volume 2 Chapter 2** Project Description.

Prior to construction it is anticipated that additional information to that provided within this Chapter would be required to inform the detailed design of crossings for flow conveyance and ecological provision which would be informed by consultation with SEPA and THC which will be secured through a CEMP.

Relevant sections of the SSEN Transmission GEMPs will inform a CEMP to be implemented and updated by the Principal Contractor. GEMPs are included as **Volume 4 Appendix 2.1** and relevant GEMPs include the following:

- Private Water Supplies;
- Working in or Near Water;
- Watercourse Crossings;
- Soil Management;
- Contaminated Land;
- Oil Storage and Refuelling;
- Forestry;
- Bad Weather; and
- Working with concrete.

The assessment of effects within this Chapter assumes that embedded mitigation measures including those detailed within the CEMP and relevant GEMPs are implemented.

11.6.3 Potential Construction Effects

Impediments to Surface Water Drainage Patterns

Construction activities in or adjacent to watercourse channels, the location of watercourse crossings in constrained channels or inadequately designed crossings could impede flows within watercourses and cause blockages, resulting in flooding upstream.

The introduction of new or upgraded access tracks can disrupt the natural drainage regime by concentrating flows and altering the infiltration capacity of soils.

The Proposed Development is shown to cross over two unnamed watercourses shown on 1:50,000 scale OS mapping. Both watercourses are small open land drains which are tributaries to the Allt Garbh-airigh to the north of the Site, with one crossing at the northeast of the Proposed Development beneath the substation platform and the other to the west as part of the access track linked to the drainage attenuation pond. The crossing of the watercourses to the northeast and west are located at NGRs NH654975 and NH 64801 97453 respectively. The Site walkover survey on the fourth of June identified that the watercourse to the north east has been diverted around the adjacent forestry land, with an image at the approximate location of the potential crossing location shown below in **Figure 1**.

Figure 1 Diverted Watercourse at Substation Platform Location

As such the only crossing over watercourses shown on 1:50,000 scale OS mapping is the crossing to the west. The watercourse does not contain a defined channel and is an area of flush and grassland which is likely to be a preferential flow route during prolonged or extreme rainfall.

The watercourse crossing to the west will be subject to CAR authorisation. Where watercourses are crossed which are not shown on 1:50,000 scale mapping (e.g., small headwater channels, field and forestry drains)

structures appropriate to the localised conditions will be installed and anticipated to be designed as over-sized culverts in line with SEPA's good practice guidance and the GEMPs.

The adoption of good practice measures detailed in the specific GEMPS listed in paragraph 11.6.2 and provided in **Volume 4 Appendix 2.1** General Environmental Management Plans would reduce the impact of modification to drainage flow patterns with artificial drainage only installed where necessary and would where practicable be installed in advance of ground being cleared. All crossing structures would be designed and construction following good practice techniques in accordance with the GEMPs and be of sufficient capacity to facilitate flows to a 1 in 200-year event with an appropriate allowance accounting for increases in flows due to climate change in accordance with SEPA guidance.

Accounting for the design and embedded mitigation the magnitude of impact on drainage patterns of surface hydrology (High sensitivity) is Negligible and the Magnitude of Change is Minor and therefore the Significance of Effect is Negligible.

Chemical Pollution

During construction a number of pollutants will be present onsite to facilitate construction activities including oil, fuels, chemicals, concrete and waste. Any pollution spillage or incident could have a detrimental effect on the water quality of nearby surface watercourses and waterbodies.

Construction good practice methods, which will be outlined within a CEMP and based on the Oil Storage and Refuelling and Working Near Water GEMPs, will limit the potential risk of spillages and contamination, to reduce the potential for chemical pollutants to be transferred to the water environment and protect watercourses from impacts related to construction works.

Additional measures such as absorbent spill pads / kits and other measures highlighted within a CEMP 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 secured through **Volume 4 Appendix 12.1** Construction Traffic Management Plan. Routine training practices such as staff inductions and toolbox talks will be conducted throughout construction.

Accounting for the design and embedded mitigation the magnitude of impact of pollution on surface watercourses (High sensitivity) is Negligible and the Magnitude of Change is Minor and therefore the Significance of Effect is Negligible.

Erosion and Sedimentation

Erosion and sedimentation can occur from excavations, stone winning, ground disturbance and overburden stockpiling. Sediment entering watercourses has the potential to affect water quality and flows of surface watercourses. This can have subsequent impacts on designated hydrological receptors hydrologically connected to an impacted watercourse, through either an increase or decrease in nutrients and flows.

Good practice site environmental management measures set out in the **Volume 4 Appendix 2.1** Soil Management GEMP and **Volume 4 Appendix 2.2** Construction Environmental Management Plan will reduce any potential effects of soil erosion and sedimentation.

Accounting for the design and embedded mitigation the magnitude of erosion and sedimentation on surface watercourses (High sensitivity) is Negligible and the Magnitude of Change is Minor and therefore the Significance of Effect is Negligible.

Modifications to Hydrogeology and Groundwater

Cutting of ground will be required as part of the substation platform, access road and attenuation basin.

Excavations, foundations and hard standing areas 2 m or deeper have the potential to divert shallow groundwater flows through de-watering if implemented or change sub-surface water flow by creating physical

barriers within superficial deposits. Excavations which are more than 5 m below the ground surface have the potential to divert and interrupt deeper groundwater flow paths and deposits.

Prior to excavation works ground investigations will be conducted by an appointed contractor, which will include identifying groundwater levels within the areas of excavation. Where groundwater is identified dewatering or groundwater diversion may be required with mitigation and control measures in accordance with best practice guidance (e.g., CIRIA Groundwater Control). Section 5.8 of the CEMP details the approach for dewatering for excavations and groundwater which includes:

- Checking for underground services;
- No pumping of silt water into watercourses;
- No disturbance in excavations to prevent stirring up of silt;
- Using the lowest corner of excavations as a pump sump;
- Positioning the pump off the bottom of excavations; and
- A nominated person to check dewatering procedures.

Accounting for the design and embedded mitigation the magnitude of modifications to hydrogeology (High sensitivity) is Negligible and the Magnitude of Change is Minor and therefore the Significance of Effect is Negligible.

Acidification due to Felling

The felling of 66.08 ha of standing coniferous timber and the storage of brash could potentially result in a short-term increase in the acidity of watercourses within the immediate catchment and influence water quality and ecology. The acidification risk posed by felling is principally related to the disruption to the nitrogen cycling and resulting increased rates of mineralisation, nitrification, nitrate leaching and potential decline in acid neutralising capacity. Disturbance of the ground due to felling activities very close to watercourses could lead to flushing of acid from groundwater, if measures to prevent any potential run-off from entering the watercourses directly are not achieved.

Forestry good practice measures are set out in the **Volume 4 Appendix 2.1** GEMPs (Forestry), including specific measures for felling and for forestry during construction. These measures will be implemented and maintained, and this will be carried out during the construction phase under supervision of an ECoW.

Accounting for the adoption of these measures the magnitude of felling acidification of watercourses due to felling on surface watercourses (High sensitivity) is Negligible and the Magnitude of Change is Minor and therefore the Significance of Effect is Negligible.

GWDTE

The effects of the Proposed Development on the habitats and ecology of GWDTE are assessed in **Volume 2 Chapter 7** Ecology and therefore the assessment in this section focuses on the effects of the Proposed Development on the hydrological function of the GWDTEs identified in **Table 11.5**.

GWDTE have the potential to be at risk from a chemical pollution incident, sedimentation and erosion and impediments and alteration to flow patterns which can indirectly alter the habitat and plant species supported.

SEPA LUPS-GU31 guidance outlines the requirement for qualitative and / or quantitative assessment of effects of all infrastructure associated with the Proposed Development on GWDTE, if the GWDTE is located:

- Within 100 m radius of all excavations less than 1 m in depth; and
- Within 250 m radius of all excavations deeper than 1m.

The SEPA classified ‘Highly Groundwater Dependent’ and ‘Moderately Groundwater Dependent’ GWDTE habitats which are identified as having the potential to be at risk from effects arising from the Proposed

Development are outlined in **Table 11.8**. This assessment is used to inform the magnitude of effects on GWDTE arising from construction phase of the Proposed Development.

Table 11.8 Potential GWDTE

NVC Habitat	SEPA Groundwater Dependency Potential (LUPS-GU31)	Within 250 m of Excavations > 1 m in Depth?	Within 100 m of Excavations < 1 m in Depth?	Groundwater Dependency
M15	Moderate - High	Yes – SuDS attenuation pond and substation compound.	Yes- access tracks, construction compound.	Not groundwater dependent. The habitat runs along the extent of an existing surface watercourse adjacent to the existing access road. The watercourse was identified to be a natural watercourse which runs along the route of the road and ultimately to Loch Buidhe past the existing substation. The habitat is in a topographic low point along existing drainage patterns. Therefore, the habitat is assessed to be surface water and ombrotrophic in nature.
M16	Moderate	Yes – SuDS attenuation pond and substation compound.	Yes- access tracks, construction compound.	Not groundwater dependent. The habitat runs along the extent of an existing surface watercourse adjacent to the existing access road. The watercourse was identified to be a natural watercourse which runs along the route of the road and ultimately to Loch Buidhe past the existing substation. The habitat is in a topographic low point along existing drainage patterns. Therefore, the habitat is assessed to be surface water and ombrotrophic in nature.
M23	Moderate	Yes – SuDS attenuation pond and substation compound.	Yes- access tracks.	Not groundwater dependent. The habitat is located along the route of a tributary of the Allt Garb Airigh. Therefore, the habitat is assessed to be surface water and ombrotrophic in nature.

NVC Habitat	SEPA Groundwater Dependency Potential (LUPS-GU31)	Within 250 m of Excavations > 1 m in Depth?	Within 100 m of Excavations < 1 m in Depth?	Groundwater Dependency
MG10	Moderate	No.	No.	Located upslope of the Proposed Development, but in a location which does not appear to have existing surface water flow routes and has potential for groundwater dependency.

Good practice design and construction and measures outlined in the CEMP will minimize potential indirect effects of the Development on GWDTEs during construction phase.

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.

Additionally, the following design measures detailed in Section 5.8 of the CEMP will ensure that effects on wetland habitats are minimised:

- A Water Management and Pollution Prevention Plan (PPP) appends the CEMP and will be 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 Proposed Development;
- Plant nappies will be placed under static plant and equipment at all times and under mobile plant when being left for prolonged periods;
- Settlement lagoons with a sufficient retention time to settle any silt will be constructed and actively managed to control water levels and ensure that any run-off is contained, especially during times of rainfall;
- Foundations are constructed in holes in the ground that will be dewatered, 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; and
- 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 including the implementation of a designated concrete wash out area.

In accordance with SEPA Land Use Planning System Guidance Note 31 there will be no excavations of >1m within 250m and <1m within 100m of GWDTEs which are identified to be groundwater dependent, and the habitats identified within the NVC survey within the aforementioned distances of the Proposed Development are assessed to be ombrotrophic in nature.

Following the implementation of mitigation measures, the magnitude of impact from construction works is Negligible. In accordance with **Table 11.4** with minimal detectable effect on GWDTEs, which are a High sensitivity receptor, and no discernible effect on its integrity as a feature or hydrological functionality, the Significance of Effect is Negligible.

Reduction in the Quality and Quantity of Private Water Supplies

There are three PWS located within the PWS Study Area, as detailed in **Table 11.6**.

No PWS are located within 250 m of the Proposed Development and as such there is no requirement for a standalone detailed PWS Risk Assessment in accordance with SEPA LUPS Guidance 31.

Considering the distance of PWS from the Proposed Development and measures set out in the Private Water Supplies GEMP the magnitude of impact to PWSs (High sensitivity) is Negligible and the Magnitude of Change is Minor and therefore the Significance of Effect is Negligible.

11.6.4 Operational Phase Effects

The introduction of hard standing surface and foundation on existing greenfield land as part of the Proposed Development has the potential to change sub-surface water flow by creating physical barriers within naturally occurring drainage macropores in soil or peat reducing the infiltration capacity and increasing the rate of surface water runoff entering watercourses and drainage features.

A surface water drainage system design has been produced for the Proposed Development and is discussed in **Volume 4 Appendix 11.1** Drainage Impact Assessment. The drainage system comprises a combination of detention basins and swales which are designed to attenuate runoff for a 1 in 200-year (plus climate change allowance) rainfall event without overtopping, with discharge rates limited to the 1 in 2-year greenfield runoff rate.

Accounting for the implementation of a surface water drainage strategy which will limit discharge rates to the 1 in 2-year greenfield runoff rate, the Proposed Development will not lead to an increase in surface water runoff. Therefore, accounting for the design and embedded mitigation, the magnitude of impact of an increase on surface water runoff on downstream receptors (High sensitivity) is Negligible and the Magnitude of Change is Minor and therefore the Significance of Effect is Negligible.

11.6.5 Cumulative Effects

The greatest potential for cumulative effects arises when the construction phase of another development overlaps with the construction phase of the Proposed Development. Cumulative effects are considered to have the potential to be significant only where such an overlap may exist.

Whilst other development might present significant effects to Hydrology and Hydrogeology receptors in their own right, no significant effects have been identified associated with the Proposed Development and assuming other developments will employ effective controls and good practice measures no significant cumulative effects are anticipated. Furthermore, the construction programmes of each development would limit the probability of activities that have the potential to lead to significant effects coinciding across developments.

11.6.6 Residual Effects

Following the incorporation of mitigation measures as detailed in this chapter, residual effects associated with hydrological resources, no significant residual effects as a result of the construction and operation of the Proposed Development have been identified and no further mitigation beyond the good practice measures outlined in this Chapter and through the detailed CEMP that shall be prepared by the Principal Contractor will be required.

11.7 Summary

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

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 are considered to be not significant in EIA terms.