10 HYDROLOGY AND HYDROGEOLOGY

10.1 Introduction

This Chapter of the Environmental Impact Assessment Report (EIA Report) evaluates the effects of the Ladyfield Renewable Energy Park (the Development) on the hydrology and hydrogeology resources. This assessment was undertaken by ERM Ltd.

This chapter includes the following sections:

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

This Chapter of the EIA Report is supported by the following figures provided in Volume 2a Figures:

- Figure 10.1 - Study Areas;
- Figure 10.2 - Hydrological Catchments;
- Figure 10.3 - Hydrological Features;
- Figure 10.4 - Watercourse Crossings; and
- Figure 10.5 - Groundwater Dependent Terrestrial Ecosystems.

This Chapter is supported by the following Technical Appendix documents provided in Volume 3: EIA Report Technical Appendices:

- 10.1: Private Water Supply Risk Assessment (PWSRA).

10.2 Legislation, Policy and Guidance

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

10.2.1 Legislative Background

The Water Framework Directive (WFD) (2000/60/EC)[253] establishes a framework for the protection, improvement, and sustainable use of all water environments. It is transposed within Scotland by The Water Environment and Water Services (Scotland) Act 2003[254] and subsidiary Regulations.

Other relevant legislation includes:

- The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017 (the EIA Regulations)[255];
- The Salmon and Freshwater Fisheries (Consolidation) (Scotland) Act 2003[256];

[253] European Commission (2023) *The Water Framework Directive (2000/60/EC)* [online] available at: http://ec.europa.eu/environment/water/water-framework/index_en.html (Accessed 29.09.23).
[254] Scottish Government (2003) *Water Environment and Water Services (Scotland) Act 2003* [online] available at: http://www.legislation.gov.uk/asp/2003/3/contents (Accessed 29.09.23).
[255] Scottish Government (2017) *The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017 (the EIA Regulations)* [online] available at: https://www.legislation.gov.uk/uksi/2017/580/contents/made (Accessed 29.09.23).
[256] Scottish Government (2003) *Salmon and Freshwater Fisheries (Consolidation) (Scotland) Act 2003* [online] available at: https://www.legislation.gov.uk/asp/2003/15/contents (Accessed 29.09.23)

- The Water Intended for Human Consumption (Private Supplies) (Scotland) Regulations 2017[257];
- The Water Environment (Drinking Water Protected Areas) (Scotland) Order 2013[258];
- The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (CAR)[259];
- The Water Quality (Scotland) Regulations 2010[260];
- The Private Water Supplies (Scotland) Regulations 2006[261]; and
- The Public and Private Water Supplies (Miscellaneous Amendments) (Scotland) Regulations 2017[262]Assessment Methodology and Significance Criteria.

10.2.2 Scottish Planning Policy and Guidance

The Scottish Planning Policy ('SPP')[263] was superseded by National Planning Framework 4 ('NPF4')[264] in February 2023. NPF4 aims to address Scotland's national spatial and thematic planning policies in one place, with a focus on protecting and restoring the natural environment.

NPF4 introduces revised policies for flood risk areas. Policy 22 looks to strengthen resilience to flood risk by promoting avoidance as a first principle and reducing the vulnerability of existing and future development to flooding providing a suitable allowance for climate change.

10.2.3 Pollution Prevention Guidelines (PPGs)

Pollution Prevention Guidelines (PPGs) and the replacement series Guidance for Pollution Prevention (GPPs) give advice on statutory responsibilities and good environmental practice[265]. Each PPG and GPP addresses a specific industrial sector or activity. The Scottish Environment Protection Agency (SEPA) is in the process of replacing the PPGs with GPPs. The following guidance are of relevance principally to surface water, however as surface water has the potential to affect groundwater, they are also of relevance to the assessment of groundwater:

- GPP1 (2020): Understanding your environmental responsibilities – good environmental practices[266];
- GPP2 (2018): Above ground oil storage tanks[267];

[257] Scottish Government (2017) *Water Intended for Human Consumption (Private Supplies) (Scotland) Regulations 2017* [online] available at: https://www.legislation.gov.uk/ssi/2017/282/note/made (Accessed 29.09.23).
[258] Scottish Government (2013) *Water Environment (Drinking Water Protected Areas) (Scotland) Order 2013* [online] available at: http://www.legislation.gov.uk/ssi/2013/29/introduction/made (Accessed 29.09.23).
[259] Scottish Government (2022) *Water Environment (Controlled Activities) (Scotland) Regulations 2011* [online] available at: https://www.legislation.gov.uk/ssi/2011/209/contents/made (Accessed 29.09.23).
[260] Scottish Government (2010) *Water Quality (Scotland) Regulations 2010* [online] available at: https://www.legislation.gov.uk/ssi/2010/95/contents/made (Accessed 29.09.23).
[261] Scottish Government (2006) *Private Water Supplies (Scotland) Regulations 2006* [online] available at: http://www.legislation.gov.uk/ssi/2006/209/contents/made (Accessed 29.09.23)
[262] Scottish Government (2017) *Private and Public Water Supplies (Miscellaneous Amendments) (Scotland) Regulations 2017* [online] available at: http://www.legislation.gov.uk/ssi/2017/321/made (Accessed 29.09.23)
[263] UK Government (2014) *Scottish Planning Policy* [online] available at: https://www.gov.scot/publications/scottish-planning-policy/ (Accessed: 29.09.23).
[264] Scottish Government (2023) *National Planning Framework 4* [online] available at: https://www.gov.scot/publications/national-planning-framework-4/ (Accessed 29.09.23).
[265] SEPA (various) *Pollution Prevention Guidelines and Guidance on Pollution Prevention* [online]. available at: http://www.netregs.org.uk/environmental-topics/pollution-prevention-guidelines-ppgs-and-replacement-series/ (Accessed 29.09.23)
[266] NetRegs (2020) *GPP1: Understanding your environmental responsibilities – good environmental practices* [online] available at: https://www.netregs.org.uk/environmental-topics/guidance-for-pollution-prevention-gpp-documents/gpp-1-understanding-your-environmental-responsibilities-good-environmental-practices/ (Accessed 29.09.23)
[267] NetRegs (2018) *GPP2: Above ground oil storage* [online] available at: https://www.netregs.org.uk/environmental-topics/guidance-for-pollution-prevention-gpp-documents/gpp-2-above-ground-oil-storage/ (Accessed 29.09.23)

- GPP4 (2017): Treatment and disposal of wastewater where there is no connection to the public foul sewer[268];
- GPP5 (2018): Works and maintenance in or near water[269];
- PPG6 (2012): Working at construction and demolition sites[270];
- GPP8 (2017): Safe storage and disposal of used oils[271];
- PPG18 (2000): Managing fire water and major spillages[272];
- GPP21 (2017): Pollution incident response planning[273]; and
- GPP22 (2018): Dealing with spills[274].

10.2.4 Other Guidance

- The Scottish Government (2001) PAN 61: Planning and Sustainable Urban Drainage Systems[275];
- The Scottish Government (2019) The Conservation (Natural Habitats, & c.) Amendment (Scotland) Regulations 2019[276];
- SEPA (2010) Land Use Planning System Guidance Note 2, Version 8 (LUPS-GU2)[277];
- SEPA (2010) Engineering in the water environment: good practice guide: River crossings[278];
- SEPA (2015) Culverting of watercourses: Policy Statement and Supporting Guidance[279];
- SEPA (2017) 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 3, (LUPS-GU31)[280];

[268] NetRegs (2017) *GPP4: Treatment and disposal of wastewater where there is no connection to the public foul sewer* [online] available at: https://www.netregs.org.uk/environmental-topics/guidance-for-pollution-prevention-gpp-documents/gpp-4-treatment-and-disposal-of-wastewater-where-there-is-no-connection-to-the-public-foul-sewer/ (Accessed 29.09.23)
[269] NetRegs (2017) *GPP5: Works and maintenance in or near water* [online] available at: https://www.netregs.org.uk/environmental-topics/guidance-for-pollution-prevention-gpp-documents/gpp-5-works-and-maintenance-in-or-near-water/ (Accessed: 29.09.23)
[270] NetRegs (2012) *PPG6: Working at construction and demolition sites* [online] available at: https://www.netregs.org.uk/media/1672/ppg-6.pdf (Accessed: 29.09.23)
[271] NetRegs (2017) *GPP8: Safe storage and disposal of used oils* [online] available at: https://www.netregs.org.uk/environmental-topics/guidance-for-pollution-prevention-gpp-documents/gpp-8-safe-storage-and-disposal-of-used-oils/ (Accessed: 29.09.23)
[272] NetRegs (N.d.) *PPG18: Managing fire water and major spillages* [online] available at: https://www.netregs.org.uk/media/1674/ppg-18.pdf (Accessed: 29.09.23)
[273] NetRegs (2021) *GPP21: Pollution incident response planning* [online] available at: https://www.netregs.org.uk/environmental-topics/guidance-for-pollution-prevention-gpp-documents/gpp-21-pollution-incident-response-planning/ (Accessed: 29.09.23)
[274] NetRegs (2018) *GPP22: Dealing with spills* [online] available at: https://www.netregs.org.uk/environmental-topics/guidance-for-pollution-prevention-gpp-documents/gpp-22-dealing-with-spills/ (Accessed: 29.09.23)
[275] The Scottish Government (2001) *PAN61 Planning and Sustainable Urban Drainage Systems* [online] available at: https://www.gov.scot/publications/pan-61-sustainable-urban-drainage-systems/ (Accessed: 29.09.23)
[276] The Scottish Government (2019) *The Conservation (Natural Habitats, & c.) Amendment (Scotland) Regulations 2019* [online] available at: https://www.legislation.gov.uk/ssi/2019/64/contents/made (Accessed: 29.09.23)
[277] SEPA (2010*) Land Use Planning System Guidance Note 2, Planning advice on Sustainable Drainage Systems (SUDS), Version 8* [online] available at: https://www.sepa.org.uk/media/143195/lups-gu2-planning-guidance-on-sustainable-drainage-systems-suds.pdf (Accessed: 29.09.23)
[278] SEPA (2010) *Engineering in the water environment good practice guide: River Crossings, WAT-SG-25* [online] available at: http://www.sepa.org.uk/regulations/water/engineering/engineering-guidance/ (Accessed: 29.09.23)
.
[279] SEPA (2015) Culverting of watercourses: position statement and supporting guidance WAT-PS-06-02, Version 2.0 [online] available at: https://www.sepa.org.uk/media/150919/wat_ps_06_02.pdf (Accessed: 29.09.23).
[280] SEPA (2017) *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 3* [online] available at: https://www.sepa.org.uk/media/144266/lups-gu31-guidance-on-assessing-the-impacts-of-development-proposals-on-groundwater-abstractions.pdf (Accessed: 29.09.23).

- SEPA (2019) Climate change allowances for flood risk assessment in land use planning (LUPS-CC1)[281];
- SEPA (2002) Managing River Habitats for Fisheries[282];
- The Scottish Government (2011) The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (the CAR Regulations)[283];
- SEPA (2019) CAR - A Practical Guide, Version 8.4[284];
- SEPA (2009), River Basin Management Plan[285];
- NatureScot (2019), Good Practice During Wind Farm Construction[286];
- The Construction Industry Research and Information Association (CIRIA) (2015), Environmental Good Practice on Site (C741)[287];
- CIRIA (2001), Control of Water Pollution from Construction Sites (C532)[288];
- CIRIA (2015), The SuDS Manual (C753)[289];
- CIRIA (2006), Control of Water Pollution from Linear Construction Projects (C648)[290];
- CIRIA (2017), Guidance on the Construction of SuDS (C768);
- SEPA WAT-RM-08 Regulatory Method: SuDS[291];
- SEPA WAT-SG-75 Sector-specific Guidance – Construction Sites[292]; and
- Water Assessment and Drainage Guide (WADAG)[293].

10.3 Assessment Methodology and Significance Criteria

10.3.1 Scoping Responses and Consultations

Information has been provided by a range of organisations during the assessment, and this is summarised in Table 10.1. The response to each point raised by consultees is also presented within the table, demonstrating where the design of the Development has addressed the response to specific issues identified by SEPA, Scottish Water (SW), Marine Science Scotland and other consultees.

[281] SEPA (2019) *Climate Change Allowances for Flood Risk Assessment in Land Use Planning (LUPS-CC1)* [online] available at: https://www.sepa.org.uk/media/426913/lups_cc1.pdf (Accessed: 29.09.23) .
[282] SEPA (2002) *Managing River Habitats for Fisheries: a guide to best practice* [online] available at: https://www.sepa.org.uk/media/151323/managing_river_habitats_fisheries.pdf (Accessed: 29.09.23).
[283] Scottish Government (2011) *Water Environment (Controlled Activities) (Scotland) Regulations 2011* [online] available at: http://www.legislation.gov.uk/ssi/2011/209/pdfs/ssi_20110209_en.pdf (Accessed: 29.09.23).
[284] SEPA (2022) *Controlled Activities Regulations - A Practical Guide, Version 8.4* [online] available at: https://www.sepa.org.uk/media/dw5de0kh/car-a-practical-guide.pdf (Accessed: 29.09.23).
[285] SEPA (2009) *River Basin Management Plan* [online] available at: https://www.sepa.org.uk/media/37739/scotland_rbmp_sea.pdf (Accessed: 29.09.23)
[286] NatureScot (2019) *Good Practice During Wind Farm Construction* [online] available at: https://www.nature.scot/guidance-good-practice-during-wind-farm-construction (Accessed: 29.09.23).
[287] CIRIA (2015) *Environmental Good Practice on Site* [online] available at: https://www.ciria.org/Training/Training_courses/Environmental_good_practice_on_site.aspx (Accessed: 29.09.23).
[288] CIRIA (2001) *Control of Water Pollution from Construction Sites (C532)* [online] available at: https://www.ciria.org/CIRIA/CIRIA/Item_Detail.aspx?iProductCode=C532&Category=BOOK(Accessed: 29.09.23).
[289] CIRIA (2015) *The SuDS Manual (C753)* [online] available at: https://www.ciria.org/ProductExcerpts/tbyb_c753.aspx (Accessed: 29.09.23).
[290] CIRIA (2006) *C648: Control of water pollution from linear construction projects: Technical Guidance* [online] available at: https://www.ciria.org/ProductExcerpts/C648.aspx (Accessed: 29.09.23).
[291] SEPA (2019) *WAT-RM-08: Regulatory Method Sustainable Drainage Systems (SUDS or SUD Systems) v6.4* [online] available at: https://www.sepa.org.uk/regulations/water/pollution-control/pollution-control-guidance/ (Accessed: 29.09.23).
[292] SEPA (2018) *WAT-SG-75 Supporting Guidance Sector Specific Guidance: Construction Sites* [online] available at: https://www.sepa.org.uk/regulations/water/pollution-control/pollution-control-guidance/ (Accessed: 29.09.23).
[293] SEPA (n.d.) *Water Assessment and Drainage Assessment Guide* [online] available at: https://www.sepa.org.uk/media/163472/water_assessment_and_drainage_assessment_guide.pdf (Accessed: 29.09.23).

Table 10.1: Consultation Responses

Consultee	Type and Date	Summary of Consultation Response	Response to Consultee
SEPA	Scoping Response 04/08/2021	A map and assessment of all engineering works within and near the water environment including buffers should be provided. A request has also been made for details relating to flood risk assessments and any related activities under the Controlled Activities Regulations (CAR).	Noted. Specific 50 m watercourse buffers are outlined in the design parameters discussed in Section 10.3.5. A map outlining hydrological features is outlined in Figure 10.3. The risk of flooding identifying area of medium to high risk of annual flooding is also summarised in Section 10.4.8
		Request for map and assessment of impacts upon groundwater abstractions and buffers. If there are no abstractions within 250m of the excavations, it should be confirmed within the EIA report.	Consultation was undertaken with the Council's Environmental Health Office (EHO) and Scottish Water to identify information on water supply abstractions. Potential effects on public and private water supplies are summarised throughout Section 10.6.2 with further detail outlined in Technical Appendix 10.1. A map outlining hydrological features is shown in Figure 10.3.
		A schedule of mitigation measures, including pollution prevention measures should be produced and provided to SEPA. Various separate maps of proposed layouts are required by SEPA; wastewater drainage layout, surface water drainage layout, layout of proposed water abstractions including details of proposed operating regime.	Mitigation measures for pollution prevention within the Outline Construction Environmental Management Plan (oCEMP) provided as Technical Appendix 11.4, will be implemented to safeguard watercourses and sub-surface water. The civil contractor will need to apply for an abstraction licence from the local water authority, detailing how much water is sought to be extracted, the frequencies and the time of the year, discussed in Section 10.6.2.9. The civil engineering contractor will finalise various drainage layouts and provide plans to SEPA prior to construction. The final details on sizing of SuDS will be required prior to the construction phase and provided by the appropriate person (e.g., contractor).
		In situations where impacting the water environment cannot be avoided, the report must include justification and various maps: All proposed temporary and permanent infrastructure overlain with all lochs and watercourses. A minimum of 50 m buffer zones around each loch and watercourse. Where this is not possible, all breaches must be recorded and photographed. The dimensions of the breached	The Development has been designed to avoid impacts on the water environment where possible. A 50 m buffer of watercourses has been incorporated into the design of the Development, except for watercourse crossings, as discussed in Section 10.3.5. Locations where this buffer cannot be met are discussed in Section 10.6.1.1 with mention of mitigation measures.

Consultee	Type and Date	Summary of Consultation Response	Response to Consultee
		watercourses and lochs must also be recorded, and drawings of proposed engineering works included.	Proposed Development location in relation to hydrological catchments is shown in Figure 10.2. Measures within the oCEMP, provided as Technical Appendix 11.4, will be implemented to safeguard watercourses and subsurface water.
		Watercourse crossings should accommodate 0.5% of Annual Exceedance Probability (AEP) flows or information to justify smaller structures. A flood risk assessment should be submitted should the development increase the risk of flooding.	Noted. Flood risk screening has been carried out in Section 10.4.8 to confirm that infrastructure is not located in areas that are at risk of flooding – watercourse crossings aside. The Development does not increase flood risk. Details on design are outlined in Section 10.3.5 and further discussed in the oCEMP that accompanies the EIA Report and forms part of the embedded development design.
		A map should be provided demonstrating all existing groundwater abstractions are 100 m away from excavations shallower than 1 m and 250 m away from excavations deeper than 1 m or proposed groundwater abstractions. Site specific risk assessments will be required for all locations which fail to meet these minimum buffer distances.	The Development has been designed to avoid effects on the water environment where possible. Consultation was undertaken with the Council's EHO and SW to identify information on water supply abstractions. Potential effects on public and Private Water Supplies (PWS) are summarised in Section 10.4.7. Measures within the oCEMP, provided as Technical Appendix 11.4, will be implemented to safeguard watercourses and subsurface water.
		For each borrow pit: A site-specific map showing that all minimum buffers can be achieved in relation to watercourses, lochs, and access roads. A ground investigation report showing the seasonally highest water table and sections showing the maximum area, depth, and profile of working in relation to the water table. A site map showing the various mitigation and prevention methods for silt, surface water run-off and dewatering discharge. Cut-off drains must be installed to maximise the diversions of water from entering quarry sites. A site map showing proposed water abstractions with details of volumes and timings. A site map showing pollution prevention measures. The drawing notes should include a commitment to check these daily.	As discussed in Section 10.6.1, the oCEMP, provided as Technical Appendix 11.4, describes water management measures to control surface water run-off and drain hardstandings and other structures during the construction and operation of the Development, including the proposed borrow pit. This will form part of a Pollution Prevention Plan (PPP) to be implemented for the Development to be appended to Chapter 3. The oCEMP and PPP are to be agreed with SEPA prior to the construction phase. Maps of the Development showing hydrological catchments, as Figure 10.2, and hydrological features, as Figure 10.3, are also to be included.

Consultee	Type and Date	Summary of Consultation Response	Response to Consultee
Scottish Water	Scoping response 16/07/2021	Scottish Water have no objection to the proposed development. They advise that this does not confirm the proposed development can be serviced – i.e. the Development is not guaranteed to be supplied with water from Scottish Water.	Noted.

10.3.2 Scope of Assessment

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

Short-term effects arising from the construction phase such as:

- 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;
- Impediments to watercourse and near-surface water flow from turbine foundations, watercourse crossings and shallow excavation works, including changes in soil and peat interflow patterns;
- Increased run-off and flood risk from increased area of hardstanding including access tracks;
- Acidification of watercourses as a result of construction works and related tree felling;
- Potential effects on PWS in terms of water quantity, quality and continuity;
- Potential effects on the hydrological function of Ground Water Dependent Terrestrial Ecosystems (GWDTEs); and
- Potential effects on designated sites in terms of decrease in condition of qualifying interests.
- Potential effects of water abstraction for concrete batching on-site reducing ;

Long-term effects arising from operational phase, could include:

- Increased run-off and flood risk from increased hardstanding, including permanent access tracks;
- Alterations to natural flow pathways from runoff from areas of hardstanding, with potential effects on the hydrological function of GWDTEs;
- Potential effects on PWS in terms of water quantity, quality and continuity;
- Chemical pollution because of battery fires from the substation; and
- Chemical pollution because of minor spills from maintenance vehicles.

Short-term effects arising from decommissioning, similar to construction phase, such as:

- Impediments to watercourse and near-surface water flow from excavation of turbine foundations and shallow excavation works, including changes in soil and peat interflow patterns;
- Potential effects on the hydrological function of GWDTEs; and
- Potential effects on designated sites in terms of decrease in condition of qualifying interests.

The key sensitive receptors are:

- Hydrologically connected designated receptors;
- Hydrological function of potential GWDTEs; and
- Quantity, quality, and continuity of PWS.

10.3.3 Elements Scoped Out of Assessment

The following effects are scoped out of assessment:

- Migration of pollutants from contaminated land as the Development has not previously been developed and it is unlikely contaminated land will be encountered;
- Designated receptors within the Wider Study Area (defined in Section 10.4.6) not hydrologically connected to the Development, as outlined in Table 10.8; and
- Pollution and sedimentation effects on the water environment at distances greater than 10 km and it is proposed that receptors beyond this distance are scoped out.

10.3.4 Study Area

The Development is situated approximately 4.7 km north of Inveraray, centred on National Grid References (NGR) 210197, 715498. The Site covers an area of approximately 790 hectares (ha). The Site lies wholly within the administrative boundary of Argyll and Bute Council (the Council).

The hydrology and hydrogeology study area (the Core Study Area) is defined by the Development Boundary and is shown in Figure 10.1. A study area of 2 km from the Core Study Area has been defined to assess the potential effects on PWS (the PWS Study Area), and a wider study area of 10 km from the Core Study Area to assess potential effects on the downstream water environment (the Wider Study Area). Both study areas are shown in Figure 10.1.

10.3.5 Design Parameters

A 50 m Buffer Zone has been established around the watercourses within the Core Study Area and those that bisect it. No infrastructure, except for watercourse crossings are located within the Buffer Zone.

The requirement for access tracks crossing watercourses has been minimised during the design stage, by utilising existing forestry tracks where possible.

An oCEMP accompanies the EIA Report and forms part of the embedded design for the Development, Technical Appendix 11.4. The oCEMP comprises methods and works that are established and effective measures to which the Applicant will be committed through any consent for the Development. Accordingly, the assessment of significance of effects of the Development are considered with the inclusion of the oCEMP as standard embedded good construction practice measures.

Measures to protect the water environment follow the best practice guidance listed below:

- CIRIA C648 – Control of water pollution from linear construction projects[283];
- CIRIA C352 – Control of water pollution from construction sites [284];
- CIRIA SuDS Manual (C753)[285];
- CIRIA Guidance on the construction of SuDS (C768)[286]; and
- SEPA WAT-RM-08 Regulatory Method: SuDS[287];
- SEPA WAT-SG-75 Sector-specific Guidance – Construction Sites[288]; and
- Water Assessment and Drainage Guide (WADAG)[289];
- GPP1 (2020): Understanding your environmental responsibilities – good environmental practices[290];

[283] CIRIA (2006) *C648: Control of water pollution from linear construction projects: Technical Guidance* [online] available at: https://www.ciria.org/ProductExcerpts/C648.aspx (Accessed: 29.09.23)
[284] CIRIA (2001) *C532: Control of water pollution from construction sites: Guidance for consultants and contractors* [Online] Available at: https://www.ciria.org/ProductExcerpts/C532.aspx (Accessed: 29.09.23)
[285] CIRIA (2015) *C753: The SuDS Manual* [online] available at: http://www.scotsnet.org.uk/documents/NRDG/CIRIA-report-C753-the-SuDS-manual-v6.pdf (Accessed 29.09.23)
[286] CIRIA (2017) *C768: Guidance on the construction of SuDS* [online] available at: https://www.ciria.org/CIRIA/CIRIA/Item_Detail.aspx?iProductcode=C768&Category=BOOK (Accessed 29.09.23)
[287] SEPA (2019) *WAT-RM-08: Regulatory Method Sustainable Drainage Systems (SUDS or SUD Systems*) *v6.4* [online] available at: https://www.sepa.org.uk/regulations/water/pollution-control/pollution-control-guidance/ (Accessed: 29.09.23)
[288] SEPA (2018) *WAT-SG-75 Supporting Guidance Sector Specific Guidance: Construction Sites v2* [online] available at: https://www.sepa.org.uk/regulations/water/pollution-control/pollution-control-guidance/ (Accessed: 29.09.23)
[289] SUDSWP (2016) *Water Assessment and Drainage Assessment Guide* [Online] Available at: https://www.sepa.org.uk/regulations/water/pollution-control/pollution-control-guidance/ (Accessed: 29.09.23)
[290] NetRegs (2020) *GPP1: Understanding your environmental responsibilities – good environmental practices* [online] available at: https://www.netregs.org.uk/environmental-topics/guidance-for-pollution-prevention-gpp-documents/gpp-1-understanding-your-environmental-responsibilities-good-environmental-practices/ (Accessed 28.09.23)

- GPP2 (2018): Above ground oil storage tanks[291];
- GPP4: Treatment and disposal of wastewater where there is no connection to the public fowl sewer[292];
- GPP5: Works and maintenance in or near water[293];
- PPG6 (2012): Working at construction and demolition sites[294];
- GPP8 (2017): Safe storage and disposal of used oils[295];
- PPG18 (2000): Managing fire water and major spillages[296];
- GPP21 (2017): Pollution incident response planning[297]; and
- GPP22 (2018): Dealing with spills[298].

The main embedded mitigation measures relied upon at various stages of development include:

- Drainage measures installed prior to earthwork activities:
    - Cut-off/ diversion ditches;
    - Temporary interception bunds;
    - Swales; and
    - Retention ponds.
- Drainage measures for permanent or semi-permanent earthworks:
    - Drainage ditches;
    - Sumps; and
    - Culverts.
- Sediment pollution prevention:
    - Silt traps and silt matting;
    - Silt fencing;
    - Check damns; and
    - Settlement lagoons.
- Chemical pollution prevention:
    - Safe storage methods of chemicals and oils; and
    - Chemical spill response measures.

[291] NetRegs (2018) *GPP2: Above ground oil storage* [online] available at: https://www.netregs.org.uk/environmental-topics/guidance-for-pollution-prevention-gpp-documents/gpp-2-above-ground-oil-storage/ (Accessed 29.09.23)
[292] NetRegs (2017) *GPP4: Treatment and disposal of wastewater where there is no connection to the public foul sewer* [online] available at: https://www.netregs.org.uk/environmental-topics/guidance-for-pollution-prevention-gpp-documents/gpp-4-treatment-and-disposal-of-wastewater-where-there-is-no-connection-to-the-public-foul-sewer/ (Accessed 29.09.23)
[293] NetRegs (2017) *GPP5: Works and maintenance in or near water* [online] available at: https://www.netregs.org.uk/environmental-topics/guidance-for-pollution-prevention-gpp-documents/gpp-5-works-and-maintenance-in-or-near-water/ (Accessed: 29.09.23)
[294] NetRegs (2012) *PPG6: Working at construction and demolition sites* [online] available at: https://www.netregs.org.uk/media/1672/ppg-6.pdf (Accessed 29.09.23)
[295] NetRegs (2017) *GPP8: Safe storage and disposal of used oils* [online] available at: https://www.netregs.org.uk/environmental-topics/guidance-for-pollution-prevention-gpp-documents/gpp-8-safe-storage-and-disposal-of-used-oils/ (Accessed 29.09.23)
[296] NetRegs (N.d.) *PPG18: Managing fire water and major spillages* [online] available at: https://www.netregs.org.uk/media/1674/ppg-18.pdf (Accessed 29.09.23)
[297] NetRegs (2021) *GPP21: Pollution incident response planning* [online] available at: https://www.netregs.org.uk/environmental-topics/guidance-for-pollution-prevention-gpp-documents/gpp-21-pollution-incident-response-planning/ (Accessed 29.09.23)
[298] NetRegs (2018) *GPP22: Dealing with spills* [online] available at: https://www.netregs.org.uk/environmental-topics/guidance-for-pollution-prevention-gpp-documents/gpp-22-dealing-with-spills/ (Accessed 29.09.23)

An exhaustive list of embedded mitigation measures with accompanying reasoning is provided in the oCEMP within Section 5. All measures are based on good construction practices outlined in the guidance documents listed above.

10.3.6 Baseline survey Methodology

A Desk Based Assessment (DBA), consultation, and site walkover have been conducted to inform the hydrology and hydrogeology assessment.

The DBA included:

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

The following sources of information were used to inform the DBA:

- The Ordnance Survey (OS) 1:50,000 (Digital);
- OS 1:25,000 Map (Digital);
- LiDAR Survey Data;
- National River Flow Archive (NRFA)[299];
- SEPA Flood Map 2019[300];
- Meteorological Office Rainfall Data[301];
- Scotland's Environment web-based maps[302]; and
- British Geological Survey (BGS) GeoIndex onshore geology viewer[303].

10.3.7 Consultation

In addition to the Scoping consultation outlined in Section 10.3.1, the following consultees were contacted to inform the hydrology, hydrogeology, and PWS assessment:

- The Council's EHO via email to obtain information on registered PWS within the PWS Study Area; and
- Residents and owners of properties which are identified as being supplied by a PWS to obtain information on the source and supply of the PWS.

Further information on this consultation is provided as part of the PWSRA in Section 10.4.7.2.

10.3.8 Site Walkover

A site walkover was conducted between 29th November – 2nd December 2021 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 DBA.

The site walkover covered the Core Study Area, as shown in Figure 10.1. This included a walkover of the key surface water courses, associated tributaries, and areas of potential GWDTEs.

[299] Centre for Ecology and Hydrology (n.d.) *National River Flow Archive* [online] available at: http://nrfa.ceh.ac.uk/ (Accessed 29.09.23)
[300] SEPA (2023) *Flood Hazard and Flood Risk Information* [online] available at: https://map.sepa.org.uk/floodmaps (Accessed 29.09.23)
[301] Met Office (2022) *Climate Data* [online] available at: http://www.metoffice.gov.uk/public/weather/climate (Accessed 29.09.23)
[302] Scotland's Environment (n.d.) [online] available at: https://www.environment.gov.scot/legal/terms-and-conditions/ (Accessed 29.09.23)
[303] BGS (2019) *GeoIndex Onshore* [online] available at: https://mapapps2.bgs.ac.uk/geoindex/home.html (Accessed 29.09.23)

10.3.9 Methodology for the Assessment of Effects

The significance of the potential effects of the 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 Ltd. 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.

10.3.10 Sensitivity of Receptors

The sensitivity of the baseline conditions, including the importance of environmental features on or near to the Development or the sensitivity of potentially affected receptors, will be assessed in line with best practice guidance, legislation, statutory designations and / or professional judgement.

Table 10.2 details the framework for determining the sensitivity of receptors.

Table 10.2 Framework for Determining Sensitivity of Receptors

Sensitivity of Receptor	Definition
Very High	A large, medium, or small waterbody with a SEPA water quality classification of 'High'. The hydrological receptor is used for recreational use (e.g., bathing waters). The hydrological receptor and downstream environment have no capacity to attenuate natural fluctuations in hydrochemistry and cannot absorb further changes without fundamentally altering its baseline characteristics / natural processes. Local groundwater constitutes a valuable resource because of its high quality and yield. Aquifer classified by the BGS as 'highly productive aquifer' and is of regional importance. Statutorily designated nature conservation sites dependent on groundwater. The hydrological receptor will support abstractions for public water supply or private water abstractions to produce mass-produced food and drinks. Groundwater vulnerability class 5: vulnerable to most pollutants, with rapid impact in many scenarios. The hydrological receptor will support abstractions for any public water supply, or private water abstractions which supply more than 25 people and / or 100 livestock (at any given point in the year) and/ or is used for the mass-production of food and drinks. GWDTEs which are classified by SEPA as "highly groundwater dependent" and have no (<1 %) functional impairment by man-made influence (such as drainage or forestry). The hydrological receptor is of high environmental importance or is designated as European or international importance, such as a Special Area of Conservation (SAC), Special Protection Areas (SPA), or Wetland of International Importance (Ramsar) with an Assessed condition of 'Favourable'. The receptor acts as an active floodplain or other flood defence.
High	A large, medium, or small waterbody with a SEPA water quality classification of 'Good'. The hydrological receptor and downstream environment have limited capacity to attenuate natural fluctuations in hydrochemistry and cannot absorb further changes without fundamentally altering its baseline characteristics / natural processes. Aquifer of local importance. Groundwater body is classified by the BGS as a 'moderately productive aquifer', with moderate yield from secondary fractures and near-surface weathering. Exploitation of local groundwater is not far-reaching. Local areas of nature conservation known to be sensitive to groundwater effects. Groundwater vulnerability class 4a - 4b: vulnerable to those pollutants not readily adsorbed or transformed. The hydrological receptor supports abstractions for PWS for up to 25 people and / or 100 livestock (at any given point in the year).

Sensitivity of Receptor	Definition
	GWDTEs which are classified by SEPA as "highly groundwater dependent" have minor (1 -25 %) functional impairment by man-made influence (such as drainage or forestry). A site of Special Scientific Interest (SSSI) or hydrological receptor is of high environmental importance designated as European or international importance, such as a SAC, SPA or Ramsar with an Assessed condition of 'Unfavourable'. The receptor is located within an active flood plain.
Medium	A large, medium, or small waterbody with a SEPA water quality classification of 'Moderate'. The hydrological receptor and downstream environment will have moderate capacity to attenuate natural fluctuations in hydrochemistry but cannot absorb certain changes without fundamentally altering its baseline characteristics / natural processes. Aquifer of limited value (less than local) and is classified by the BGS as a 'low productivity aquifer' as water quality does not allow potable or other quality sensitive uses. Exploitation of local groundwater is not far-reaching. Local areas of nature conservation known to be sensitive to groundwater effects. GWDTEs/ wetlands which are classified by SEPA as "highly groundwater dependent" but have moderate (25 % - 50 %) functional impairment by man-made influence (such as drainage or forestry). Groundwater vulnerability class 2-3: vulnerable to some pollutants. GWDTEs which are classified by SEPA as "moderately groundwater dependent" have no functional impairment by man-made influence (such as drainage or forestry). The hydrological receptor does not act as an active floodplain or other flood defence but is considered to provide some degree of natural flood management (e.g. peat soils). The hydrological receptor is of local environmental importance (such as Local Nature Reserves (LNR)).
Low	A large, medium, or small waterbody with a SEPA water quality classification of 'Poor' or 'Bad'. The hydrological receptor and downstream environment will have capacity to attenuate natural fluctuations in hydrochemistry but can absorb any changes without fundamentally altering its baseline characteristics / natural processes. Poor groundwater quality and / or very low permeability make exploitation of groundwater unfeasible. Changes to groundwater not expected to affect local ecology. Groundwater vulnerability class 1: vulnerable to conservative pollutants. The hydrological receptor does not support abstractions for public water supply or private water abstractions. GWDTEs which are classified by SEPA as "highly groundwater dependent" but have major (>50%) functional impairment by man-made influence (such as drainage or forestry). GWDTEs which are classified by SEPA as "moderately groundwater dependent" but have functional impairment by man-made influence (such as drainage or forestry). GWDTEs which are classified by SEPA as "highly or moderately groundwater dependent" but are ombrotrophic. The hydrological receptor does not act as an active floodplain or other flood defence. The hydrological receptor is not of regional, national, or international environmental importance. The hydrological receptor is not designated for supporting freshwater ecological interest.
Negligible	The receptor is resistant to change and is of little environmental value.

10.3.11 Magnitude of Effect

The magnitude of potential effects will be identified through consideration of the Development, the degree of change to baseline conditions predicted because of the Development, the duration and reversibility of an effect and professional judgement, best practice guidance and legislation.

The criteria for assessing the magnitude of an effect are presented in Table 10.3.

Table 10.3 Framework for Determining Magnitude of Effects

Magnitude of Effects	Definition
High	A short or long-term major shift in hydrochemistry or hydrological conditions sufficient to negatively change the ecology of the receptor. This change will equate to a downgrading of a SEPA water quality classification by two classes e.g., from 'High' to 'Moderate'. A sufficient material increases in the probability of flooding onsite and offsite, adding to the area of land which requires protection by flood prevention measures or affecting the ability of the functional flood plain to attenuate the effects of flooding by storing flood water. A major loss of (greater than 50 % of study area) or total loss of highly dependent and high value GWDTE, or where there will be complete hydrological severance which will fundamentally affect the integrity of the feature. A major permanent or long-term negative change to groundwater quality or available yield. The yield of existing supplies may be lost or major long-term or short-term reduction in quantity and/ or deterioration in quality. Changes to groundwater quality or water table level that will negatively alter local ecology or will lead to a groundwater flooding issue.
Medium	A short or long term non-fundamental change to the hydrochemistry or hydrological environment, resulting in a change in ecological status. This change will equate to a downgrading of a SEPA water quality classification by one class e.g., from 'High' to 'Good.' A moderate increase in the probability of flooding onsite and offsite, adding to the area of land which requires protection by flood prevention measures or affecting the ability of the functional flood plain to attenuate the effects of flooding by storing flood water. A loss of part (approximately 10 % to 50 % of study area) of a moderately dependent and moderate value GWDTE – significant hydrological severance affects the integrity of the feature, but it could still function. Changes to the local groundwater regime that may slightly affect the use of the receptor. The yield of existing supplies may be reduced or quality slightly deteriorated. Fundamental negative changes to local habitats may occur, resulting in impaired functionality.
Low	A detectable non-detrimental change to the baseline hydrochemistry or hydrological environment. This change will not result in a downgrading of the SEPA water quality classification. A marginal increase in the probability of flooding onsite and offsite, adding to the area of land which requires protection by flood prevention measures or affecting the ability of the functional flood plain to attenuate the effects of flooding by storing flood water. A detectable but non-material effect on the receptor (up to 5 %) or a moderate effect on its integrity as a feature or where there will be a minor severance or disturbance such that the functionality of the receptor will not be affected. A detectable effect on a GWDTE (loss of between 5 % - 10 % of study area) or a minor effect on a GWDTE's integrity as a feature or where there will be a minor severance or disturbance such that the functionality of the receptor will not be affected. Changes to groundwater quality, levels or yields do not represent a risk to existing baseline conditions or ecology.
Negligible	No perceptible changes to the baseline hydrochemistry or hydrological environment. No change to the SEPA water quality classification. No increase in the probability of flooding onsite and offsite. A slight or negligible change from baseline condition of geological resources. Change hardly discernible, approximating to a 'no change' in geological condition. Minimal detectable effect on a GWDTE (between to 0.1 % - 5 % of study area) or no discernible effect on its integrity as a feature or its functionality.

10.3.12 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. Table 10.4 summarises guideline criteria for assessing the significance of effects.

Table 10.4 Framework for Assessment of the Significance of Effects

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

Effects predicted to be of major or moderate significance are 'significant' in the context of the EIA Regulations and are shaded in light grey in Table 10.4.

10.3.13 Assessment Limitations

At the time of reporting, limited responses were received from property owners/residents following the PWS consultation which was conducted in October 2021. However, only one PWS (Ladyfield Farm) within the PWS Study Area is hydrologically connected to the Development. The source of the Ladyfield farm PWS is known. A desk based PWS Risk Assessment (PWSRA) has been carried out.

10.4 Baseline Conditions

10.4.1 Topography and Land use

The Development is situated approximately 4.7 km north of Inveraray, centred on National Grid References (NGR) 210197, 715498. The Site covers an area of approximately 790 hectares.

Within the Core Study Area, the predominant use of land is a private forestry plantation used for commercial purposes as shown in Plate 10.1. While the majority of the Core Study Area is covered by coniferous vegetation, there are also upland moorland areas present as shown in Plate 10.2.

Plate 10.1. Area of active forest felling with pre-existing access tracks. North facing (left), east facing (right), NGR NN 09869 15967.

The central and northern section of the Development is situated in an area which generally slopes to the west with varying degrees of slope. The southern section of the study area generally slopes west and south-west. The elevation of the study area ranges from approximately 470 meters (m) Above Ordnance Survey Datum (AOD) at its highest in the south-eastern section of the Development, to approximately 6 m AOD along the southern FLS access track joining with the A83.

Plate 10.2 Area of upland grassland surrounded by dense mature forestry. Area steeply sloping to the south and dry underfoot. NGR NN 09979 14132, east facing (left), south facing (right).

The core study area extends to the north until the change in vegetation from a forested area to a moorland area. To the west the study area is bound by the River Aray and the A819. Throughout the study area, there are several pre-existing FLS access tracks which are currently in use for felling purposes.

10.4.2 Climate

The closest SEPA gauging station to the Development is Barnaline Lodge at Avich at Loch Awe, located at National Grid Reference NM 97180 13937, approximately 11.4 km west of the Core Study Area. The station is located at an elevation of 49.3 m AOD and is within the Loch Awe catchment.

The Mean Monthly Rainfall (MMR) 1991-2020 is recorded as ranging from 93.7 – 242.8 mm across the Core Study Area. Table 10.5 summarises the average annual rainfall for Lephinmore, Loch Awe.

Precipitation data from the Meteorological Office[304] is reviewed for the nearest climate station to the Development. The nearest climate station to the Development is located at Lephinmore, approximately 23.8 km to the south-west of the Core Study Area. The climate station at Lephinmore provided an average long term annual rainfall in the standard period (1981 – 2010) as 1925.1 mm.

Table 10.5 Long term average rainfall for Lephinmore, Loch Awe (1991-2020)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall (mm)	242.8	165.4	171.9	117.2	93.7	111.4	110.0	137.6	161.1	221.4	209.3	215.7

10.4.3 Surface Hydrology

The Core Study area is predominantly situated within the River Aray catchment with sub catchments including, Allt Sheileachan, Allt à Mhadaidh and Allt Pharuig. Figure 10.4 shows the main watercourses and their catchments. The surface watercourses shown on Ordinance Survey maps for the Development location are not always present within the Development area. Some watercourses are completely absent, others aren't consistently present due to their ephemeral nature – particularly those near the top of the catchment, and other watercourses have previously been altered. For these reasons, LiDAR survey data was also included in the Development selection and design process to identify surface watercourses more accurately – as discussed in Chapter 3 – Site Selection and Design.

To the north and north west of the Development, many tributaries which drain from the slope of Beinn Ghlas flow in the Allt Sheileachan which flows through the northern aspect of the Core Study area. The watercourse briefly flows through a heavily forested section of the Development before flowing north-east, out of the Core Study Area and discharging into the River Aray, as shown in Plate 10.3. The River Aray has an overall SEPA water quality classification of 'Moderate'.

[304] Met Office (n.d.) *Meteorological Office Climate Averages* [online] available at: https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-climate-averages/gcur0c9pr (Accessed 29.09.23)

Plate 10.3. Allt Sheileachan at NGR NN 11076 17271. Large watercourse with moderate flows through a flat, heavily forested area. Grassy banks with cobbles and gravel in riverbed Views upstream (left) downstream (right).

Across the northern section of the Core Study area is a collection of unnamed watercourses which flow from east to west and ultimately drain into the River Aray. These watercourses drain downslope in dendritic drainage pattern. Many of these watercourses flow downslope, across the length of the Development, crossing forest clearances and pre-existing access tracks in the process. Where the watercourses do cross the access tracks, pre-existing culverts are present.

West of the central section of the Core Study Area lies Lochan à Mhadaidh. This is situated within an area of flat terrain located north of Stùc Scardan. Allt Mhadaidh flows west from Lochan à Mhadaidh and flows west across the Development. This intersects with several significant watercourses across the Development as shown in Plate 10.4. A large culvert has previously been installed to allow a pre-existing access track to be built as shown in Plate 10.5. This watercourse cross two access tracks before discharging into the River Aray.

Plate 10.4. Intersection of Allt Mhadaidh with an unnamed watercourse, both flowing east to west. Steep grassy banks with forestry upstream. Very fast flow rate with large cobbles and boulders in riverbed. NGR NN 10072 15100, Upstream (left) downstream (right).

Plate 10.5. Culvert installed to allow for the continuous flow of Allt Mhadaidh. Watercourse flows east to west. Plastic culvert >1m wide with a 2m wide watercourse. Boulders and cobbles in Riverbed. NGR NN 09922 15111. Culvert view (left) downstream (right).

To the south of the Core study area lie two unnamed watercourses, both of which originate south west of Stùc Scardan and flow south-west, through the Development. These watercourses flow almost parallel to one another and both flow underneath two pre-existing access tracks before

continuing to south south-west and discharging into the River Aray. These watercourses flow through the proposed access track Development area.

To the south-east of the Core Study area lies two watercourses which flow south through the Development and act as significant tributaries to the Allt Pharuig. The Westerly watercourse originates near the summit of Stùc Scardan flowing south. In places this watercourse flows down steep, rocky slopes before continuing downstream and intersecting with Allt Pharuig as shown in Plate 10.6. This watercourse lies downstream of proposed Development infrastructure.

Plate 10.6. Tributary of Allt Pharuig flowing south with moderate level and flow. 0.5m wide, flowing down steep grassy slopes with crags present further upstream. Large cobbles are vegetation present in watercourse. NGR NN 10776 14015, upstream (left) downstream (right).

The other tributary stream of Allt Pharuig originates to the east of the Development boundary, flowing west before flowing south, intersecting with Allt Pharuig. This watercourse is located within a large, gradually sloping grassland area, downslope of proposed Development infrastructure as shown in Plate 10.7. After the intersection, Allt Pharuig flows east passing through the proposed access track boundary and a pre-existing access track before discharging into the River Aray.

Plate 10.7. Tributary watercourse of Allt Pharuig flowing south-west through a gradually sloping grassland area. 0.3 m wide with a moderate level, fast flow rate and vegetation in stream. NGR NN 10784 13475, upstream (left) downstream (right).

There is a small area of potential drainage in the south-east area of the Core Study area which is within the River Shira catchment. Along the proposed access track boundary, several watercourses drain west and south-west, all within the River Aray catchment.

10.4.4 Hydrogeology

The groundwater units underlying the Site are identified by Scotland's Environment mapping service as the Oban and Kintyre body[305]. These units have an overall SEPA classification of 'Good'.

BGS 1:625,000 digital mapping and the BGS GeoIndex mapper shows the bedrock aquifer underlying the majority of the Core Study Area to consist of Argyll Group – psammite, semipelite and pelite which dominates the central and northern area of the Core Study Area.

To the south of the Core Study Area lies bands of unnamed igneous intrusions, specifically Late Silurian to Early Devonian – felsic rock. In the northern aspect of the Development, there is a relatively small, isolated igneous intrusion of Neoproterozoic – mafic igneous rock which underlies the northern boundary of the Core Study Area. These rocks are classified as "low productive aquifer" where "nearly all flow of groundwater is in the near-surface weathered zone and secondary fractures".

BGS 1:50,000 digital mapping and the BGS GeoIndex mapper indicates that much of the northern and north-western areas the Core Study Area to be underlain by hummocky glacial deposits. Along the eastern aspect of the Core Study Area lie several alluvium deposits which are generally found along the River Aray. Also scattered throughout the central and southern areas of the Development area are deposits (of varying size) of Devensian till. Further information on Superficial Soils can be found in Chapter 11 – Geology and Peat, and Figure 11.1 illustrates the 'Superficial Soils' map.

[305] SEPA (n.d.) *Groundwater classification* [online] available at: https://map.environment.gov.scot/sewebmap/ (Accessed 29.09.23)

The BGS groundwater vulnerability[306] ranges between 4a to 5 defining the underlying rocks as vulnerable to pollutants not readily adsorbed.

Groundwater vulnerability classes range from 1 to 5, with 5 being most vulnerable. Class 4 is subdivided into 4a and 4b. It is the hydrogeological characteristics within the pathway rather than the 'importance' of a particular aquifer that results in the final vulnerability classification. The methodology behind the classification assumes that where contaminants move through unsaturated fractured bedrock, no attenuation of pollutants can take place. Large parts of Scotland show areas of Classes 4 and 5, reflecting the widespread occurrence of rocks dominated by fracture flow. Rocks which are not exposed at the surface and are overlain by superficial deposits have a reduced potential for attenuation of contaminants.

10.4.5 Ground Water Dependent Terrestrial Ecosystems (GWDTEs)

GWDTEs are specifically protected under the Water Framework Directive and are sensitive receptors to the pressures that are potentially caused by the Development.

In accordance with SEPA guidance[307], a Phase 1 Habitat Survey was undertaken in May 2021 by MacArthur Green Ltd to identify wetland habitats occurring within the Core Study Area. Wetland habitats were identified in line with the criteria outlined in 'A Functional Wetland Typology for Scotland' (SNIFFER, 2009[308]). Where wetland habitats were identified, a further detailed habitat assessment was undertaken, with identification of National Vegetation Classification (NVC) communities. The survey methods employed for this assessment are outlined in Chapter 8: Ecology and the report from the NVC surveyor attached in Technical Appendix A8.1: National Vegetation Classification & Habitats Survey.

Eight Phase 1 habitats were identified, and a total of fifteen NVC communities were recorded on the Development in areas of woodlands, grassland, heath, bog (mores) swamp and wetland habitats.

For this assessment, the baseline survey for GWDTE's was carried through use of a 250 m buffer of the Core Study Area to allow for the potential impacts of turbine excavations in proximity to the Core Study Area boundary to be assessed, and for the extension of potential hydrological effects.

The potential GWDTE's were recorded on the Development in areas of woodland, grassland, bog, and wetland habitats. The NVC communities that have the potential to be moderately or highly groundwater dependent based on the SEPA guidance are outlined in Table 10.6.

[306] BGS (2015) *Groundwater Vulnerability (Scotland) GIS dataset, Version 2* [online] available at: http://nora.nerc.ac.uk/id/eprint/509618/1/OR15002.pdf (Accessed 29.09.23)
[307] SEPA (2017) *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 3* [online] available at: https://www.sepa.org.uk/media/144266/lups-gu31-guidance-on-assessing-the-impacts-of-development-proposals-on-groundwater-abstractions.pdf (Accessed: 29.09.23)
[308] SNIFFER (2009*) WFD95 A Functional Wetland Typology for Scotland Field Report 2009* [online] available at: https://www.sniffer.org.uk/wfd95-a-functional-wetland-typology-for-scotland (Accessed 29.09.23)

Table 10.6 Potential GWDTE Communities Identified

Phase 1 Habitat	Recorded NVC Community	SEPA Groundwater Dependency Potential (LUPS-GU31)	Location within the Core Study Area	Site-specific Groundwater Dependency
A1.1.1 Broad-Leaved Semi-Natural Woodland	W4 - *Betula pubescens - Molinia caerulea woodland*	High	One area present within the Development Boundary, situated on the central section of the Allt à Mhadaidh.	Low – One habitat is likely surface water dependant as it has the Allt à Mhadaidh watercourse running through its centre.
			One habitat 300 m south of the central aspect of the Development Boundary on the bank of an unnamed watercourse.	Low – The habitat 300 m south of the Development Boundary is in the riparian zone of an unnamed watercourse.
			One habitat situated 1.8 km south of the central aspect of the Development Boundary area and south of Eas à Chleibh.	High – located on the southern upper slope of Eas à Chleibh and unlikely fed by surface water.
	M25 - *Molinia caerulea - Potentilla erecta mire*	Moderate	Habitat present in the central aspect of the Development Boundary, situated at the confluence of Allt à Mhadaidh and a large unnamed watercourse.	Low – The habitat is likely surface water fed as it has the Allt à Mhadaidh running through its centre.
E2.1 Acidic Neutral Flush	M6 - *Carex echinata - Sphagnum recurvum mire*	High	Three isolated habitats present in the Core Study Area scattered throughout the central aspect of the Development Boundary.	Low to High – Two habitats are in the immediate vicinity with two unnamed watercourses (Low). The third habitat is away from any surface watercourses and in flush area (High).
			Most of these communities are clustered south and upslope of the central aspect of the Development Boundary, separated by an unnamed watercourse.	Moderate to High – The majority of these habitats are upslope and away from the unnamed watercourse within a Flush habitat (High). However, one habitat is nearby to the bank of the unnamed watercourse (Moderate).
	M25 - *Molinia caerulea - Potentilla erecta mire*	Moderate	One habitat situated in the Core Study Area located across an unnamed watercourse in the centre the Development.	Low – the habitat is located across an unnamed watercourse.
			Three other habitats situated south of the Development Boundary.	Moderate – All three habitats are not associated with a surface water feature and are upslope of the nearest watercourse.

Phase 1 Habitat	Recorded NVC Community	SEPA Groundwater Dependency Potential (LUPS-GU31)	Location within the Core Study Area	Site-specific Groundwater Dependency
	M23 - Juncus effusus/acutiflorus - Galium palustre rush-pasture	High	One isolated habitat situated on the eastern edge of the Development Boundary on a tributary watercourse to Allt Pharuig.	Low – the habitat is located directly across an unnamed watercourse.
			Three other habitats are situated south of the Development boundary.	Low to High – One habitat is located directly across an unnamed watercourse (Low). The two other habitats are located away from any surface watercourses in a flush area (High).
	W4 - Betula pubescens - Molinia caerulea woodland	High	One habitat situated south of the Development Boundary, approximately 0.37 km south-east of Allt Pharuig	High – The habitat is located away from surface watercourses and in a flush area.
E1.6.1 Blanket Bog	M6 – *Carex 24chinate – Sphagnum recurvum mire*	High	Three habitats, clustered together in an area of forest clearing within the Core Study Area, 0.4 km west of Stùc Scardan.	Low – One habitat is located across a small unnamed watercourse. The two remaining habitats are located near the banks of two unnamed watercourses, one leading north, another leading south. Both are potentially also fed by an upstream blanket bog.
	M23 – Juncus effusus/acutiflorus – Galium palustre rush-pasture	High	One habitat located west of the central area of the access track boundary, west of the headwaters of Eas à Chleibh	Moderate – The habitat is located on a slope upslope of its nearest watercourse but is potentially fed by an upslope blanket bog.
B5 Marsh/Marshy Glassland	M23 – *Juncus effusus/acutiflorus – Galium palustre rush-pasture*	High	Three isolated habitats present north of the forested area located in the southern section of the Development Boundary.	Moderate to High – One habitat is in the vicinity of a small unnamed watercourse (Moderate). The two other habitats are not associated with any surface water feature (High).
			Two habitats lie south and south-east outside the Development Boundary.	Low – Both habitats lie across a dendritic structure of small surface watercourses.
			Ten clustered habitats further south of the Development Boundary between Eas à Chleibh and Eas Dubhair.	Low to Moderate – Two of the habitats lie in immediate vicinity to a surface watercourse (Low). The remaining eight lie further away from the two watercourses on the upper slopes of

Phase 1 Habitat	Recorded NVC Community	SEPA Groundwater Dependency Potential (LUPS-GU31)	Location within the Core Study Area	Site-specific Groundwater Dependency
				Meall Rèidh, potentially away from the likely emergence of groundwater (Moderate).
	M6 – Carex 25chinate – Sphagnum recurvum mire	High	Three isolated areas habitats, one lies on the east Development Boundary, one is immediately south-east of the Development Boundary, the third is further south of the Development Boundary.	Low – All three habitats are located immediately in the riparian areas of their nearest respective watercourse and are likely surface water fed.
	M25 – Molinia caerulea – Potentilla erecta mire	Moderate	Six habitats clustered together south of the Development Boundary.	Low to Moderate – One habitat lies in the riparian area of a neighbouring unnamed watercourse and is likely surface water fed (Low). The remaining five habitats are on the upper slopes of the Meall Rèidh potentially away from the likely emergence of groundwater (Moderate).
B1.1 Unimproved Acidic Grassland	M23 – *Juncus effusus/acutiflorus – Galium palustre rush-pasture*	High	Two habitats found together, situated on the tributaries of Eas à Chleibh south of the Developmeny Boundary.	Low – An unnamed tributary of the Eas à Chleibh runs through the middle of both habitats.
D2 Wet Dwarf Shrub Heath	M15 – *Scirpus cespitosus – Erica tetralix wet heath*	Moderate	Three habitats all within the Development Boundary. Two are present in forested areas to the north, with one present in a forest clearing 0.42 km west of Stùc Scardan.	Low – All three habitats have surface watercourses running through them.
	M25 – Molinia caerulea – Potentilla erecta mire	Moderate	Two isolated areas are present in forested areas to the north of the Core Study Area.	Low – The habitat has an unnamed watercourse running through it.
	M6 – Carex 25chinate – Sphagnum recurvum mire	High		Low – The habitat has an unnamed watercourse running through it.

Phase 1 Habitat	Recorded NVC Community	SEPA Groundwater Dependency Potential (LUPS-GU31)	Location within the Core Study Area	Site-specific Groundwater Dependency
E1.7 Wet Modified Bog	M25 – *Molinia caerulea – Potentilla erecta mire*	Moderate	Several differently sized habitats found scattered across the length of the Core Study Area. These habitats are generally found in strips and are isolated. Found in both forested and moor areas.	Low – All habitats are in the riparian zone or are located across surface watercourses spread across the Study Area. One habitat is not in the vicinity of a watercourse but is downslope of a rain-fed blanket bog so is likely to be surface water fed.
	M6 - Carex echinata - Sphagnum recurvum mire	High	Differently sized narrow habitats present across all areas of the Development. Most communities are found within forested areas.	Low – All habitats are in the riparian zone or are located across surface watercourses spread across the Study Area. One habitat is not in the vicinity of a watercourse but is downslope of a rain-fed blanket bog so is likely to be surface water fed.
	M23 - *Juncus effusus/acutiflorus - Galium palustre rush-pasture*	High	Three small areas found to the south of the Core Study Area, situated north of the dense forestry in an upland grassland area.	Low – All three habitats are in the riparian zone or are located across surface watercourses spread across the Study Area.

Figure 10.5 illustrates the location of the wetland habitats in relation to the Development infrastructure, as identified from the Phase 1 Habitat and NVC surveys, in accordance with SNIFFER guidance[309] and as required by SEPA.

10.4.6 Designated Hydrological Receptors

The statutory designated sites relating to water within the Wider Study Area were identified using NatureScot[310] and SEPA[311] GIS datasets. The statutory designations that are considered hydrologically connected to the Development are listed in Table 10.7. Statutory designations which were identified within the Wider Study Area but are not hydrologically connected to the Development are listed in Table 10.8, and have been scoped out of further assessment.

Table 10.7 Statutory Designated Sites hydrologically connected to the Development (within 10 km Wider Study Area)

Designation	Distance from the Development	Qualifying Interest	Hydrologically Connected to the Development
Upper Loch Fyne and Loch Goil Marine Protected Area (MPA)[312]	4.6 km south of the Core Study Area	Flame shell beds and Wester Ross maerl beds.	Hydrologically connected to the Development via the River Aray and the River Shira.
Strone Point, North Loch Fyne SSSI[313]	4.7 km south of the Core Study Area	Ardrishaig Phyllites	Hydrologically connected to the Development by Loch Fyne which is situated downstream of the Development.
Glen Etive and Glen Fyne SPA[314]	Immediately adjacent east and north of the Core Study Area.	Golden eagle population	Hydrologically connected by an unnamed watercourse draining into Lochan Sheileachan. Hydrologically connected via Allt Sheileachan.
Glen Shira SAC[315]	2.25 km east of the Core Study Area.	Old sessile oak woods with Ilex and Blechnum & western acidic oak woodland	Hydrologically connected via an unnamed watercourse which drains into Stuckgoay Burn.

[309] SNIFFER (2009) *WFD95 A Functional Wetland Typology for Scotland Field Report 2009* [online] available at: https://www.sniffer.org.uk/wfd95-a-functional-wetland-typology-for-scotland (Accessed: 29.09.23).
[310] SNH (2019) *Natural Spaces* [online] available at: https://www.nature.scot/doc/state-nature-scotland-report (Accessed 29.09.23).
[311] SEPA (2019) *Datasets* [online] available at: https://www.sepa.org.uk/data-visualisation/water-classification-hub/ (Accessed 29.09.23).
[312] NatureScot (2014) *Upper Loch Fyne and Loch Goil MPA* [online] available at: https://www.nature.scot/doc/naturescot-commissioned-report-764-upper-loch-fyne-and-loch-goil-pmpa-and-wester-ross-pmpa (Accessed 29.09.23).
[313] NatureScot (2022*) Strone Point, North Loch Fyne SSSI* [online] available at: https://sitelink.nature.scot/site/1500 (Accessed 29.09.23).
[314] NatureScot (2022) *Glen Etive and Glen Fyne SPA* [online] available at: https://sitelink.nature.scot/site/10113 (Accessed 29.09.23).
[315] NatureScot (2022) *Glen Shira SAC* [online] available at: https://sitelink.nature.scot/site/8638 (Accessed 29.09.23).

Table 10.8 Statutory Designated Sites hydrologically not connected to the Development (within 10 km Wider Study Area)

Designation	Distance from the Development	Qualifying Interest	Hydrologically Connected to the Development
Ardchyline Woods SSSI[316]	6.3 km south of the Core Study Area	Upland oak woodland	Hydrologically disconnected form the Development by upper Loch Fyne.
Beinn an Lochain SSSI[317]	8.3 km south-west of the Core Study Area	Siliceous scree and tall herb ledge.	Hydrologically disconnected form the Development by upper Loch Fyne and topography.

10.4.7 Private and Public Water Supplies

10.4.7.1 Public Water Supplies

Scottish Water (SW) confirmed there are no SW abstractions or Drinking Water Protected Areas in the area that may be affected by the Development, and as such Public Water Supplies are scoped-out of the assessment of potential effects.

10.4.7.2 Private Water Supplies

The ERM Ltd. methodology for Private Water Supply Risk Assessment (PWSRA) has been developed in conjunction with SEPA. Identification of PWS through consultation with the Council within 2 km of the Core Study Area;

- Resident or property owner consultation via letter to those properties identified to be supplied by a PWS;
- Desk-based study and hydrological assessment;
- Site-based survey of the PWS, including discussion with resident (where possible and required);
- Risk assessment; and
- Review and approval by statutory consultees.

The Water Intended for Human Consumption (Private Supplies) (Scotland) Regulations 2017[318] define private water supplies as either:

- Type A - Supplies providing 10 m^3 of water a day or serving 50 or more persons and supplies to commercial or public activities irrespective of their size; or
- Type B - Supplies serving only domestic premises with less than 50 persons supplied.

On 24th September 2021, a Freedom of information (FoI) request was submitted to the Council, to acquire information on registered PWS located within a 2 km radius of the Core Study Area, including the access track to the Development. The FoI response identified 33 PWS to be located within 2 km of the Core Study Area.

Consultation with residents and landowners of properties identified to be served by PWS was carried out on 29th October 2021. The consultation process provided a questionnaire to residents to obtain further information on the PWS supplying their property, as well as a corresponding map indicating the location of each PWS supply. From the questionnaire responses provided, one PWS was identified within the 2 km Study Area which is potentially hydrologically connected to the Development. The details of which are outlined in Table 10.9.

[316] NatureScot (2021) *Ardchyline Woods SSSI* [online] available at: https://sitelink.nature.scot/site/70 (Accessed 29.09.23)
[317] NatureScot (2021) *Beinn an Lochain SSSI* [online] available at: https://sitelink.nature.scot/site/163 (Accessed 29.09.23)
[318] Scottish Government (2017) *Water Intended for Human Consumption (Private Supplies) (Scotland) Regulations 2017* [online] available at: https://www.legislation.gov.uk/ssi/2017/282/note/made (Accessed 29.09.23)

Details of the identified PWSs which were scoped out of further assessment based on their hydrological connectivity to the Development are outlined in Table 2 of Technical Appendix 10.1 - PWSRA.

Table 10.9 PWS Within 2 km Study Area Hydrologically Connected to the Development

Properties	Source Type	Source Easting Northing	Approximate Distance to Development	Hydrologically Connectivity to Development
Ladyfield Farm	Type B - Spring	209195 715403	138 m west of Development Boundary	Yes – Hydrologically connected by PWS source intake drawing from the Allt à Mhadaidh which flows east to west through the Development

10.4.8 Flood Risk

The Indicative River and Coastal Flood Map (Scotland)[319] produced by SEPA shows the areas of Scotland with a 0.1 % or greater chance of flooding in any given year (representative of a 1 in 1000-year recurrence interval). These areas are marked as low (0.1 % chance of flooding) to high (10 % chance of flooding) risk areas for flooding.

The SEPA flood maps show that in the northern area of the Core Study Area, isolated aspects of the Allt Sheileachan are at medium-high risk of annual flooding from surface water. To the west of the Development, Lochan Sheileachan, Lochan à Mhadaidh and Loch Scardan are also at medium-high risk of annual flooding. This is also true for sections of the River Aray within the Core Study area and small, isolated areas scattered through the Development. As these areas are very small and isolated, it is likely these areas are a result of slight depressions in topography and do not indicate widespread flooding.

The annual risk of flooding from river flooding is shown as medium to high within the Allt Sheileachan to the north of the Core Study Area and in small, isolated areas in the north of the Development. Lochan à Mhadaidh and Lochan Sheileachan are also at medium-high risk from river flooding, as well as the River Aray.

There is no risk of annual flooding from coastal flooding within the Core Study Area.

In conclusion, there is a small section of the Development to the north that lies within an area of high likelihood of river flooding, but there is no infrastructure nearby. The River Aray crossing to the north-west is the only watercourse crossing within the high-risk zone (10 % chance of flooding in any given year) of river flooding. All remaining infrastructure and watercourse crossings lie outside of the low-risk zone (0.1 %) of river flooding. The SEPA flood maps show isolated patches of surface water flooding which is due to small depressions in the local topography and does not indicate widespread flooding. There is no risk of coastal flooding. As such, there is negligible risk to the Development from annual flooding. Therefore, a stand-alone Flood Risk Assessment (FRA) will not be required for the Development.

10.5 Sensitivity of Receptors

The sensitivities of the identified receptors and their relationship to the potential effects from the construction of the Development are outlined below in Table 10.10. The framework for determining sensitivity is explained in Table 10.2 and Section 10.3.10.

[319] SEPA (2022) *SEPA Flood Maps* [online] available at: https://map.sepa.org.uk/floodmaps (Accessed 29.09.23)

Table 10.10: Sensitivity of Receptors

Receptor	Potential Effects	Sensitivity	Sensitivity Description
Surface hydrology (watercourses)	Increased run-off, erosion and sedimentation, stream flow impediments and pollution as a result of construction groundworks, water abstraction for concrete production, and chemical handling and storage.	High	A large, medium, or small waterbody with a SEPA water quality classification of 'Good'.
Groundwater	Pollution because of erosion and sedimentation from construction activities and uncontained spills from chemical handling and storage.	High	Groundwater body is classified as a 'low productive aquifer'. Exploitation of local groundwater is not far reaching. Local areas of nature conservation are thought to be sensitive to groundwater effects. Groundwater vulnerability is classified as 5 to 4a (high).
Near-surface Water	Diversion of near-surface flow because of track construction and the installation of turbine foundations / hardstanding.	High	Supports peaty soils.
GWDTE	Pollution because of track construction and uncontained spills from chemical handling / storage. Changes to groundwater interflow patterns because of construction.	Low to High	GWDTE sensitivity is based upon the LUPS-GU31 guidance[320] and the Botanaeco GWDTE Decision Tool v4[321]. Site specific GWDTE sensitivity is summarised in Table 10.6.
Ladyfield Farm – PWS Type B	Pollution because of track upgrades and uncontained spills from vehicles, and chemical handling/storage. Drying out or changes to quantity because of upgrades to access track.	High	The hydrological receptors support abstractions for PWS for up to 25 people and / or 100 livestock (at any given point in the year).

10.6 Assessment of Potential Effects

The effects of the Development on hydrological receptors have been considered for the construction, operation, and decommissioning phases of the Development. Effects occurring during construction and decommissioning are short-term effects, with those occurring because of the operational phase of the Development being considered as long-term effects.

10.6.1 Embedded Mitigation

The following mitigation measures relating to the hydrological environment are embedded into the design and construction of the Development:

- 50 m watercourse buffers for construction works with the exception of watercourse crossings as discussed in Section 10.6.1.1;
- Good practice methods and works for protection of hydrological receptors as outlined in Section 10.3.5 and elaborated upon in Technical Appendix 11.4; and

[320] SEPA (n.d) *Land Use Planning System - SEPA Guidance Note 31* [online] available at: https://www.sepa.org.uk/media/144266/lups-gu31-guidance-on-assessing-the-impacts-of-development-proposals-on-groundwater-abstractions.pdf (Accessed: 29.09.23)
[321] Botanaeco (n.d.) *GWDTE Decision Tool* [online] Available at: https://botanaeco.co.uk/gwdte (Accessed: 29.09.23)

- The requirement for access tracks crossing watercourses has been minimised, where possible, during the design stage.

An oCEMP accompanies the EIA Report and forms part of the embedded development design. The oCEMP includes established and effective mitigation measures to which the Applicant will be committed to through the development consent. Accordingly, the assessment of significance of effects throughout Section 10.6 of this chapter are considered with the inclusion of oCEMP as standard mitigation procedure.

The oCEMP describes water management measures to control surface water run-off and drain hardstandings and other structures during the construction and operation of the Development. This will form part of a PPP to be implemented for the Development. Measures outlined in the oCEMP and PPP will be based on good construction practice outlined in the aforementioned guidance documents in Section 10.2.1 and Section 10.2.2. The oCEMP and PPP are to be agreed with SEPA prior to the construction phase.

A 50 m watercourse buffer zone, where possible, in conjunction with the measures set out in the oCEMP is implemented for the Development infrastructure, except watercourse crossings. It is sufficient to avoid potential effects on the hydrological and hydrogeological resource, as their effectiveness has been demonstrated on several wind farm construction sites for which ERM Ltd. have provided technical advice.

Although the oCEMP is a draft and will evolve to take account of consultee feedback and detailed design, there is sufficient confidence in the effectiveness of the measures set out in the oCEMP for them to be treated as part of the Development for the purposes of this assessment. Measures and procedures outlined in the oCEMP will be adopted and incorporated into a single working CEMP to be agreed with statutory consultees and the planning authority following consent by way of an appropriately worded planning condition.

10.6.1.1 Breaches in Embedded Mitigation

50m watercourse buffer

Throughout the Development there are two sections of new track proposed within 50m of their nearest watercourses. Towards the south of the Development, a track is proposed to run between two small watercourses to its north and south immediately after the track crosses the southern watercourse – using an existing watercourse crossing. The northern watercourse lies 18 m from the proposed path at its nearest point and the southern watercourse lies 25 m away. The track is proposed to run roughly parallel to both watercourses for approximately 300 m east to where both watercourse springs emerge. Another proposed track towards the centre of the Development, to the east of a newly proposed watercourse crossing, is proposed to run parallel to an unnamed watercourse for approximately 100m before reaching a section of turbine hardstanding. At its nearest point, the proposed track lies 5 m from the surface watercourse.

As discussed in Chapter 3 – Site Selection and Design and Section 10.4.3 of this chapter, it should be noted that many watercourses within the Development area shown on Ordnance Survey maps are ephemeral and/or have been previously been altered for changes in land use. Where access tracks are in proximity to surface watercourses, a suitable buffer will be provided, as per standard mitigation procedures outlined in Technical Appendix 11.4. For all new track proposed within the Development, new drainage ditches will be constructed for both the construction and operational phases of the Development to mitigate any pollution risk. Good construction practice to be utilised in the installation of these drainage ditches is detailed in Technical Appendix 11.4.

10.6.2 Potential Construction Effects

Construction effects are considered short-term. The nature and magnitude of effects that could result from construction activities, as described in Chapter 3 – Site Selection and Design, are assessed in the following paragraphs, which includes:

- The potential upgrade of access tracks for the construction of the Development;

- Construction of the Substation and BESS Compound;
- Construction of new and upgrading access tracks (including simple watercourse crossings throughout the Development and the more significant River Aray crossing to the north-west of the Development), turbines and associated infrastructure, hardstanding and Temporary Construction Compounds (TCC) for the Development;
- Tree felling to facilitate the upgraded access into the Development;
- Earthworks cut at trackside and crane hardstanding in areas of undesirable topography to facilitate Development; and
- Potential abstraction of water for concrete batching on-site.

10.6.2.1 Chemical Pollution

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

Surface Hydrology

Watercourses could be at risk from a pollution incident during construction. All surface watercourses are of High sensitivity.

Buffer distances between proposed construction works and watercourses have been maximised to reduce the potential for chemical pollutants to be transferred to the water environment. A 50m buffer zone between watercourses and infrastructure (excluding watercourse crossings) has been adopted.

The proposed river crossing spanning the River Aray in the north-western region of the Development would need to be licensed under SEPA CAR guidelines[322], detailing justification for the crossing, detailed crossing design, best practice management, etc. This license will be applied for by the Applicant's principal contractor prior to the commencements of the construction and agreed to by SEPA. These best practice methods for watercourse crossing constructions based on CIRIA water pollution control guidelines and SEPA watercourse crossing guidelines[323] are all outlined in Section 10.2.4 and further discussed in Technical Appendix 11.4. Continued and regular visual inspection by the Ecological Clerk of Works (ECoW) will take place during construction as part of a surface water monitoring programme. Furthermore, monthly in-situ monitoring and sampling prior to construction (for 12 months) and throughout the construction will be included to the programme with the intention of safeguarding water quality during construction.

If batteries are connected during the construction period, the emergency response plan will be followed, as outlined in Technical Appendix 11.4, in the event of an on-site battery fire. An automatic fire suppression system with a shut-off mechanism (e.g., a penstock) to prevent spread of polluted water will be in place and detailed in the site drainage plan. This system would include a valve and bunded area from which contaminated water can be pumped out and removed from the Development.

Best practice embedded construction methods as outlined in Technical Appendix 11.4 including use of impermeable membranes and bunding of the two TCC's will safeguard water quality.

Measures such as absorbent spill pads / kits and other measured highlighted within the oCEMP will effectively limit the uncontained release of chemical to minor fugitive releases. These would be minimised through best practice construction methods such as vehicle speed limits and regular vehicle and machine maintenance. Routine training practices such as staff inductions and toolbox

[322] Scottish Government (2011) *Water Environment (Controlled Activities) (Scotland) Regulations 2011* [online] available at: https://www.sepa.org.uk/media/34540/car_licence_applicant_guide.pdf_ (Accessed: 29.09.23).
[323] SEPA (2010) *Engineering in the water environment good practice guide: River Crossings, WAT-SG-25* [online] available at: http://www.sepa.org.uk/regulations/water/engineering/engineering-guidance/ (Accessed: 29.0923).

talks will be conducted throughout the construction phase of the Development. Information regarding staff training is detailed in the oCEMP.

Therefore, short-term effects on these watercourses, of High sensitivity, will be of Negligible magnitude and therefore (in accordance with Table 10.4) of Minor significance. This is considered **not significant** in terms of the EIA Regulations.

Groundwater and Near Surface Water, and Bedrock

Pollutants encountering bedrock also have the potential to indirectly alter the quality of the groundwater resource. pH and chemical alterations to groundwater are difficult to rectify due to the fractured nature of the rock and the length attenuation and dispersal of chemicals. As noted previously, the underlying hydrogeology consists of a "low productive aquifer" where "nearly all flow of groundwater is in the near-surface weathered zone and secondary fractures".

Measures such as spill pads, impermeable geotextile membranes and measures described within the oCEMP will effectively limit the uncontained release of chemicals to minor fugitive releases.

Given the short-term effect, High sensitivity of near-surface water, and High sensitivity of groundwater and Negligible magnitude of effect, the predicted significance of the effect of chemical pollution on both groundwater and near-surface water will be Minor. This is **not significant** in terms of the EIA Regulations.

GWDTEs

GWDTE communities located within 100m of excavations < 1 m in depth and within 250m of excavations > 1 m in depth are at risk from a pollution incident during construction. There are 12 habitats identified within these buffers that are at risk. Best practice embedded construction measures, summarised in Technical Appendix 11.4 will be in place to limit release of chemicals to surface water run-off, groundwater, and near-surface water.

Therefore, as outlined in Table 10.6, the sensitivity of the GWDTEs present vary from Low to High sensitivity. The magnitude of direct and indirect effects is considered to be Negligible. As such, there will be a short-term effect of Minor predicted significance on the hydrological function of High sensitivity GWDTEs and Negligible predicted significance on Medium and Low sensitivity GWDTEs. For all GWDTEs, this is **not significant** in terms of the EIA Regulations.

PWS

There is one Type B PWS within the 2km Study Area that is hydrologically connected to the Development. The Type B PWS is PWS Ladyfield Farm, which is located 138 m west of the Development Boundary. The source for this PWS is an intake located within the western extent of the Development Boundary and draws directly from the Allt à Mhadaidh, which flows east to west through the Development. The nearest excavation < 1 m is for a proposed track upgrade 657 m south-east of the PWS source intake, and the nearest excavation > 1 m is for proposed turbine hardstanding 872 m south-east from the PWS source intake. However, there are several proposed watercourse crossings upstream of the PWS intake location meaning the PWS is hydrologically connected to the Development.

The quality of this PWS could potentially be affected by chemical pollution in instances such as spillages by vehicles and machinery upon use of the access track. As per the PWSRA in Section 10.4.7.2, 27 PWS's identified by the Council have been scoped out of further assessment, as they are determined to be hydrologically disconnected from the Development.

Best practice embedded construction measures outlined in Technical Appendix 11.4 will be in place to prevent release of chemicals to surface watercourses and waterbodies, and groundwater bodies.

Given the proximity to Development infrastructure and the potential for High magnitude change, the PWSRA details the implementation of specific mitigation measures such as a water quality monitoring programme, and a watching brief when working within the catchment.

The magnitude of effect is High (i.e., a major permanent or short-term negative change to groundwater quality or available yield) for this PWS (High sensitivity). This is of Moderate significance. This is **significant** in terms of the EIA Regulations.

10.6.2.2 Erosion and Sedimentation

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

Areas particularly at risk of erosion and sedimentation are in areas of large earthworks. As deep cuttings are required in some areas due to the topography facilitating the Development, larger volumes of deposits will require to be excavated and transported. This will also leave behind a larger area of exposed ground and larger stockpiles required to hold deposits. This will likely increase sediment wash off into watercourses surrounding those areas.

Larger earthworks will be located at the borrow pit location. These areas will be visually inspected regularly by the Ecological Clerk of Works (ECoW) and mitigation measures outlined in the oCEMP will be implemented.

Surface Hydrology

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

Where the buffers are encroached by upgraded tracks, improvements to the public road, new access tracks, hardstanding, and load bearing surfaces, good practice construction measures will effectively prevent sediment entering watercourses. Measures such as check dams, silt traps, settlement lagoons and buffer strips will minimise sedimentation and erosion; further details of these measures are detailed in the oCEMP.

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

The watercourse crossing over the River Aray proposed in the north-west of the Development could potentially disturb the natural sediment carried by the River Aray. This could be as a result of the crossing posing as a barrier for sediment travelling downstream, or it could cause riverbed disturbances during the construction phase and release more sediment into the water. These disturbances alongside others are outlined in good practice for river crossings guidelines laid out by SEPA[324]. These guidelines are further detailed in the oCEMP and will be adhered to throughout construction to limit potential effects of construction on sedimentation.

The embedded mitigation detailed above and further expanded on within the oCEMP ensures that the magnitude of the short-term effect on surface hydrology will be Negligible. Due to the High sensitivity of surface water and the magnitude being Negligible, the erosion and sedimentation effects of the Development on surface hydrology is of Minor significance. This is **not significant** in terms of the EIA Regulations.

Groundwater and Near Surface Water

Sediment also has the potential to change near surface water flow in superficial geology deposits and peaty soil characteristics by creating a physical barrier within naturally occurring drainage

[324] SEPA (2010) *Engineering in the water environment: good practice guide River crossings* [online] available at: https://www.sepa.org.uk/media/151036/wat-sg-25.pdf (Accessed 18/05/2023)

micropores. Sediment entering near-surface water in superficial deposits also has the potential to impact on groundwater quality within bedrock deposits / fissures.

Measures described in Technical Appendix 11.4, such as impermeable ground membrane layers and bunded areas, will effectively prevent sediment entering sub-surface water in superficial deposits (and groundwater) and peat. For these reasons, the magnitude of this effect will be Negligible. Given the High sensitivity of both groundwater and near-surface water and the Negligible magnitude of effect, the significance of the effect associated with erosion and sedimentation is Minor. This is considered to be **not significant** in terms of the EIA Regulations.

GWDTEs

Sediment potentially changing the hydrological flow characteries and quality of groundwater present at the Development has the potential to affect GWDTEs reliant on the groundwater.

Measures described in Technical Appendix 11.4, such as impermeable ground membrane layers and bunded areas, will effectively prevent sediment entering sub-surface water in superficial deposits (and groundwater) and peat. This will mitigate the short-term effects on GWDTEs resulting from sedimentation. For these reasons, the magnitude of this effect will be Negligible. Sensitivity of GWDTEs ranges from Low to High. The significance of the effect on Low and Medium sensitivity GWDTEs will be Negligible. The significance of the effect on High sensitivity GWDTEs will be Minor. Across all sensitivities this is considered to be **not significant** in terms of the EIA Regulations.

PWS

The quality of some PWS within 100 m of excavations of less than 1 m depth could be affected by sediment mobilisation.

There is one Type B PWS within the 2km Study Area that is considered to be hydrologically connected to the Development. The Type B PWS is PWS Ladyfield Farm, which is located 130 m west of the Development Boundary. The source for this PWS is an intake located within the western extent of the Development Boundary and draws directly from the Allt à Mhadaidh, which flows east to west through the Development. The nearest excavation < 1 m is for a proposed track upgrade 657 m south-east of the PWS source intake, and the nearest excavation > 1 m is for proposed turbine hardstanding 872 m south-east from the PWS source intake. However, there are several proposed watercourse crossings upstream of the PWS intake location meaning the PWS is hydrologically connected to the Development.

The quality of this PWS could potentially be affected by sedimentation.

Given the proximity to Development infrastructure and the potential for High magnitude change, the PWSRA details the implementation of specific mitigation measures such as a water quality monitoring programme, and a watching brief when working within the catchment.

The magnitude of the short-term effect is High (i.e., a major permanent or long-term negative change to groundwater quality or available yield) for this PWS (High sensitivity). This is of Moderate significance. This is **significant** in terms of the EIA Regulations.

10.6.2.3 Impediments to Surface Water Flow

The access tracks will require 30 watercourse crossings across the Development. 20 of these will be new installations, while 10 will be upgraded on existing the existing track within the Development area. The Development has been designed, as detailed in Chapter 2 – Development Description, to minimise the number of watercourse crossings.

The minimisation of the number of proposed watercourse crossings and the re-use of the existing watercourse crossing locations reduces one of the main activities that could give rise to impediment of flows. Additionally, measures described in the oCEMP, such as the use of wide bottomless-arched culverts, where appropriate, are likely to prevent impediments to flow being created. The

indicative watercourse crossing design is outlined in Chapter 2 - Development Description, detailed design will be carried out at the construction phase and will be agreed with SEPA.

The two new river crossings to be constructed spanning the River Aray may disrupt surface water flow and will be subject to SEPA CAR licensing. Details described in Technical Appendix 11.4, such as ensuring the location of the crossing is perpendicular to flow and selecting appropriate design structure to limit the impact on surface water flow, will be implemented in its construction to meet CAR guidelines as well as SEPA good practice for river crossing construction – outlined in Section 10.2.4.

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

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

Therefore, given the embedded mitigation detailed previously, the magnitude of effect on watercourses (High sensitivity) and Designated Hydrological Receptors (High sensitivity) is Negligible. As the magnitude of effect is Negligible, and receptors have High sensitivity, the effect of the Development on watercourses and designated hydrological receptors is of Minor significance. This is **not significant** in terms of the EIA Regulations.

10.6.2.4 Changes in Groundwater Interflow Patterns

Groundwater and Near Surface Water

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

Areas particularly at risk of changes in flow patterns are in areas of large earthworks. As deep cuttings are required in some areas due to undesirable topography to facilitate the Development, larger volumes of deposits will require to be excavated and transported. This change in topography could result in changes to flow patterns.

Larger areas of earthworks cutting are located at the Borrow Pit, and these areas will be visually inspected regularly by the ECoW and mitigation measures outlined in Technical Appendix 11.4 will be implemented.

The drying out of peaty soil can result from alterations to the natural drainage regime. Measures set out in Technical Appendix 11.4, such as the rewetting of peat through controlled irrigation techniques, are considered sufficient, and sufficiently reliable, to avoid substantial alterations to the natural drainage regime. As a result, peat is not expected to dry out, beyond what would be the case in the baseline scenario.

No substantial impediments to near-surface water flow will be created as the detailed site drainage design will consider any severance of saturated areas to ensure hydrological connectivity is maintained, in accordance with SEPA / SNH (now NatureScot) 'Good practice during wind farm construction' as shown in Technical Appendix 11.4.

Consequently, short-term effects on Groundwater and Near-surface Water (High sensitivity receptors) are of Negligible magnitude and therefore of Minor significance. This is **not significant** in terms of the EIA Regulations.

10.6.2.5 Mitigation of Pollutants from Contaminated Land

Desk studies have not identified any areas of contaminated land within the Development and no effects are anticipated.

Should potentially contaminated land be encountered during excavations, however, this would be tested and appropriate action taken in accordance with The Environmental Protection Act 1990. Effects associated with contaminated land are therefore considered to be of Negligible magnitude for receptors of High and Very High sensitivity, which results in a residual significance of Minor and **not significant** in terms of the EIA Regulations. Should an area of contaminated land be encountered during excavations, measures outlined in Section 6 of Technical Appendix 11.4 will be implemented.

10.6.2.6 Acidification of Watercourses

Large scale felling of forestry and the storage of brash could potentially result in a short-term increase in the acidity of watercourses within the immediate catchment and have an effect on 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. Nitrate leaching from brash is a lesser issue, as is the impact of soil disturbance on surface water acidification. However, disturbance of the ground due to felling activities very close to watercourses could lead to flushing of acid from groundwater, if measures to prevent run-off from entering the watercourses directly are not achieved. Felling will also involve the movement of heavy machinery across a soft ground surface, and hence will lead to soil disturbance which could have the potential to lead to acidification and sedimentation.

The required areas to be felled to account for access tracks and turbine hardstanding fall with the Glen Aray catchment and totals an area of 0.791 km^2 (79.3 ha).

Forestry good practice measures are set out in Technical Appendix 11.4, including specific measures for felling and for forestry activities within 100 m of natural watercourses. These measures will be implemented and maintained, and this will be carried out during the construction phase under supervision of an ECoW, whose role is described in Technical Appendix 11.4.

Considering the comparatively small area requirement for felling, and the adoption of measures mentioned, the magnitude of the resulting effects of felling would be Negligible. Given the High sensitivity of watercourses the resulting significance of felling would be Minor. This is **not significant** in terms of the EIA regulations.

10.6.2.7 Increase in Runoff and Flood Risk

Increase in Runoff

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

Measures, including SuDS measures, to attenuate run-off and intercept sediment prior to run-off entering watercourses are described as part of embedded best practice in Technical Appendix 11.4 and form a part of the Development good construction practice.

The Forests and Water Guidelines document reports that, due to rainfall interception losses:

"*Research suggests there may be a 1.5-2.0 % reduction of potential water yield [watercourse flow] for every 10 % of a catchment under mature conifer forest*".

It is assumed, therefore, that felling of mature forest may result in an average increase in water yield of up to 1.5 to 2 % for every 10 % of the catchment area that is subject to felling. It should be noted that, as interception loss has limited effect during the latter stages of periods of heavy rain, when the trees surfaces are saturated, this is likely to have a potential effect on average run-off, but not flood risk.

Table 10.11 demonstrates the required area to be felled to account for access tracks and turbine hardstanding in the Glen Aray catchment.

Table 10.11 Felled Area Required for Glen Aray Catchment

Catchment	Catchment Size (km^2)	Felled Area for Development infrastructure (km^2)	% of catchment	% Surface Water increase (as per Forests and Water Guidelines)
Glen Aray	59.14	0.793	1.341	0.201 – 0.268

Felling is required for most of the hardstanding of the Development as only 16% of the total hardstanding is pre-existing tracks. New hardstanding will be introduced for all turbines installed and for new access tracks. However, as summarised in Table 10.11, the required felling covers a relatively small area for the construction of the Development, by comparison of the wider catchment. The total area of 79.3 ha to be felled across the Development is not concentrated but spread widely across the whole site. The distributed nature of felling across the Development will make up an insignificant percentage of the total catchment area.

In accordance with the Forestry Commission (2019) *Managing Forest operations to protect the water environment* measures outlined within Section 3.7 of the oCEMP, such as cut-off ditches, check dams and forestry drainage, will control surface water flows to ensure surface water is not rapidly transferred to natural watercourses.

As such, the magnitude of effect from increased run-off because of felling is Negligible. Given the High sensitivity of watercourses the residual effect is of Minor significance. This is **not significant** in terms of the EIA Regulations.

Flood Risk

The two TCC's (temporary construction compounds) will not be located within areas described as having a 0.5 % or greater annual risk of flooding.

The design of the Development layout has incorporated a 50 m Buffer Zone, where possible, between watercourses and infrastructure, meaning any overtopping of minor watercourses is unlikely to reach infrastructure.

As such, the Development is not considered to be at risk of flooding and is unlikely to increase pluvial flood risk (i.e., surface water runoff from rainfall).

For these reasons, the effect on watercourses of High sensitivity is of Negligible magnitude, and therefore Minor significance. This is considered **not significant** in terms of the EIA Regulations.

10.6.2.8 Effects on the Hydrological Function of Groundwater Dependent Habitats

Wetland habitats supporting NVC communities are present within the Core Study Area. Most of the communities that according to SEPA guidance had a groundwater dependency of High or Moderate were determined to have a lower site-specific groundwater dependency in Section 10.5.

According to SEPA Guidance LUPS-31, groundwater dependent communities may be affected if they are within 100 m radius of all excavations < 1 m in depth and within 250 m of all excavations > 1 m. Excavations for access tracks are likely to be < 1 m in depth and restricted to the footprint of the access track, while the footprint of the proposed turbines where excavations may reach up

to 3 m in depth with potential for direct impact (i.e., habitat loss) to wetland habitats in these areas.

The total area of the potential GWDTE within a 250m buffer of the Development boundary occupies an area of approximately 31.97 ha. The footprint of the Development infrastructure occupies an area of approximately 0.651 ha on groundwater dependent communities that is widely distributed across the entire Development. Therefore, a total direct loss of approximately 2.04 % of the total baseline survey area habitat as a result. However, as per Table 10.6, the majority of the habitats present are considered to have a low groundwater dependency based on site specific conditions such as being surface water fed (ombrotrophic), the immediate topography, their proximity to surface water features, or their proximity to rain-fed mires.

As shown in Figure 10.5, there are several GWDTE habitats that fall within the 250 m and 100 m excavation buffer zones.

There is a habitat consisting of NVC communities M25a and M6c located to the northeast of the Development located directly over proposed hardstanding for Turbine 2, as well as some nearby proposed access track. Due to the proximity to the Turbine 2, these communities have the potential to be directly affected by excavation as well as indirectly affected because of construction, such as dewatering works. Furthermore, due to their location directly overlapping with proposed turbine hardstanding as well as nearby access track, this will result in direct loss of habitat totalling 0.40 % of the total baseline survey habitat area due to excavation.

Another habitat in the north area of the Development consisting of NVC communities M15a, M25a and M6c is located approximately 180 m south-west of Turbine 1 and directly overlapping with its proposed access track. Due to the proximity to the Turbine 1, these communities have the potential to be indirectly affected because of construction. Also, due to their location directly overlapping with proposed access tracks, this will result in direct loss of habitat totalling 0.20 % from excavation.

In the east of the Development, there is a small habitat consisting of NVC communities M25b and M6c approximately 130 m northeast of Turbine 8 which overlaps with proposed access tracks. Due to the proximity to turbine hardstanding, these communities have the potential to be indirectly affected because of construction of Turbine 8. Due to their location directly overlapping proposed access tracks, there will also be direct loss of habitat totalling 0.13 %.

There is another habitat in the east of the Development approximately 210 m north-east of Turbine 8 consisting of NVC communities M15c and M25a that overlaps with proposed access tracks. The location of the habitat leads to potential indirect risk from construction of Turbine 8 and associated hardstanding, as well as direct loss of habitat totally 0.26 % from excavation for the proposed access tracks.

In the north of the development is a habitat consisting of M25 and M6c NVC communities located 110 m north-west of Turbine 7 that directly overlaps with proposed upgrading of access track. The location of the habitat leads to potential indirect risk from construction of Turbine 7 as well as direct loss of habitat from excavation totalling 0.03 %.

There is another habitat in the centre of the Development approximately 65 m north of Turbine 9 and 80 m west of Turbine 10 consisting of NVC communities M25, M20 and M6c that overlaps with proposed access tracks. Due to the proximity to turbine hardstanding, these communities have the potential to be indirectly affected because of construction of Turbines 9 and 10. Due to their location directly overlapping proposed access tracks, there will also be direct loss of habitat totalling 0.31 %.

There is a centrally located habitat located 160 m north-west of Turbine 11 and directly overlapping proposed upgraded access track composed entirely of W4b NVC communities. The location of the habitat leads to potential indirect risk from construction of Turbine 11 as well as direct loss of habitat from excavation for upgrading access tracks totalling 0.18 %.

To the east of the Development 100 m north of Turbine 13 and 200 m east of Turbine 11 is a habitat consisting of M20, M25 and M6c. Due to their location these communities could potentially be indirectly affected overlapping with proposed hardstanding and access tracks, there will be a direct loss of habitat totalling 0.23 % due to excavation.

Another habitat in the south of the Development immediately borders the proposed hardstanding of Turbine 13 to south-east and consists of NVC communities M15b, M17c, M17b and M6c. Due to the proximity to turbine hardstanding these communities have the potential to be indirectly affected because of construction of Turbine 13. Due to their location overlapping with proposed hardstanding and access tracks, there will also be a direct loss of habitat totalling 0.30 % due to excavation.

There are six more habitats within 250 m buffer zone and due to their proximity to turbine excavations and topographic conditions, these communities have the potential to be indirectly affected because of the construction of proposed turbine hardstanding and accompanying Development Infrastructure. However, no direct loss of GWDTEs is anticipated within these communities.

Temporary sub-surface water controls and physical sub-surface barriers resulting from turbine foundations, hardstanding and access track construction have the potential to change the quality and quantity of water supplying GWDTEs.

The embedded design measures outlined in Technical Appendix 11.4 will also minimise the indirect effects on wetland habitats. As such, indirect hydrological effects will equate to a slight or negligible magnitude of effect from baseline condition of geological resources.

Good practice design and construction measures outlined in Technical Appendix 11.4 will minimise potential indirect effects of the Development on wetland habitats, including those not determined to be groundwater dependent.

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.

Specifically, the following design measures will ensure that effects on wetland habitats are minimised:

- A PPP is implemented to ensure good practice working methods are followed throughout construction works;
- Silt traps will be deployed to trap and filter sediment-laden run-off throughout the construction phase of the Development;
- Settlement lagoons will be constructed and actively managed to control water levels and ensure that any run-off is contained, especially during times of rainfall;
- Turbine foundations are constructed in holes in the ground that will be de-watered, and hence water flow is typically into the foundation area. This will prevent concrete leaching into groundwater or surface water in the event of shutter collapse;
- All excavations will be sufficiently dewatered before concrete pours begin and that dewatering continues while the concrete cures. However, construction good practice will be followed to ensure that fresh concrete is isolated from the dewatering system; and
- If required, turbine foundations may be dewatered, temporarily lowering water levels in the superficial deposits and near-surface groundwater. The dewatering process would involve the treatment of any extracted water to remove any sediment and redistribute the water onto a vegetated surface in proximity to the excavation. This process would not involve any net loss of water from the hydrological system and would ensure that the water being treated is of the same (or similar) quality to what was extracted. Hence, there would not be an unacceptable effect on groundwater or near-surface water supplying GWDTEs.

The magnitude of direct and indirect effects is considered to be Negligible i.e., a minimal detectable effect on a GWDTE (between to 0.1 % - 5 % of study area) or no discernible effect on its integrity as a feature or its functionality, as outlined in Table 10.4. As such, there will be Negligible predicted significance on the hydrological function of Low sensitivity GWDTEs and Negligible predicted significance on Medium sensitivity GWDTEs. This is **not significant** in terms of the EIA Regulations.

10.6.2.9 Effects of water abstraction for concrete batching on-site

Surface Hydrology

If water is to be extracted from the River Aray to the immediate west of the Development Boundary for the use of concrete batching on site, this surface watercourse could be at risk from a pollution incident, or from sedimentation. All surface watercourses are of High sensitivity.

For water abstractions to take place, a civil contractor would need to apply for a water abstraction license from SEPA ensuring that volume, frequency and time of extractions are detailed to meet guidelines laid out in the SEPA CAR guidance[325] (50 m^3 /day to 2000 m^3 / day abstraction limit under 'simple license abstraction'). If concrete batching on-site is determined to be necessary for the construction of hardstanding, specifically for turbine foundations, as a worst-case scenario it is anticipated that each of the turbine foundation will require 150 m^3 of water. If each foundation is to be poured in a single day, 150 m^3 of water will be required to be abstracted per day. For all 13 turbine foundations to be constructed a total of 1,950 m^3 of water will be required. During the concrete batching process, measures such as spill pads, impermeable geotextile membranes and measures described in Technical Appendix 11.4 will effectively limit the uncontained release of chemicals to minor fugitive releases.

Water abstraction from surface watercourses can also cause a reduction in flow rate and flow velocity, which, in turn, can increase sediment deposition and accumulation in riverbeds. In the event that water abstraction from the River Aray is needed for concrete batching for turbine foundations, this will need to be licensed by SEPA and will, therefore, have to meet abstraction limits laid out in SEPA CAR guidance. This SEPA guidance places daily and yearly volume limits on surface water abstraction to prevent increased sedimentation caused by extraction and ensures sustainable extraction practices. This license will be applied for by the civil contractor.

Good practice design and construction measures outlined in Technical Appendix 11.4 in conjunction with limits placed on water abstraction methods from the SEPA licensing process will minimise potential effects of water abstraction on the local surface watercourse. Considering these limitations alongside mitigation measures, the magnitude of effect of water abstractions is expected to be Negligible, and therefore of Minor significance. This is considered **not significant** in terms of the EIA Regulations.

10.6.3 Potential Operational Effects

Potential effects associated with the operation of the Development are:

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

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

[325] SEPA (2011) *Water Environment (Controlled Activities) (Scotland) Regulations 2011* [online] available at: https://www.sepa.org.uk/media/34540/car_licence_applicant_guide.pdf (Accessed: 30/06/2023).

There will be a minor reduction in the potential for increased surface water run-off during the operational phase due to the reduction in hardstanding areas used during the construction phase, such as the restoration of the two TCC's.

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

As a result, the significance of all effects associated with operation of the Development are assessed as being Minor to Negligible, and **not significant** in terms of the EIA Regulations.

10.6.4 Potential Decommissioning Effects

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

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

10.6.5 Mitigation and Residual Effects

Embedded mitigation measures and construction good practice measures are outlined in Section 10.6.1. and fully discussed in Technical Appendix 11.4. The embedded mitigation and construction good practice measures are based on experience of providing detailed site design for several wind farm developments across Scotland, in consultation with SEPA.

With the embedded mitigation measures described in Technical Appendix 11.4, all identified potential effects have been assessed as being of no greater than minor significance in all cases except for the potential effects of chemical pollution and erosion and sedimentation on PWS quality and/or yield. The embedded mitigation measures proposed are established measures that are widely used in construction projects and which the Applicant and its contractors are well used to undertaking. Given the levels of certainty in the success of application of the mitigation measures and their effectiveness, it is appropriate that the mitigation measures are taken into account and assumed to be fully effective in the determination of this application.

10.6.5.1 Additional mitigation measures

It has been identified that potential construction effects resulting in chemical pollution (discussed in Section 10.6.2.1) and/or erosion and sedimentation (discussed in Section 10.6.2.2) could impact the quality and/or yield of the one hydrologically connected PWS (Ladyfield PWS) of High sensitivity. With the magnitude of both these effects being identified as Moderate, the significance of these effects are identified as Moderate. Therefore, the significance of chemical pollution and the significance of erosion and sedimentation under the EIA Regulations is **significant** in both cases.

As such, additional mitigation measures are proposed within accompanying Technical Appendix 10.1 (PWSRA) to reduce the potential impact of any potential construction effects on the Ladyfield PWS. This additional mitigation follows guidance from:

- SEPA Land Use Planning System (LUPS) SEPA Guidance Note 4[326]; and

[326] SEPA (2017) *Land Use Planning System (LUPS) SEPA Guidance Note 4 v9.0* [online] available at: https://www.sepa.org.uk/media/306610/planning-information-note-4-sepa-position-on-development-protected-by-a-flood-protection-sch.pdf [Accessed 29.09.23].

- NatureScot Guidance - Good practice during Wind Farm construction[327].

These additional mitigation measures within the PWSRA include:

- Implementation of a water quality monitoring scheme measuring:
    - Quality of PWS;
    - Quantity of PWS;
    - Continuity of PWS;
- Investigation into the source of the problem following adverse changes to the PWS; and
- Provision of emergency standby alternative supply following adverse changes to the PWS.

Considering this additional mitigation proposed within the PWSRA, effects on the PWS will be of Negligible magnitude. Therefore, residual significance will be Minor. This is **not significant** in terms of the EIA Regulations.

Beyond this, no additional mitigation measures have been proposed in addition to the embedded measures. Residual effects are therefore the same as effects assessed in Section 10.6 for all phases of the Proposed Development. These are therefore **'not significant'** in terms of the EIA Regulations.

10.7 CUMULATIVE EFFECT ASSESSMENT

A cumulative effect is an additional effect on hydrological resources (within the same hydrological catchment) arising from the Development in addition to the combination of other developments likely to affect the hydrological environment.

At distances greater than 10 km, it is considered that schemes are unlikely to contribute to a cumulative hydrological effect due to attenuation and dilution over distance of potentially polluting chemicals. Therefore, for the purposes of the assessment of potential cumulative effects on the immediate catchment and hydrological regime, only proposed developments, which require large scale construction / excavation, within approximately 10 km of the Development have been considered.

Operational wind farms and other large-scale developments are unlikely to contribute to pollution and sedimentation effects due to the absence of excavation and presence of plant during the operational period and are therefore scoped out of the assessment.

10.7.1 Cumulative Developments within 10km (scoping, consented, under construction or operational)

The following developments have been identified within 10 km of the Development.

- Blarghour Variation (application) approx. 4.62 km from the Development within the River Awe catchment.
- An Carr Dubh (application) approx. 4.97 km from the Development located on the border of the River Awe catchment and Loch Fyne catchment.
- Blarghour (consented) approx. 5.71 km from the Development within the River Awe catchment.
- Clachan Flats (operational) approx. 6.36 km from the Development located within the Loch Fyne catchment.
- Eredine Wind Farm (scoping) approx. 9.04 km from the Development located on the border of the River Awe catchment and Loch Fyne catchment.
- Blarghour Farm (operational) approx. 9.77 km from the Development located within the River Awe catchment.

[327] NatureScot (2019) *Guidance – Good practice during Wind Farm construction* [online] available at: https://www.nature.scot/doc/guidance-good-practice-during-wind-farm-construction (Accessed 29.09.23).

10.7.2 Predicted Cumulative Effects

The greatest potential for cumulative effects arises when the construction phase of another development overlaps with the construction phase of the Development. Cumulative effects are considered to have the potential to be significant only where such an overlap may exist, as activities that could be potentially detrimental to the hydrological environment are greatly reduced during the operational phase of developments (e.g., excavation works, concrete pouring etc.). Therefore, wind farms that are operational are scoped out of further cumulative effect assessment.

10.7.2.1 Construction Phase

The date for construction phases for all the developments (Blarghour Variation, An Carr Dubh, Blarghour and Eredine) are currently unknown, but they are anticipated to be unlikely to coincide with the construction phase of the Development. If the construction phases do coincide, we would anticipate an assessment of the hydrological environment that would identify the requirements for mitigation in line with the measures identified within the oCEMP for the Development, as these are in line with standard practice as required by SEPA.

Given this, the magnitude of cumulative effects during the construction phase will be Negligible and, in this instance, of Negligible significance. This is **not significant** in terms of the EIA Regulations.

10.7.2.2 Operational Phase

No significant residual cumulative effects are predicted.

10.8 SUMMARY OF EFFECTS

The summary of effects in Table 10.12 states whether the residual significance will be major, moderate, minor, or negligible, once appropriate mitigation (beyond that specified in the oCEMP) has been implemented. This assessment relies on professional judgment to ensure that the effects are appropriately assessed.

Table 10.12 provides a summary of the effects detailed within this chapter.

Table 10.12: Summary of Effects

Receptor	Potential Effect	Significance of Effect	Mitigation Proposed	Residual Effect
Construction Phase				
Surface hydrology (watercourses) and Designated Hydrological Receptors	Chemical Pollution	Minor	None beyond measures embedded in the oCEMP, including impermeable membranes, bunding of the TCC and absorbent spill pads / kits.	Negligible
	Erosion and Sedimentation	Minor	None beyond measures embedded in the oCEMP, including settlement bunding implemented in areas near watercourse buffers.	Negligible
	Pollution from contaminated land	Minor	None	Negligible
	Impediments to flow	Minor	None beyond measures embedded in the oCEMP, including arched culverts, brash matting, limited brash stockpiling to reduce the accumulation of brash in watercourses.	Negligible

Receptor	Potential Effect	Significance of Effect	Mitigation Proposed	Residual Effect
	Acidification because of felling.	Minor	None beyond measures embedded in the oCEMP, including brash matting, limited brash stockpiling to reduce the accumulation of brash in watercourses.	Negligible
	Increase in Run-off and Flood Risk.	Minor	None	Negligible
	Effects of water abstraction for concrete batching on-site	Minor	None beyond measures embedded in the oCEMP, as well as abstraction limitations in the SEPA abstraction licensing process.	Negligible
Groundwater and Near-Surface water	Changes in Groundwater Interflow Patterns.	Minor	None beyond measures embedded in the oCEMP, including controlled irrigation techniques and detailed Development drainage design.	Minor
	Chemical Pollution.	Minor	None beyond measures embedded in the oCEMP, including spill-kits and Geotextile impermeable membranes.	Minor
GWDTE's (High dependency)	Chemical Pollution.	Minor	None	Minor
	Changes in Groundwater Interflow Patterns.	Minor	None	Minor
GWDTE's (Moderate dependency)	Chemical Pollution.	Negligible	None	Negligible
	Changes in Groundwater Interflow Patterns.	Negligible	None	Negligible
PWS	Chemical Pollution.	Major	Monitoring and watching brief.	Minor
	Erosion and Sedimentation.	Major	Monitoring and watching brief.	Minor
Operational Phase				
Watercourses	Increase in Run-off and Flood Risk	Minor	None	Negligible
Surface hydrology (watercourses) and Designated Hydrological Receptors, Groundwater, PWS and Near-surface water	Erosion and Sedimentation.	Minor	None	Negligible

Receptor	Potential Effect	Significance of Effect	Mitigation Proposed	Residual Effect
Groundwater, Near-surface water and PWS	Changes in Groundwater Interflow Patterns.	Minor	None	Minor
Surface hydrology (watercourses) and Designated Hydrological Receptors, Groundwater, PWS and Near-surface water	Risk of a Pollution Event from Minor Spills from Maintenance Vehicles.	Minor	None	Negligible
Decommissioning				
Surface hydrology (watercourses) and Designated Hydrological Receptors, Groundwater, Near-surface water and PWS	Chemical Pollution.	Minor	None beyond measures embedded in the oCEMP.	Negligible
Surface hydrology (watercourses) and Designated Hydrological Receptors, Groundwater, Near-surface water and PWS	Erosion and Sedimentation.	Minor	None beyond measures embedded in the oCEMP.	Negligible

10.9 Statement of Significance

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

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