14 HYDROLOGY AND HYDROGEOLOGY

14.1 Introduction

14.1.1 This Chapter of the Environmental Impact Assessment Report (EIA Report) evaluates the effects of the Torrance Wind Farm Extension II (the Proposed Development) on the hydrology and hydrogeology resources. This assessment was undertaken by Arcus Consultancy Services Limited (Arcus), an ERM Group company.

14.1.2 This Chapter of the EIA Report is supported by Technical Appendix (TA) 14.1 Water Construction Environmental Management Plan (WCEMP), provided in Volume 4 Technical Appendices.

14.1.3 This Chapter is structured as follows:

- Legislation, Policy and Guidance;
- Assessment Methodology and Significance Criteria;
- Scoping Responses and Consultation;
- Baseline Conditions;
- Assessment of Potential Effects;
- Assessment of Cumulative Effects;
- Mitigation Measures;
- Residual Effects; and
- Summary.

14.1.4 This Chapter is also supported by the following figures:

Figure 14.1: Hydrology Study Area;
Figure 14.2: Hydrological Catchments;
Figure 14.3: Watercourse Crossings; and
Figure 14.4: Groundwater Dependent Terrestrial Ecosystems.

14.2 Legislation, Policy and Guidance

14.2.1 The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations (2017) (the EIA Regulations)[1] establish in broad terms what is to be considered when determining the effects of development proposals on hydrology and hydrogeology. The following legislation, guidance and information sources have been considered in carrying out this assessment.

Legislative Background

14.2.2 The Water Framework Directive (WFD) (2000/60/EC)[2] 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[3] and subsidiary Regulations.

[1] Scottish Government (2017) Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017 [Online] Available at: http://www.legislation.gov.uk/ssi/2017/102/contents/made (Accessed 28/10/2022)
[2] European Commission (2000) The Water Framework Directive (2000/60/EC) [Online] Available at: http://ec.europa.eu/environment/water/water-framework/index_en.html (Accessed 28/10/2022)
[3] Scottish Government (2003) The Water Environment and Water Services (Scotland) Act 2003 [Online] Available at: http://www.legislation.gov.uk/asp/2003/3/contents (Accessed 28/10/2022)

14.2.3 Other relevant legislation includes:

- The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017 (the EIA Regulations)[4];
- The Water Intended for Human Consumption (Private Supplies) (Scotland) Regulations 2017[5];
- The Water Environment (Drinking Water Protected Areas) (Scotland) Order 2013[6];
- The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (CAR)[7];
- The Water Quality (Scotland) Regulations 2010[8];
- The Private Water Supplies (Scotland) Regulations 2006[9]; and
- The Public and Private Water Supplies (Miscellaneous Amendments) (Scotland) Regulations 2017[10].

Scottish Planning Policy and Guidance

14.2.4 The Scottish Planning Policy (SPP)[11] was published in 2014 and replaces the previous SPP (published in 2010). SPP is a non-statutory document which sets out the Scottish Government's policy on how nationally important land use planning matters should be addressed.

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

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

14.2.6 Pollution Prevention Guidelines (PPGs) and the replacement series Guidance for Pollution Prevention (GPPs) give advice on statutory responsibilities and good environmental practice[12]. Each PPG and GPP addresses a specific industrial sector or activity. The Scottish Environment Protection Agency (SEPA) and Northern Ireland Environment Agency (NIEA) partnership NetRegs are 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:

[4] Scottish Government. (2017) The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017 (the EIA Regulations). Available at https://www.legislation.gov.uk/ssi/2017/101/made. (Accessed 28/10/2022).
[5] Scottish Government (2017) the Water Intended for Human Consumption (Private Supplies) (Scotland) Regulations 2017 [Online] Available at: https://www.legislation.gov.uk/ssi/2017/282/note/made (Accessed 28/10/2022)
[6] Scottish Government (2013) The Water Environment (Drinking Water Protected Areas) (Scotland) Order 2013 [Online] Available at: http://www.legislation.gov.uk/ssi/2013/29/introduction/made (Accessed 28/10/2022)
[7] Scottish Government (2011) The Water Environment (Controlled Activities) (Scotland) Regulations 2011 [Online] Available at: https://www.legislation.gov.uk/ssi/2011/209/contents (Accessed 28/10/2022)
[8] Scottish Government (2010) The Water Quality (Scotland) Regulations 2010 [Online] Available at: https://www.legislation.gov.uk/ssi/2010/95/contents/made (Accessed 28/10/2022)
[9] Scottish Government (2006) The Private Water Supplies (Scotland) Regulations 2006 [Online] Available at: http://www.legislation.gov.uk/ssi/2006/209/contents/made (Accessed 28/10/2022)
[10]Scottish Government (2017) the Private and Public Water Supplies (Miscellaneous Amendments) (Scotland) Regulations 2017 [Online] Available at: http://www.legislation.gov.uk/ssi/2017/321/made (Accessed 28/10/2022)
[11] UK Government (2014) Scottish Planning Policy [Online] Available at: https://www.gov.scot/publications/scottish-planning-policy/ (Accessed: 28/10/2022)
[12] NetRegs (n.d.) Guidance for Pollution Prevention (GPPs) - Full List[Online]. Available at: https://www.netregs.org.uk/environmental-topics/guidance-for-pollution-prevention-gpp-documents/guidance-for-pollution-prevention-gpps-full-list/ (Accessed 28/10/2022)

- GPP1 (2020): Understanding your environmental responsibilities – good environmental practices;
- GPP2 (2018): Above ground oil storage tanks;
- GPP4 (2017): Treatment and disposal of wastewater where there is no connection to the public foul sewer;
- GPP5 (2018): Works and maintenance in or near water;
- PPG6 (2012): Working at construction and demolition sites;
- GPP8 (2017): Safe storage and disposal of used oils;
- PPG18 (2000): Managing fire water and major spillages;
- GPP21 (2021): Pollution incident response planning; and
- GPP22 (2018): Dealing with spills.

Other Guidance

- The Scottish Government (2001), PAN 61: Planning and Sustainable Urban Drainage Systems[13];
- The Scottish Government (2019), The Conservation (Natural Habitats, & c.) Amendment (Scotland) Regulations 2019[14];
- SEPA (2010), Land Use Planning System Guidance Note 2, Version 8 (LUPS-GU2)[15];
- SEPA (2010), Engineering in the water environment: good practice guide: River crossings[16];
- SEPA (2015), Culverting of watercourses: Policy Statement and Supporting Guidance[17];
- 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)[18];
- SEPA (2019), Climate change allowances for flood risk assessment in land use planning (LUPS-CC1)[19];
- SEPA (2002), Managing River Habitats for Fisheries[20];
- The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (the CAR Regulations)[21];
- SEPA (2022), CAR - A Practical Guide, Version 9[22];
- SEPA (2009), River Basin Management Plan[23];

[13] 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: 28/10/2022)
[14] 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 28/10/2022).
[15] 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: 28/10/2022)
[16] 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 28/10/2022)
[17] 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: 28/10/2022)
[18] 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-and-groundwater-dependent-terrestrial-ecosystems.pdf (Accessed: 28/10/2022)
[19] SEPA (2019) Climate Change Allowances for Flood Risk Assessment in Land Use Planning (LUPS-CC1) [Online] Available: https://www.sepa.org.uk/media/426913/lups_cc1.pdf (Accessed 28/10/2022)
[20] 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: 28/10/2022)
[21] Scottish Government (2011) the Water Environment (Controlled Activities) (Scotland) Regulations 2011 [Online] Available at: http://www.legislation.gov.uk/ssi/2011/209/pdfs/ssi_20110209_en.pdf (Accessed 28/10/2022)
[22] SEPA (2022) Controlled Activities Regulations - A Practical Guide, Version 9 [Online] Available at: https://www.sepa.org.uk/media/34761/car_a_practical_guide.pdf (Accessed 28/10/2022)
[23] SEPA (2009) River Basin Management Plan [Online] Available at: http://www.sepa.org.uk/water/river_basin_planning.aspx (Accessed 28/10/2022)

- NatureScot (2019), Good Practice During Wind Farm Construction[24];
- The Construction Industry Research and Information Association (CIRIA) (2015), Environmental Good Practice on Site (C741)[25];
- CIRIA (2001), Control of Water Pollution from Construction Sites (C532)[26];
- CIRIA (2015), The SuDS Manual (C753)[27];
- CIRIA (2006), Control of Water Pollution from Linear Construction Projects (C648)[28];
- CIRIA (2017), Guidance on the Construction of SuDS (C768);
- SEPA WAT-RM-08 (2019) Regulatory Method: SuDS[29];
- SEPA WAT-SG-75 (2018) Sector-specific Guidance – Construction Sites[30]; and
- Water Assessment and Drainage Guide (WADAG)[31].

14.3 Assessment Methodology and Significance Criteria

Scope of Assessment

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

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

- Chemical pollution (including accidental pollution) of surface water, near-surface water and groundwater as a result of construction works;
- Erosion and sedimentation of surface water, near-surface water and groundwater as a result of construction works;
- 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 areas of hardstanding including access tracks;
- Acidification of watercourses as a result of construction works and related tree felling;
- Potential effects on the hydrological function of Groundwater Dependent Terrestrial Ecosystems (GWDTEs); and

14.3.3 Long-term effects arising from the operational phase such as:

[24] NatureScot (2019) Good Practice During Wind Farm Construction [Online] Available at: https://www.nature.scot/guidance-good-practice-during-wind-farm-construction (Accessed: 28/10/2022)
[25] CIRIA (2015) Environmental Good Practice on Site [Online] Available at: https://www.ciria.org/Training/Training_courses/Environmental_good_practice_on_site.aspx (Accessed 28/10/2022)
[26] CIRIA (2001), Control of Water Pollution from Construction Sites (C532) [Online] Available at: https://www.ciria.org/ProductExcerpts/C532.aspx (Accessed 28/10/2022)
[27] CIRIA (2015) The SuDS Manual (C753) [Online] Available at: https://www.ciria.org/ProductExcerpts/tbyb_c753.aspx (Accessed 28/10/2022)
[28] CIRIA (2006) *C648: Control of water pollution from linear construction projects: Technical Guidance* [Online] Available at: https://www.ciria.org/ProductExcerpts/C648.aspx (Accessed: 28/10/2022)
[29] 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: 28/10/2022)
[30] 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: 28/10/2022)
[31] 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: 28/10/2022)

- 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;
- Chemical pollution as a result of battery fires from the substation compound; and
- Chemical pollution as a result of minor spills from maintenance vehicles.

14.3.4 Long-term effects arising from decommissioning, similar to the construction period, such as:

- Chemical pollution (including accidental pollution) of surface water, near-surface water and groundwater as a result of construction works;
- Erosion and sedimentation of surface water, near-surface water and groundwater as a result of construction works;
- 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; and
- Potential effects on the hydrological function of GWDTEs.

14.3.5 The key sensitive receptors are considered to be:

- River Almond;
- How Burn;
- Barbauchlaw Burn;
- Armadale groundwater body; and
- Hydrological function of potential GWDTEs.

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

Elements Scoped Out of Assessments

14.3.7 The following are scoped out of the assessment:

- The migration of pollutants from contaminated land is scoped out of the assessment as the Site has not previously been developed and it is unlikely contaminated land will be encountered.
- Statutory designated receptors not hydrologically connected to the Site are scoped out, as there is no potential for effects on these receptors.
- There is limited potential for pollution and sedimentation effects on the water environment at distances greater than 10 km and therefore receptors beyond this distance are scoped out.
- No public or private water supplies within 1.5 km of the Proposed Development were recorded during consultation with North Lanarkshire Council and Scottish Water. Therefore, these receptors have been scoped out.

Study Area

14.3.8 The hydrology and hydrogeology study area (the Core Study Area) is defined by the indicative developable area and is shown in **Figure 14.1**. 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 14.1**. At distances greater than 10 km within upland catchments, it is considered the

Proposed Development is unlikely to contribute to a hydrological effect, in terms of chemical or sedimentation effects, due to dilution and attenuation of potentially polluting chemicals.

Survey Methodology

14.3.9 A desk-based assessment, consultation and site walkover have been conducted to inform the hydrology and hydrogeology assessment.

Desk-Based Assessment

14.3.10 The desk-based assessment includes:

- Identification of watercourses, surface water catchments and springs;
- Identification of underlying hydrogeology and connectivity to the Site;
- Assessment of topography and slope to inform drainage patterns;
- Collation of data provided through consultation, including information on public and private water supply sources;
- Assessment of flood risk data and mapping; and
- Assessment of potential for the presence of GWDTEs.

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

- The Ordnance Survey (OS) 1:50,000 (Digital);
- OS 1:25,000 Map (Digital);
- National River Flow Archive (NRFA)[32];
- SEPA Flood Map 2019[33];
- Meteorological Office Rainfall Data[34];
- Scotland's Environment web-based maps[35]; and
- The British Geological Survey (BGS) GeoIndex onshore geology viewer[36].

Consultation

14.3.12 In addition to Scoping consultation (outlined in Section 14.4) the following consultee was contacted to inform the hydrology and hydrogeology assessment:

- The Council Environmental Health Office (EHO) via email to obtain information on registered PWS within the PWS Study Area.

Assessment Methodology

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

14.3.14 The assessment follows the systematic approach outlined in Sections 14.3.14 to 14.3.21.

14.3.15 The methodology outlined in Sections 14.3.14 to 14.3.21 has been developed by Arcus in consultation with SEPA, NatureScot (formerly SNH), Marine Scotland

[32] Centre for Ecology and Hydrology (undated) National River Flow Archive [Online] Available at: http://nrfa.ceh.ac.uk/ (Accessed 28/10/2022)
[33] SEPA (n.d.) Flood Maps [Online] Available at: http://map.sepa.org.uk/floodmap/map.htm (Accessed 28/10/2022)
[34] Met Office (2019) Climate Data [Online] Available at: http://www.metoffice.gov.uk/public/weather/climate (Accessed 28/10/2022)
[35] Scotland's Environment (n.d.) [Online] Available at: https://www.environment.gov.scot/ (Accessed: 28/10/2022)
[36] BGS (2019) GeoIndex Onshore [Online] Available at: https://mapapps2.bgs.ac.uk/geoindex/home.html (Accessed 28/10/2022)

and the Scottish Government. The assessment is based on a source-pathway-receptor methodology, where the sensitivity of the receptors and the magnitude of potential change upon those receptors identified within the study areas outlined in Section 14.3.8.

Sensitivity of Receptors

14.3.16 The sensitivity of the baseline conditions, including the importance of environmental features on, or near to, the Site or the sensitivity of potentially affected receptors, will be assessed in line with good practice guidance, legislation, statutory designations and / or professional judgement. Table 14.1 details the framework for determining the sensitivity of receptors.

Table 14.1 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 and downstream environment has 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 British Geological Survey (BGS) as 'highly productive aquifer' and is of regional importance. Statutorily designated nature conservation sites dependent on groundwater. Groundwater dependent terrestrial ecosystems (GWDTEs) which are classified by SEPA as "highly groundwater dependent" and are have no (<1 %) functional impairment by man-made influence (such as drainage or forestry). The receptor acts as an active floodplain or other flood defence, in accordance with SPP 2014.
High	A large, medium or small waterbody with a SEPA water quality classification of 'Good'. The hydrological receptor and downstream environment has limited capacity to attenuate natural fluctuations in hydrochemistry and cannot absorb further changes without fundamentally altering its baseline characteristics / natural processes. 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. 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). The receptor is located within an active flood plain, in accordance with SPP 2014.
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.

Sensitivity of Receptor	Definition
	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). 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. 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.
Negligible	The receptor is resistant to change and is of little environmental value.

Magnitude of Effect

14.3.17 The magnitude of potential effects will be identified through consideration of the Proposed Development, the degree of change to baseline conditions predicted as a result of the Proposed Development, the duration and reversibility of an effect and professional judgement, good practice guidance and legislation.

14.3.18 The criteria for assessing the magnitude of an effect are presented in Table 14.2

Table 14.2 Framework for Determining Magnitude of Change

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 increase in the probability of flooding onsite and offsite, adding to the area of land which requires protection by flood prevention measures or affecting the ability of the functional flood plain to attenuate the effects of flooding by storing flood water (in accordance with SPP). A 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. 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 (in accordance with SPP). 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. 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 (in accordance with SPP). A detectable but non-material effect on the receptor (up to 5 %) or a moderate effect on its integrity as a feature or where there will be a minor severance or disturbance such that the functionality of the receptor will not be affected. A detectable effect on a GWDTE (loss of between 5 % - 10 % of study area) or a minor effect on a GWDTE's integrity as a feature or where there will be a minor severance or disturbance such that the functionality of the receptor will not be affected. Changes to groundwater quality, levels or yields do not represent a risk to existing baseline conditions or ecology.

Magnitude of Effects	Definition
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.

Significance of effect

14.3.19 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 14.3 summarises guideline criteria for assessing the significance of effects.

Table 14.3 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

14.3.20 Effects predicted to be of major or moderate significance are considered to be 'significant' in the context of the EIA Regulations, and are shaded in light grey in the above table.

Assessment Limitations

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

Embedded Mitigation

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

- 50 m watercourse buffers for construction works with the exception of watercourse crossings and encroachment of buffer for infrastructure at T4 (as discussed in paragraph 14.3.26);
- Good practice methods and works for protection of hydrological receptors as outlined in the Appendix A14.1: Water Construction Environmental Management Plan (WCEMP); and

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

14.3.23 A WCEMP (A14.1) will accompany the EIA Report and form part of the embedded development design. The WCEMP will comprise methods and works that are established and effective measures to which the Applicant will be committed through the Proposed Development consent. Accordingly, the assessment of significance of effects of the Proposed Development are considered with the inclusion of Appendix A14.1 as standard mitigation procedure.

14.3.24 The WCEMP describes water management measures to control surface water run-off and drain hardstandings and other structures during the construction and operation of the Proposed Development. This will form part of a Pollution Prevention Plan (PPP) to be implemented for the Proposed Development. Measures outlined in the WCEMP and PPP will be based on good construction practice outlined in the aforementioned guidance documents in Section 14.2. The WCEMP and PPP are to be agreed with SEPA prior to the construction phase.

14.3.25 A 50 m watercourse buffer zone in conjunction with the measures set out in the WCEMP is implemented for the Proposed Development infrastructure, with the exception of 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 Arcus has provided technical advice for.

14.3.26 The exception to the 50 m buffer zone around watercourses is the area of hardstanding located immediately south of T4. This is located 45 m north of a watercourse. This design encroachment relates to restrictions in the location of T4 with respect to required offtake distance to the northern field boundary. This will require additional measures to mitigate potential effects on the watercourse.

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

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

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

14.4 Baseline Conditions

Topography and Land Use

14.4.1 The Core Study Area is situated in an area predominantly used for agricultural purposes, specifically sheep farming. The lower topographical areas to the south and south-east is dominated by coniferous woodland with small areas of neutral grassland to the south-east near Netherton Farm. The south-west of the Core Study Area comprises of improved grassland, neutral grassland and marsh/grassland with smaller areas of flush, spring and broadleaved woodland. The north-west of the Core Study Area is dominated by improved grassland, whereas the north-east of the Site is largely neutral grassland and marsh/grassland. This is discussed in greater detail in Chapter 10: Ecology.

14.4.2 The Core Study Area rises from approximately 175 m above ordnance datum (AOD) at the south-eastern boundary to 220 m AOD at Blairmuckhill Farm at the north-western boundary. This results in an undulating topography which generally slopes south and south-east in places. As such, water drains into How Burn and the River Almond which are situated south of the Core Study Area.

14.4.3 The Core Study Area is bound by the M8 to the south of the Site and an unnamed road running east to west, south of Blackridge. The western boundary of the Core Study Area is located just east of Treebanks Farm and the eastern aspect is bound by the existing Torrance Wind Farm.

Climate

14.4.4 The National River Flow Archive (NRFA) reports Average Annual Rainfall (AAR 1961 – 1990) at the River Almond at Whitburn gauging station, 3.55 km east of the Core Study Area, as 1,033 millimetres (mm).

14.4.5 As monthly long-term climate data is not freely available from the NRFA, long term average rainfall data (1981 to 2010) obtained by the Meteorological Office at the Blackburn SWks observing station, located 9.5km east of the Core Study Area, are presented in Table 14.4.

Table 14.4 Long term average rainfall data (1991 – 2020), Blackburn S Wks

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall (mm)	105.8	88.1	74.9	57.9	61.9	69.6	83.7	87.04	69.6	102.3	97.69	103.96

Surface Hydrology

14.4.6 The Core Study Area lies within the sub catchment of How Burn which lies within the River Almond catchment. **Figure 14.2** shows the main watercourses and their catchments. The watercourses within the Core Study Area primarily comprise artificial drainage ditches.

14.4.7 To the west, a potentially modified watercourse flows south-east through a grassland field. This watercourse is shown to be a small section of How Burn which flows under a bridge culvert before continuing south under the M8 and

converging with How Burn. While the watercourse presents as natural, this stream appears to be fed by artificial drainage ditches.

14.4.8 There are a number of relatively small artificial drainage ditches/field drains located across the Core Study Area. These drains are a maximum of 0.5 m across and generally present with a low water level and very slow flow. How Burn continues to flow east from the Core Study Area for approximately 1.9 km before discharging into the River Almond. Both How Burn and the River Almond are shown to be classified by SEPA as having an overall water quality of "Poor"[37]. A very small area to the north of the Core Study Area is located in the sub catchment of Barbauchlaw Burn within the River Avon catchment as shown on **Figure 14.2**. Barbauchlaw Burn is classified by SEPA as having an overall water quality classification of "Poor".

Hydrogeology

14.4.9 The groundwater units underlying the Core Study Area are identified by Scotland's Environment mapping service as the Armadale groundwater body[38]. These units have an overall SEPA classification of 'Poor'.

14.4.10 BGS 1:50,000 digital mapping and the BGS GeoIndex[39] mapper shows the bedrock aquifer underlying the majority of the Core Study Area to consist of sandstone, siltstone and mudstone (repeated cycles of sedimentary rock) of the Scottish Lower Coal Measures Formation to the south, east, north-east and central areas. To the north-west of the Core Study Area lies a large area of quartz-microgabbro of the Midland Valley Sill-Complex. There are two large fault lines near to the Core Study Area. One fault runs east to west immediately north of the Core Study Area, through Blackridge. The other fault line runs north-west to south-east, positioned south-west of the Core Study Area. The majority of this bedrock underlying the Core Study Area are classified as a "moderately productive aquifer" in which "flow is virtually all through fractures and other discontinuities". There is a small area to the north-west which is underlain by a "low productivity aquifer".

14.4.11 The Core Study Area is underlain by deposits of Devensian Till throughout including eastern, central and western areas, with peat deposits concentrated to the west and east.

Groundwater Dependent Terrestrial Ecosystems (GWDTEs)

14.4.12 In accordance with SEPA guidance[40] a Phase 1 habitat survey was undertaken to identify wetland habitats occurring within the Core Study Area. Wetland habitats were identified in line with the criteria outlined in 'A Functional Wetland Typology for Scotland' (SNIFFER, 2009[41]). Where wetland habitats

[37] SEPA (undated) Water Environment Hub [Online] Available at: Water Environment Hub (sepa.org.uk) (Accessed: 05/04/2022)
[38] SEPA (undated) Groundwater classification [Online] Available at: https://map.environment.gov.scot/sewebmap/ (Accessed: 20/11/2022)
[39] BGS (undated) BGS GeoIndex [online] Available at: https://mapapps2.bgs.ac.uk/geoindex/home.html?_ga=2.68526809.996502206.1647511070-786556653.1647511070 (Accessed 20/11/2022)
[40] 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-and-groundwater-dependent-terrestrial-ecosystems.pdf (Accessed: 20/11/2022)
[41] 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: 20/11/2022)

were identified, 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 10: Ecology and the TA 10.1 Habitat Survey Report.

14.4.13 The survey was carried out through use of a 250 m buffer of the Core Study Area to allow for the extension of potential, hydrological effects. The lower topography to the south and south-east is dominated by coniferous woodland with some areas of semi-improved neutral grassland. Semi-improved neutral grassland is largely found to the east of the Core Study Area, in addition to marsh grassland. To the west, lies smaller areas of broad-leaved woodland/parkland, marsh grassland, flush and spring and improved grassland. Improved grassland dominates the north and north-west of the Core Study Area. Vegetation associated with springs and flushes are present to the south and west.

14.4.14 The NVC communities that have the potential to be moderately or highly groundwater dependent GWDTE based on the SEPA guidance are outlined in Table 14.5. Further consideration of the groundwater dependency of each community is assessed for those habitats located within 250 m of turbines, and 100 m of infrastructure, which are outlined in Table 14.6.

Table 14.5 Potential GWDTE communities

Recorded NVC Community (Phase 1 habitat)	SEPA Groundwater Dependency potential (LUPS-GU31)	Location and total coverage (% of Core Study Area)
M6b (acidic grassland – unimproved)	High	Isolated area to the south-east of the Site within an area of forestry. 0.02 km^2 (0.97%)
W4b/c (broadleaved parkland/scattered trees)	High	Three small areas, concentrated to the south-west of the Site along an artificial drain and within a flat field extending south from the artificial drain. Small area to the north of the Site is situated in a modified field used for livestock. 0.017 km^2 (0.87%)
W4, W7b/c (broadleaved woodland – plantation)	High	A number of small areas, scattered throughout the Site. These areas are not concentrated in any location in particular however, these are all located in close proximity to man-made features including roads, fence lines, artificial drainage, existing access tracks and within forestry. 0.021 km^2 (1.06%)
W4a/b/c, W7 (broadleaved woodland – semi-natural)	High	Three moderate areas to the south-west of the Site near artificial drainage and along fence lines. One larger area to the north of the Site located at edge of livestock field, alongside road. 0.057 km^2 (2.83%)
M6a/b/c, M23b	High	Four isolated areas throughout the Site, two of which are situated within open field likely used for livestock. One area to the north-west of the Site located along a road. One other area

Recorded NVC Community (Phase 1 habitat)	SEPA Groundwater Dependency potential (LUPS-GU31)	Location and total coverage (% of Core Study Area)
(flush and spring – acidic neutral flush)		situated within forestry to the south-east of the Site. 0.014 km^2 (0.71%)
MG9, MG10a, M23a/b, M25c, M27c (marsh/marshy grassland)	High	Large areas present throughout the Site, particularly in flat, open areas and those near watercourses. 0.38 km^2 (18.95%)
MG10a, MG9 (neutral grassland – semi-improved)	Moderate	Small to moderate areas present throughout the Site, the majority of which are present in flat or gently sloping locations 0.23 km^2 (11.42%)
MG10a, MG9, M23 (neutral grassland – unimproved)	High	These areas are small to moderate in size and are generally situated in forest rides or at the edge of forested land. 0.048 km^2 (2.36%)
W1, W7b/c (scrub – dense/continuous)	High	Two small areas located to the south-east of the Site. Found near forested and marshy areas. 0.0008 km^2 (0.038%)
W1, W3 (scrub – scattered)	Moderate	Two small areas, one near an artificial watercourse and the other in a flat area at the base of two slopes. 0.0017 km^2 (0.082%)
M6c (wet modified bog)	High	One small area found on flat terrain to the south-west of the Site. 0.0024 km^2 (0.12%)

Table 14.6 Site-Specific Groundwater Dependency (within 250 m of turbines and 100 m of tracks)

Recorded NVC communities within the Site	Site-specific Groundwater Dependency	Reason	Polygons included for further assessment
W7b/c	Low	Small areas of W7 communities are shown to be underlain by peat deposits, located immediately adjacent to areas of hardstanding or artificial watercourses. Additionally, two polygons are within areas of dense forestry. This suggests these locations are likely to be ombrotrophic as opposed to groundwater fed.	Not included in further assessment
W4a/b/c	Low	These communities shown within the infrastructure buffers are both along an artificial watercourse or underlain by superficial peat deposits suggesting the	Not included in further assessment

Recorded NVC communities within the Site	Site-specific Groundwater Dependency	Reason	Polygons included for further assessment
		habitats are primarily fed by surface water as opposed to groundwater.	
M6a/b/c	Low-Moderate	The two polygons (ID 137 & 139) are both partially underlain by peat and glacial till deposits which suggests that these are surface water fed. Whilst these are recorded as Spring/Flush features, there are no recorded water features here which indicates a low-moderate dependency on groundwater.	ID 137 ID 139
MG10a	Low-Moderate	The majority of these habitats are situated within forest rides or along linear features such as artificial drains and fence lines where these are dominated by surface water runoff, therefore of low groundwater dependency. One polygon (ID 133) may potentially be groundwater fed as it is partially underlain by an area of alluvium which is more permeable than the surrounding glacial till	ID 133
MG9	Low-Moderate	The majority of the polygons for this NVC community are shown to be located along linear features or underlain by peat deposits, suggesting the influence of groundwater. However, one large polygon to the west of the site (ID 118) has the potential to be partially fed by groundwater due to its location in a flat and marshy area.	ID 118
M23a/b	Moderate	A large number of these polygons are located in areas underlain by peat deposits, particularly in the east of the site. Most other polygons are located along linear features such as drains or fence lines where surface water is likely to drain or within modified agricultural fields. One polygon to the west of the site (ID 384), situated on a gentle slope, underlain by alluvium and away from artificial drainage/surface water features which suggests a partial influence of groundwater.	ID 384
M25c	Low	Located along surface water linear feature and is therefore ombrotrophic.	Not included in further assessment
M27c	Low	Located along artificial ditches which suggests surface water fed opposed to groundwater.	Not included in further assessment

14.4.15 As a result of the site-specific groundwater dependency and the comments from the NVC surveyor report, it is considered that the majority of GWDTE habitats identified in the NVC survey are ombrotrophic in nature, meaning they are rain-fed as opposed to being supported by groundwater. Therefore, these habitats are considered to be of low groundwater dependency and scoped out of further assessment.

14.4.16 Five areas of GWDTE are thought to be at least partially dependent on groundwater. These include the following polygons and will be assessed within the impact assessment:

- ID 137;
- ID 139;
- ID 133;
- ID 118; and
- ID 384.

Flood Risk

14.4.17 The Indicative River and Coastal Flood Map (Scotland)[42] produced by SEPA shows the areas of Scotland with high (10 %), medium (0.5 %) and low (0.1 %) chances of annual flooding. Within the Core Study Area, a small section of How Burn is shown as having a medium to high risk of annual flooding from river flooding. No other areas of the Core Study Area are shown as being at risk to river flooding. The flood maps show flooding is restricted to the waterbodies and does not indicate widespread flooding across the Core Study Area.

14.4.18 Very small areas of the Core Study Area are shown as having a medium to high risk of annul flooding from surface water flooding. These areas are scattered throughout the Site but are mainly in the eastern aspects of the Site, east of the B718.

Public and Private Water Supplies

Public Water Supplies

14.4.19 The Site is not located in drinking water protected area (DWPA) and is not situated within 10 km of a DWPA. Review of Torrance Wind Farm EIA submission has stated there are no public water supplies within the surrounding vicinity.

Private Water Supplies

14.4.20 Consultation with the North Lanarkshire Council EHO was held on 31st March 2022 and a follow-up email was sent on 18th April 2022. No response as received. Review of the PWS data for Torrance Wind Farm showed there to be no PWS within 1.5 km of the wind farm which is situated immediately adjacent to Torrance Wind Farm Extension II. This suggests it is unlikely there are PWS within the vicinity of this Development.

14.4.21 Further consultation was carried out within North Lanarkshire Council on 18th October 2022 and a response was received on 10th November 2022. This consultation confirmed there are no PWS within 2 km of the Proposed Development. As no PWS and public water supply abstractions have been

[42] SEPA (n.d.) SEPA Flood Maps [online] Available at: https://map.sepa.org.uk/floodmaps (Accessed 20/11/2022)

identified as part of this assessment, this receptor can be scoped out of further assessment.

Designated Hydrological Receptors

14.4.22 Statutory designated sites relating to water within the wider 10 km Study Area have been identified through the use of NatureScot[43] and SEPA[44] GIS datasets. No statutory designations that are considered hydrologically connected to the Proposed Development were identified within 10 km of the Proposed Development. Statutory designations which were identified within the 10 km Study Area, but were deemed not hydrologically connected to the Proposed Development, are listed in Table 14.7, and have been scoped out of further assessment.

Table 14.7 Statutory Designated Sites not hydrologically connected to the Proposed Development (within 10 km Wider Study Area)

Designation	Distance from the Proposed Development	Qualifying Interest	Hydrologically Disconnected from the Proposed Development
Blawhorn Moss SSSI, SAC[45]	1.85 km north of Site boundary.	Active and degraded raised bogs.	Hydrologically disconnected from Site by Barbauchlaw Burn.
Black Loch Moss SSSI, SAC[46]	4.62 km north-west of Site boundary.	Active and degraded raised bogs.	Hydrologically disconnected from Site by Barbauchlaw Burn.
Longriggend Moss SSSI[47]	8.71 km north-west of Site boundary	Blanket bog.	Hydrologically disconnected from Site by Barbauchlaw Burn and topography.
Lady Bell's Moss SSSI[48]	7.29 km west of Site boundary	Raised bog.	Hydrologically disconnected from the Site by intervening topography
Slamannan Plateau SSSI, SPA[49]	9.57 km north-west of Site boundary	Taiga bean geese.	Hydrologically disconnected from the Site by intervening topography and tributaries of the River Avon
Darnrig Moss SSSI[50]	9.56 km north of Site boundary	Raised bog.	Hydrologically disconnected by the River Avon and intervening topography.
Petershill SSSI[51]	8.22 km north-east of Site Boundary	Carboniferous limestone fossils,	Hydrologically disconnected by Bathgate Water and intervening topography.

[43] NatureScot (2021) SiteLink [Online] Available at: https://sitelink.nature.scot/map (Accessed 20/11/2022)
[44] SEPA (2019) Datasets [Online] Available at: https://www.sepa.org.uk/data-visualisation/water-classification-hub/ (Accessed 20/11/2022)
[45] NatureScot (2020) Blawhorn Moss SSSI [online] Available at: https://sitelink.nature.scot/site/230 (Accessed 20/11/2022)
[46] NatureScot (2020) Black Loch Moss SSSI [online] Available at: https://sitelink.nature.scot/site/1661 (Accessed 20/11/2022)
[47] NatureScot (2021) Longriggend Moss SSSI [online] Available at: https://sitelink.nature.scot/site/1099 (Accessed 20/11/2022)
[48] NatureScot (2021) Lady Bell's Moss SSSI [online] Available at: https://sitelink.nature.scot/site/889 (Accessed 20/11/2022)
[49] NatureScot (2022) Slamannan Plateau SSSI [online] Available at: https://sitelink.nature.scot/site/9171 (Accessed 20/11/2022)
[50] NatureScot (2021) Darnrig Moss SSSI [online] Available at: https://sitelink.nature.scot/site/498 (Accessed 20/11/2022)
[51] NatureScot (2021) Petershill SSSI [online] Available at: https://sitelink.nature.scot/site/1283 (Accessed 20/11/2022)

Designation	Distance from the Proposed Development	Qualifying Interest	Hydrologically Disconnected from the Proposed Development
		neutral grassland and calcareous grassland.	
East Kirkton Quarry SSSI[52]	8.5 km north-east of Site boundary	Anthropoda, Permian-Carboniferous Fish/Amphibia.	Hydrologically disconnected by Bathgate Water and intervening topography.
Easter Inch Moss And Seafield Law Local Nature Reserve (LNR) [53]	7.61 km east of Site boundary	Peat bog	Upslope of the River Almond and therefore hydrologically disconnected.
Tailend Moss SSSI[54]	9.25 km east of Site boundary	Raised bog, wet peatland communities, dry heath	Upslope of the River Almond and therefore hydrologically disconnected.
Skolie Burn SSSI[55]	8 km south-east of Site Boundary	Late Dinantian (Lower Carboniferous) Geology, herb rich unimproved grassland	Hydrologically disconnected by Breich Water and its tributaries
Hassockrigg and North Shotts Mosses SSSI, SAC[56]	2.19 km south-west of Site boundary	Raised bog, actively growing sphagnum moss,bog asphodel, common cotton grass and lagg fen	Upslope of How Burn and River Almond, therefore hydrologically disconnected.

14.4.23 Two Local Nature Reserves were identified within 10 km of the Site; Kingshill LNR located 7.41 km south-west of the Site, and Braedale LNR which is located 9.77 km south-west of the Site. Neither of these LNRs are hydrologically connected.

14.4.24 As there are no hydrologically connected statutory designated sites within 10 km of the Proposed Development, effects on this receptor can be scoped out of further assessment.

Sensitivity of Receptors

14.4.25 The sensitivities of the identified receptors, and their relationship to the potential effects from the construction of the Proposed Development, are outlined in Table 14.8.

[52] NatureScot (2017) East Kirkton Quarry SSSI [online] Available at: https://sitelink.nature.scot/site/586 (Accessed 20/11/2022)
[53] NatureScot (2020) Easter Inch and Seafield Law Local Nature Reserve [online] Available at: https://sitelink.nature.scot/site/9204 (Accessed 20/11/2022)
[54] NatureScot (2022) Tailend Moss SSSI [online] Available at: https://sitelink.nature.scot/site/1513 (Accessed 20/11/2022)

[55] NatureScot (2022) Skolie Burn SSSI [online] Available at: https://sitelink.nature.scot/site/1440 (Accessed 20/11/2022)
[56] NatureScot (2021) Hassockrigg and North Shotts Mosses SSSI [online] Available at: https://sitelink.nature.scot/site/1690 (Accessed 20/11/2022)

Table 14.8 Sensitivity of Receptors

Receptor	Potential Effects	Sensitivity	Sensitivity Description
Surface hydrology	Increased run-off, erosion and sedimentation, stream flow impediments and pollution as a result of construction groundworks and chemical handling and storage.	Low	A large, medium or small waterbody with a SEPA water quality classification of 'Poor'.
Groundwater	Pollution as a result of erosion and sedimentation from construction activities and uncontained spills from chemical handling and storage.	High	Groundwater body is classified as 'moderately productive aquifer'.
Near-surface Water	Diversion of near-surface flow as a result of track construction and the installation of turbine foundations / hardstanding. Pollution as a result of erosion and sedimentation from construction activities and uncontained spills from chemical handling and storage.	High	Supports carbon-rich and peaty soils.
GWDTE (low-moderately groundwater dependent)	Pollution as a result of track/hardstanding construction and uncontained spills from chemical handling / storage. Drying out or changes to groundwater interflow patterns from impediments to flow as a result of construction.	Medium	GWDTEs which are classified by SEPA as "moderately groundwater dependent" and have functional impairment by man-made influence (such as drainage, forestry or modified by livestock).

14.5 Assessment of Potential Effects

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

Potential Construction Effects

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

- Construction of new and upgraded access tracks, turbines and associated infrastructure, hardstanding and temporary construction compound for the Proposed Development;
- Construction of substation compound;
- Construction of recreational foot paths;

- Installation of drainage features;
- Tree felling to facilitate the new access into the Site; and
- Earthworks cut at trackside and crane hardstanding in areas to facilitate Development.

Chemical Pollution

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

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

Surface Hydrology

14.5.5 Watercourses could be at risk from a pollution incident during construction. All surface watercourses are considered to be of Low sensitivity.

14.5.6 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 50 m buffer (for OS 1:50k scale watercourses) of watercourses from infrastructure (excluding watercourse crossings and exemptions as discussed previously) has been adopted.

14.5.7 The exception to this buffer zone a small area of hardstanding adjacent to turbine 4 (T4), which lies 45 m from the unnamed watercourse to the south. This design encroachment relates to restrictions in the location of T4 with respect to required offtake distance to the northern field boundary.

14.5.8 Whilst this is the case, mitigation measures and good practice embedded construction methods as outlined in TA14.1 WCEMP including use of impermeable membranes and bunding of the construction compound will safeguard water quality. It is also recommended in line with good practice that a surface water quality monitoring programme is carried out. These mitigation measures will be implemented across the Site, but will be effective in mitigating impacts to surface hydrology at T4.

14.5.9 As such, effects on these watercourses, of Low sensitivity, will be of Negligible magnitude and therefore (in accordance with Table 14.3) of Negligible significance. This is considered 'not significant' in terms of the EIA Regulations.

Groundwater and Near Surface Water and Bedrock

14.5.10 Pollutants coming into contact with 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 lengthy attenuation and dispersal of chemicals. As noted previously, the underlying hydrogeology consists of a "moderately productivity aquifer" where "flow is virtually all through fractures and other discontinuities". It is noted that a fault line runs under the area where a turbine and associated infrastructure is planned. This increases the likelihood of pollutants coming into

contact with groundwater, however the emergence of groundwater has not been noted in this area.

14.5.11 Good practice embedded construction methods described within the outline WCEMP, TA14.1, will effectively limit the uncontained release of chemicals to minor fugitive releases. This will result in a low potential for contamination of groundwater with pollutants.

14.5.12 As such, effects on groundwater and near-surface water (High sensitivity) will be of Negligible magnitude, the significance of the effect associated with chemical pollution is considered to be Minor. This is considered to be not significant in terms of the EIA Regulations.

GWDTEs

14.5.13 GWDTE communities located within 100 m of excavations less than 1 m in depth and within 250 m of excavations greater than 1m in depth are considered to be at risk from a pollution incident during construction. There are six communities within these buffers that are considered to be at risk. Good practice embedded construction measures, summarised in TA14.1 will be in place to limit release of chemicals to surface water run-off, groundwater and near-surface water. Figure 14.1 shows GWDTEs within the Site.

14.5.14 As outlined in Section 14.3.17, wetland habitats with Moderate groundwater dependency are defined as Medium sensitivity. The magnitude of direct and indirect effects is Low, based on findings in Section 14.3.18. As such, there will be an effect of Negligible predicted significance on the hydrological function of Moderate sensitivity GWDTEs. This is not significant in terms of the EIA Regulations.

Erosion and Sedimentation

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

14.5.16 Areas particularly at risk of erosion and sedimentation are in areas of large earthworks. As excavations for turbines are required in to facilitate the Proposed 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 these areas.

14.5.17 Larger areas of earthworks are located at T1, T2, T3, T4, the DNO switchgear building and along sections of site access tracks. These areas will be visually inspected regularly by the ECoW and mitigation measures outlined in TA14.1 implemented.

Surface Hydrology

14.5.18 Given the overland distance between construction areas and watercourses, any silt or other materials carried by overland flow as a result of construction are likely to be entrained in vegetation and existing drainage ditches (in the absence of intervening good practice measures) before reaching watercourses. As outlined earlier, turbine 4 is situated within the 50 m buffer zone between infrastructure and watercourses. This will be addressed through the use of mitigation and embedded design measures identified in TA14.1.

14.5.19 Good practice embedded construction measures, such as check dams, silt traps and settlement lagoons, will limit sediment entering the watercourse as described in TA14.1.

14.5.20 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 Site, including the hydrology and water quality of onsite watercourses. These measures are further detailed in TA14.1.

14.5.21 Given the Low sensitivity of the watercourses and Negligible magnitude of change, the significance of effects associated with erosion and sedimentation is assessed as being Negligible. This is considered to be not significant in terms of the EIA Regulations.

Groundwater and Near Surface Water

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

14.5.23 Measures described in TA14.1, 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 near-surface water and groundwater and Negligible magnitude of effect, the significance of the effect associated with erosion and sedimentation is considered to be Minor for near-surface water and groundwater. This is considered to be not significant in terms of the EIA Regulations.

Impediments to Flow

14.5.24 There are four small artificial drains across this Development which pass under the crane pads or site access tracks. These drains will require culverting or may be diverted around the infrastructure. This may result in up to four new watercourse crossings, as shown in **Figure 14.3**. There are two existing watercourse crossing which will be utilised as part of this Development, both of which may require upgrading. The Proposed Development has been designed, as detailed in Chapter 3: Description of Proposed Development, to minimise the number of watercourse crossings and therefore utilises one existing watercourse crossing at WC05.

14.5.25 The minimisation of the number of new watercourse crossings and the re-use of the existing watercourse crossing location reduces activities that could give rise to impediment of flows. The indicative watercourse crossing design is outlined in Chapter 3: Description of proposed Development, detailed design will be carried out at the construction phase and will be agreed with SEPA. Additionally, as noted in Section 3.6 of TA 14.1 Watercourse Crossing Inventory, WC01 will not be culverted, but will instead be diverted around the area of hardstanding for T3. Good practice for watercourse diversions will be implemented during construction and can be found in section 3.4.2 of TA 14.1.

14.5.26 The effects on watercourses of Low sensitivity are considered to be of Negligible magnitude and, therefore of Negligible significance. This is not significant in terms of the EIA Regulations.

Changes in Groundwater Interflow Patterns

14.5.26.1 Groundwater and Near Surface Water

14.5.27 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.

14.5.28 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 Proposed Development, larger volumes of deposits will require to be excavated and transported. This change in topography could result in changes to flow patterns.

14.5.29 Larger areas of earthworks cutting are located at the Substation, Construction Compound and crane hardstandings. These areas will be visually inspected regularly by the ECoW and mitigation measures outlined in TA14.1 implemented.

14.5.30 No substantial impediments to near-surface water flow will be created as the detailed site drainage design will take into account any severance of saturated areas to ensure hydrological connectivity is maintained, in accordance with SEPA / SNH 'Good practice during wind farm construction' as shown in TA14.1.

14.5.31 Consequently, 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.

Acidification of Watercourses

14.5.32 Felling of trees and the storage of brash could potentially result in a short-term increase in the acidity of surface water within the immediate catchment of the felling area.

Surface hydrology

14.5.33 If stored close to watercourses, nitrate leaching can occur from stockpiled brash. This could result in acidification of watercourses.

14.5.34 Felling can also involve the movement of heavy machinery across a soft ground surface and lead to soil disturbance. This could have the potential to lead to acidification and sedimentation. As the area is narrow and located beside an access road, the machinery will not be required to track over large areas to reach the felling area. However, sedimentation and acidification could still result from the removal of trees and vegetation and the exposure of bare ground.

14.5.35 The area to be felled is relatively small, 6.65 ha as shown in Figure 8.2, and will be felled over as short a time as practicable. The felling works as part of the Proposed Development are not located within 50 m of any natural or WFD classified watercourses.

14.5.36 Forestry good practice measures are set out in the TA14.1, including specific measures for felling. These measures will be implemented and maintained, and this will be carried out during the construction phase under the supervision of an Ecological Clerk of Works (ECoW), whose role is described in TA14.1.

14.5.37 The effects on watercourses of Low sensitivity are therefore of Negligible magnitude and, therefore of Negligible significance. This is not significant in terms of the EIA Regulations.

Groundwater and Near Surface Water

14.5.38 Disturbance of the ground due to felling activities could lead to flushing of acid from groundwater.

14.5.39 The area required to be cleared is relatively small and felling works will be active for as short a time as practicable. Good practice measures are included within TA14.1.

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

Increase in Runoff and Flood Risk

Increase in Runoff

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

14.5.42 Measures, including SuDS measures, to attenuate run-off and intercept sediment prior to run-off entering watercourses are described as part of embedded good practice in Section 3 of TA14.1 and form a part of the Proposed Development.

14.5.43 For these reasons, the effect on watercourses of Low sensitivity are considered to be of Negligible magnitude, and therefore Negligible significance. This is considered not significant in terms of the EIA Regulations.

Flood Risk

14.5.44 No Development infrastructure is located within areas described as having a 0.5% or greater annual risk of flooding.

14.5.45 The design of the Proposed Development layout has incorporated a buffer zone between watercourses and infrastructure of 50 m, meaning any overtopping of

minor watercourses is unlikely to reach infrastructure. The exception to this is the minor encroachment of this buffer at T4, however the distance between infrastructure and the watercourse is 45 m, therefore placing all aspects of the proposed Development outside of areas of flood risk.

14.5.46 As such, the Proposed Development is not considered to be at risk of flooding and is unlikely to contribute to the displacement of pluvial flood water.

14.5.47 For these reasons, the effect on watercourses of Low sensitivity is considered to be of Negligible magnitude, and therefore Negligible significance. This is considered not significant in terms of the EIA Regulations.

Effects on the Hydrological Function of Wetland Habitats

14.5.48 Wetland habitats supporting NVC communities are present within the Site. The majority of the communities that according to SEPA guidance had a potential groundwater dependency of High or Moderate were determined within the baseline to have a lower site-specific groundwater dependency described in Sections 14.5.15 to Section 14.5.19.

14.5.49 According to SEPA Guidance LUPS-31, groundwater dependent communities may be affected if they are within 100 m radius of all excavations less than 1 m in depth and 250 m radius of all excavations more than 1 m in depth. 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.

14.5.50 The footprint of the Proposed Development infrastructure is located within areas where a small number of communities have been identified as more likely to have a higher level of groundwater dependency. This will result in the direct loss of habitat. The potential loss of habitat and potential impacts to site-specific GWDTEs are discussed in Table 14.10.

14.5.51 Five of the communities are located within the 100 m and 250 m buffers from Development infrastructure. These communities are polygons 133, 137, 139, 118 and 384, also outlined within Table 14.9. Indirect impacts of disturbance to surrounding wetland habitats can include:

- Disruption of near-surface water through superficial deposits through construction of cut and fill access tracks by installation of aggregation causing a physical blockage to water flow in micro and macropores within the communities, where the access track runs perpendicular to natural flow;
- Disruption of near-surface water through superficial deposits by turbine foundations and crane hardstanding creating physical barriers;
- Temporary diverting of sub-surface flows through turbine dewatering works, temporarily lowering the local water table and sub-surface water levels downslope; and
- Temporary localised lowering of the water levels within the soil layers downslope of the access track and turbine foundations immediately after construction, due to a reduction in the quantity of near-surface water into this area.

Table 14.9 Potential Loss and Impacts to Site-Specific GWDTEs

Habitat and NVC	Polygon ID	Potential for impact from the Proposed Development
Marsh/ marshy grassland (MG10/M23)	133 & 384	Point 133 partially located in the same area as the crane pad and turbine foundation of T4. This will result in a direct loss of 4.8 % of the total area of habitats designated as groundwater dependant within this assessment Point 133 is located immediately upslope and downslope of T4, while point 384 is located 38 m upslope of T4. Therefore, construction may result in indirect habitat loss due to dewatering and excavation works.
Neutral grassland – semi improved (MG9)	118	Point 188 is partially located in the proposed crane pad area for T4. This will result in the loss of 1.2 % of the total area of habitats designated as groundwater dependant within this assessment This area is located immediately downslope of T4, associated hardstanding and the connecting access track. Therefore, construction may result in indirect habitat loss due to excavation works.
Flush and spring – acidic/neutral flush (M6)	137	Point 137 is partially located along areas of the site access track and will result in mire habitat loss. The percentage of this habitat directly lost is 0.7 % of the total area of habitats designated as groundwater dependant within this assessment Other areas of this polygon lie within the infrastructure buffer zones, immediately downslope of the access tracks which may result in indirect habitat loss from excavation and dewatering effects.
Wet modified bog (M6/M20)	139	Point 139 is not located within the same area as infrastructure and will therefore not be subject to direct loss of habitat. This community is located 30 m upslope of proposed new access tracks. Therefore, this habitat is subject to indirect habitat loss due to dewatering effects.

14.5.52 Good practice design and construction measures outlined in the WCEMP in TA14.1 will minimise potential indirect effects of the Proposed Development on wetland habitats, including those not determined to be groundwater dependent. The embedded design measures outlined in TA14.1 will further minimise the indirect effects on wetland habitats.

14.5.53 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.

14.5.54 Additionally, the following design measures will ensure that effects on wetland habitats are minimised where dewatering will take place:

- A PPP is implemented to ensure good practice working methods are followed throughout construction works.
- Turbine foundations are constructed in holes in the ground that will be de-watered, and hence water flow is typically into the foundation area. This will prevent concrete leaching into groundwater or surface water in the event of shutter collapse.

- All excavations will be sufficiently dewatered before concrete pours begin and that dewatering continues while the concrete cures. However, construction good practice will be followed to ensure that fresh concrete is isolated from the dewatering system.
- If required turbine foundations may be dewatered, temporarily lowering water levels in the superficial deposits and near-surface groundwater. The dewatering process would involve the treatment of any extracted water to remove any sediment and redistributing the water onto a vegetated surface in proximity to the excavation, considering the location of GWDTEs within the wider area. 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.

14.5.55 Any dewatering for the construction of turbine foundations or for excavations are relatively localised and temporary in nature (during construction phase), with shallow groundwater levels anticipated to recover and flow to adjust around turbines on completion.

14.5.56 In accordance with Table 14.1, wetland habitats with Moderate groundwater dependency are defined as Medium sensitivity. As shown in Table 14.10, the maximum loss of GWDTE habitat is calculated to be 4.8 % which indicates the magnitude of direct effects is considered to be Negligible in accordance with Table 14.2. The magnitude of indirect effects is considered to be Negligible as described as change is hardly discernible, approximating to a 'no change' in hydrogeological condition' in accordance with Table 14.2.

14.5.57 As such, the effects of direct loss will be of Negligible predicted significance on the hydrological function of moderately dependent GWDTEs and the effects of indirect loss will be of Negligible predicted significance moderately dependent GWDTEs. This is not significant in terms of the EIA Regulations.

Potential Operational Effects

14.5.58 Potential effects associated with the operation of the Proposed Development are:

- Increased run-off rates and volume from increased hardstanding, resulting in increased flood risk;
- Alterations to natural flow pathways from runoff from areas of hardstanding, with potential effects on the hydrological function of GWDTEs;
- Risk of chemical pollution as a result of battery fires from the substation; and
- Risk of a chemical pollution event from minor spills from maintenance vehicles.

14.5.59 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. The magnitude of effects of the risk of a battery fire is similar during operation as previously discussed for during construction.

14.5.60 There will be a minor reduction in the potential for increased surface water run-off during the operational phase due to the reduction in hardstanding

areas used during the construction phase, such as the removal of the construction compounds.

14.5.61 Whilst alterations to natural flow pathways will not be introduced during the operational phase, any changes during construction will continue through operation, as the majority of infrastructure will remain in place. Alterations to natural flow pathways will be reduced through adopting good practice design and construction, as set out in the WCEMP, TA14.1, such as cross drainage, use of shallow drainage ditches and prevention of blockages.

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

Potential Decommissioning Effects

14.5.63 Plans for decommissioning works are outlined Section 3.24 of this EIA Report.

14.5.64 During decommissioning all buildings and electrical equipment will be removed to approx. 0.5 m below ground level. Exterior and interior components of demolished buildings shall be taken off-site for reuse or recycling. Where possible, reuse will be prioritised and if that is not possible, recycling will be encouraged.

14.5.65 Turbine foundations and hardstanding would be removed to approx. 0.5 m below ground level, with concrete and materials re-used on-site. Where this is not possible, materials will be assessed for potential re-use off-site or recycling. The area will be reinstated from original overburden, stored locally. To ensure disturbance is minimal, all cables would be cut off below ground level, de-energised, and left in the ground. Access tracks would be left for use by the landowner. No stone would be removed from the Site. The borrow pit would be left to naturalise following retrieval of any stored material. This approach is considered to be less environmentally damaging than seeking to remove foundations, cables and roads entirely.

14.5.66 Potential effects of decommissioning the Proposed Development are similar in nature to those during construction, however, 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 WCEMP finalised prior to decommissioning. Potential effects associated with decommissioning include:

- Risk of chemical pollution (including accidental pollution) from minor spills from onsite vehicles and plant;
- Increased erosion and sedimentation of surface water, near-surface water and groundwater as a result of decommissioning works;
- Increased impediments to watercourse and near-surface water flow from shallow excavation works;
- Potential effects on the hydrological function of Groundwater Dependent Terrestrial Ecosystems (GWDTEs); and

14.5.67 It is therefore considered that decommissioning activities would be less intrusive and therefore no significant effects are anticipated. The magnitude and significance of all effects on hydrological receptors associated with decommissioning are assessed as being Minor, and 'not significant' in terms of the EIA Regulations.

14.6 Assessment of Cumulative Effects

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

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

14.6.3 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.

Cumulative Developments within 10 km (in planning, consented or under construction)

14.6.4 Wind farms within 10 km of the Proposed Development are listed in Table 14.10.

Table 14.10 Wind Farms within 10 km of the Proposed Development.

Site Name	Status	Location	Hydrological Connection
Brownhill Wind Farm	Consented (July 2020)	Approx. 2.2 km south of the Proposed Development. Located within the River Almond catchment	Located within the same hydrological catchment – included for further assessment
Dewshill Wind Farm	Application	Approx. 4.15 km east of the Proposed Development. Located within the River Avon catchment	Located within the same hydrological catchment – included for further assessment
Easter Drumclair Wind Farm	Consented (April 2022)	Approx. 6.45 km north of the Proposed Development. Located within the River Avon catchment	Located within the same hydrological catchment – included for further assessment
Drumelzie Wind Farm	Consented (December 2016)	Approx. 3.3 km north of the Proposed Development. Located within the River Avon catchment	Located within the same hydrological catchment – included for further assessment
Forestfield Wind Farm	Consented (November 2021)	Approx. 2.47 km east of the Proposed Development. Located within the River Avon catchment	Located within the same hydrological catchment – included for further assessment
Greengairs East Wind Farm	Consented (October 2020)	Approx. 8.26 km north-west of the Proposed Development. Located within the River Kelvin	Located in separate hydrological catchments –

Site Name	Status	Location	Hydrological Connection
		and River Clyde catchments	scoped out of further assessment
Greenwall Wind Farm	Consented (September 2015)	Approx. 9.95 km south-east of the Proposed Development. Located within the River Clyde catchment	Located in separate hydrological catchment – scoped out of further assessment
Hartwood Wind Farm	Consented	Approx. 6.02 km south-west of the Proposed Development. Located within the River Clyde catchment	Located in separate hydrological catchment – scoped out of further assessment
Heathland Wind Farm	Consented (10th January 2022)	Approx. 8.57 km south-east of the Proposed Development. Located within the River Almond and River Clyde catchments	Located within the same hydrological catchment – included for further assessment
Longhill Burn Wind Farm	Consented (February 2022)	Approx. 8.84 km south-east of the Proposed Development. Located within the River Almond catchment	Located within the same hydrological catchment – included for further assessment
Southrigg 2 Wind Farm	Consented (July 2019)	Approx. 1.12 km west of the Proposed Development. Located within the River Almond catchment	Located within the same hydrological catchment – included for further assessment
Tormywheel Wind Farm	Consented (March 2020)	Approx. 8.18 km south-west of the Proposed Development. Located within the River Almond and River Clyde catchments	Located within the same hydrological catchment – included for further assessment
West Benhar Wind Farm	Consented (September 2015)	Approx. 2.31 km south of the Proposed Development. Located within the River Almond and River Clyde catchments	Located within the same hydrological catchment – included for further assessment

14.6.5 A small area of the Site is located within the River Avon catchment to the north Development. The infrastructure proposed within this area is a recreational footpath with a total footprint of 75 m^2 and an excavation depth of less than 1 m. This infrastructure is located out with the 50 m watercourse buffer and good practice mitigation measures identified within TA 14.1 will be implemented. Therefore, it is considered that there will be no perceptible change to the hydrological environment and as such, this Development will not contribute to the cumulative impacts to the River Avon catchment.

14.6.6 While there are six developments within 10 km of the Proposed Development with a common downstream hydrological receptor (River Almond), potential cumulative effects from three of these developments may be scoped out as the total path distance between the closest infrastructure point to the confluence of hydrologically connected hydrological receptors exceeds 10 km. By exceeding

this distance, the effects of dilution would likely disperse any potential pollutants and sediments to a negligible quantity. The developments which can be scoped out for this reason include:

- Tommywheel Wind Farm, total path distance is approximately 10.9 km via Breich Water.
- Longhill Burn Wind Farm, total path distance is approximately 11.5 km via Killandean Burn
- Heathland Wind Farm, total path distance approximately 12.4 km via Breich Water.

14.6.7 As a result, there are three other developments with the potential for cumulative effects with the same hydrological catchment, with the common downstream surface water receptor being the River Almond. These developments include: Southrigg 2, West Benhar Wind Farm and Brownhill Wind Farm.

Predicted Cumulative Effects

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

14.6.9 The developments, Southrigg 2 Wind Farm, West Benhar Wind Farm and Brownhill Wind Farm, are all located within the River Almond catchment. The date of construction phases for these wind farms are unknown which means there is potential for the construction phases to coincide. Given their respective locations, the primary cumulative impact is likely to be an increase in flow rates associated with increased run-off from new hardstanding areas of the two wind farm developments.

Construction Phase

14.6.10 The increase in flow rates is of negligible magnitude for the Proposed Development. According to the cumulative applications submitted, CEMPs have been committed to being developed with appropriate water management and mitigation measures to be implemented during construction at Southrigg 2, West Benhar Wind Farm and Brownhill Wind Farm. These will be similar to those described in the WCEMP for the Proposed Development, including a requirement for a Construction Site Licence, as these are in line with standard practice as required by SEPA. Given this, the magnitude of cumulative impacts during the construction phase will be negligible and, therefore, of negligible significance. This is not significant in terms of the EIA Regulations.

Operational Phase

14.6.11 It is anticipated that there will be a minor reduction in the potential for increase in flow rates during the operational phase of all wind farm developments, when compared to the construction phase, due to the reduction in overall hardstanding areas post-construction. Therefore, the magnitude of cumulative effects during the operational phase will be negligible, and the significance of these effects will also be negligible, being not significant in terms of the EIA Regulations.

14.7 Mitigation Measures

14.7.1 Embedded mitigation measures and construction good practice measures are included in TA14.1. 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.

14.7.2 With the embedded mitigation measures described in TA14.1, all identified potential effects have been assessed as being of no greater than minor significance. 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.

14.7.3 To address the breach of the 50 m watercourse buffer at the hardstanding of T4, good practice measures, including the use of cut-off ditches, silt fencing and surface water monitoring will be implemented. The details of these measures can be found in TA14.1 WCEMP. Residual effects are therefore the same as effects assessed in Sections 14.6.1 to Section 14.6.64 for all phases of the Proposed Development. These are therefore not significant in terms of the EIA Regulations.

14.8 Residual Effects

14.8.1 No significant residual cumulative effects are predicted.

14.9 Summary

14.9.1 Table 14.11 provides a summary of the effects detailed within this Chapter.

Table 14.11 Summary of Effects

Receptor	Potential Effect	Significance of Effect	Additional Mitigation Proposed	Residual Significance
Construction Phase				
Surface hydrology (watercourses)	Chemical Pollution	Negligible	None	Negligible
	Erosion and Sedimentation	Negligible	None	Negligible
	Impediments to Flow	Negligible	None	Negligible
	Increase in Run-off from increase in hardstanding	Negligible	None	Negligible
	Acidification of watercourses	Negligible	None	Negligible
Hydrogeology (groundwater)	Chemical pollution	Minor	None	Minor
	Erosion and Sedimentation	Minor	None	Minor

Receptor	Potential Effect	Significance of Effect	Additional Mitigation Proposed	Residual Significance
	Changes in Groundwater Interflow Patterns	Minor	None	Minor
	Acidification of watercourses	Minor	None	Minor
Near-surface water	Chemical pollution	Minor	None	Minor
	Erosion and Sedimentation	Minor	None	Minor
	Acidification of watercourses	Minor	None	Minor
GWDTEs (Moderate dependency)	Chemical pollution	Negligible	None	Negligible
	Changes in Groundwater Interflow Patterns	Negligible	None	Negligible
Operational Phase				
Surface hydrology (watercourses)	Increase in Run-off from permanent hardstanding	Negligible	None	Negligible
	Changes in flow and drainage patterns	Negligible	None	Negligible
	Chemical pollution	Negligible	None	Negligible
Hydrogeology (groundwater)	Changes in Groundwater Interflow Patterns	Minor	None	Minor
	Chemical pollution	Minor	None	Minor
Near-surface water	Changes in Groundwater Interflow Patterns	Minor	None	Minor
	Chemical pollution	Minor	None	Minor
GWDTEs (Moderate Dependency)	Changes in Groundwater Interflow Patterns	Negligible	None	Negligible
	Chemical pollution	Negligible	None	Negligible

Receptor	Potential Effect	Significance of Effect	Additional Mitigation Proposed	Residual Significance
Decommissioning Phase				
Surface hydrology (watercourses)	Chemical Pollution	Minor	None	Minor
	Erosion and Sedimentation	Minor	None	Minor
	Impediments to Flow	Minor	None	Minor
Hydrogeology (groundwater)	Chemical pollution	Minor	None	Minor
	Erosion and Sedimentation	Minor	None	Minor
	Changes in Groundwater Interflow Patterns	Minor	None	Minor
Near-surface water	Chemical pollution	Minor	None	Minor
	Erosion and Sedimentation	Minor	None	Minor
GWDTEs (Moderate dependency)	Chemical pollution	Negligible	None	Negligible
	Changes in Groundwater Interflow Patterns	Negligible	None	Negligible

Statement of Significance

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

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