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CONSULTANTS IN ENGINEERING, ENVIRONMENTAL SCIENCE & PLANNING

ENVIRONMENTAL IMPACT ASSESSMENT REPORT (EIAR) FOR THE PROPOSED BARNADIVANE WIND FARM & SUBSTATION, CO. CORK

VOLUME 2 – MAIN EIAR
CHAPTER 7 - – HYDROLOGY AND WATER QUALITY

Prepared for:

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Date: **February 2023**

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7. HYDROLOGY AND WATER QUALITY

7.1 Introduction

This chapter has been prepared to describe the aspects of the hydrological environment that could be affected by the activities associated with the construction of the Proposed Wind Farm at Barnadivane near Macroom in Co. Cork.

This chapter also assesses the potential impact of the Proposed Development on the water quality of the local environment. The drainage of the associated hard standing areas and access track are considered, taking account of mitigation measures to reduce or eliminate any potential impacts.

A detailed summary of the proposed project assessed in the EIAR is contained in Chapter 2 - Section 2.3.1 and a description of the development for which consent is sought is contained in Chapter 2 - Section 2.3.2 and 2.3.3.

7.1.1 Study Area

The proposed site layout is shown in Figure 7.1. The following sources of information were considered in this assessment:

- the design layout of the Proposed Development
- published literature as described below
- A desk-based assessment of the surface water hydrology and water quality within the site boundary of the Proposed Development
- The EIS for the previously permitted Barnadivane Wind Farm
- The EIS for the previously permitted Carrigarierk Wind Farm

Path: R:\Map Production\2021\P21-143\Workspaces\EIAR\P21-143_GIS_Fig7-1_Site_Location_Layout_A3.mxd

Legend

- Development Planning Boundary
- Study Area Boundary
- Proposed Turbine Layout
- Alternative Grid Connection Route
- Turbine Delivery Route

TITLE:	Site Location Layout
PROJECT:	Barnadivane Wind Farm and Substation, Co. Cork
FIGURE NO:	7.1
CLIENT:	Barna Wind Energy Ltd. & Arran Windfarm Ltd.
SCALE:	1:100000
REVISION:	0
DATE:	23/02/2023
PAGE SIZE:	A3

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N W E S

0 1.25 2.5 5 Kilometers

The Study area regarding hydrology and water quality is comprised of catchments, sub-catchments, sub-basins and associated hydrological features within the vicinity and hydrologically connected to the Proposed Development. The delineation of the water bodies encompassing the drainage networks is defined by the latest available Water Framework Directive (WFD) "Cycle 3".

For each project component, catchment characteristics and associated hydrological features are addressed within this Chapter.

The study area for this assessment comprises the relevant hydrological catchments within which elements of the above project are located or hydrologically connected to. A detailed description of the existing environment of the study area is contained in Section 7.3.

7.1.2 Aims

The aims of this EIAR chapter are to:

- Establish the baseline condition of the receiving surface water environment;
- Identify sensitive surface water receptors;
- Identify potential impacts as a result of the Proposed Development and assess the likelihood of such effects occurring;
- Outline embedded design mitigation and industry best practice that would be implemented during the construction and operation of The Proposed Development;
- Determine the scale of any potential effects, assuming design mitigation and industry best practice are implemented, by assessing the degree of sensitivity of the water environment receptors and the potential magnitude of change from the baseline condition;
- Establish if the scale of the effect is considered to be significant;
- If required, provide specific mitigation measures; and,
- Identify any cumulative and residual effects.

7.2 Methodology

A qualitative assessment has been undertaken using a combination of professional judgement, national and European Union legislation and other statutory policy and guidance. The assessment focuses on potential effects resulting from the Proposed Development, which may include changes to the surface water regime or pollution and degradation in water quality.

A desk-based assessment and field assessment were undertaken between October-December 2022 to inform the assessment. The desk-based study assessed the surface water hydrology and water quality in the catchments relevant to the Proposed Development, including an assessment of the watercourses that will be intercepted by and those that will receive surface water runoff from the layout of the Proposed Development, AGCR and turbine delivery route (TDR). The field assessment of the existing hydrological environment, was undertaken to both verify desk-based assessment, record all significant hydrological features and assess the proposed crossing points along water features.

In summary, the overall methodology follows the process of: reviewing relevant legislation and guidance; baseline characterization of the existing site environment; review of proposed project construction, operation and decommissioning phases; assessment of potential effects and their likelihood, outline of proposed mitigation measures; assessment of residual impacts during the construction, operational and decommission phases of the Proposed Development; and any need for additional mitigation.

7.2.1 Relevant Legislation and Guidance

7.2.1.1 Relevant EU Directives and Legislation

The Water Framework Directive (2000/60/EC)[1]

Directive 2000/60/EC of the European Parliament and Council established a framework for community action in the field of water policy. This Directive is also known as the WFD and came into force on the 22 December 2000. The WFD requires EU member states to aim to reach good chemical and ecological status in inland and coastal waters. The WFD is designed to enhance the status and prevent further deterioration of aquatic ecosystems and associated wetlands, to promote sustainable water use, to reduce pollution of water and to ensure progressive reduction of groundwater pollution. The WFD established a strategic framework for managing the water environment and requires a River Basin Management Plan (RBMP) to be developed every six years. In cases where good status/potential could not be achieved by 2015, a provision was given under Article 4.4 of the WFD extending the deadline to 2021 or 2027. The date has been extended to 2027 in respect of a large number of waterbodies.

The WFD has been implemented in Ireland by dividing the island of Ireland into eight river basin districts. These districts are natural geographical areas that occur in the landscape. River Basin Management Plan 2018-2021[2] has been prepared by Department of Housing, Planning and Local Government, presenting a RBMP for catchments throughout Ireland. This RBMP sets out the actions that Ireland will take to improve water quality and achieve 'good' ecological status in water bodies (rivers, lakes, estuaries and coastal waters) by 2027.

The WFD has been transposed into Irish law following:

- European Communities (Water Policy) Regulations, 2003 (S.I. No. 722 of 2003)[3].
- European Union (Water Policy) Regulations 2022 (S.I. No. 166 of 2022)[4].

[1] European Union, Water Framework Directive (2000/60/EC), 2000. Available online here:resource.html (europa.eu). Accessed August 2022.
[2] Department of Housing, Local Government and Heritage, River Basin Management Plan for Ireland, 2017. Available online here: gov.ie - River Basin Management Plan 2018 - 2021 (www.gov.ie) Accessed August 2022.
[3] Department of Environment, Heritage and Local Government , 2003. S.I. No. 722/2003 - European Communities (Water Policy) Regulations 2003. Amended in 2005 (S.I. No 413/2005), 2008 (S.I. No. 219/2008) and 2010 (S.I. No. 93/2010). Available online here: S.I. No. 722/2003 - European Communities (Water Policy) Regulations 2003 (irishstatutebook.ie). Accessed August 2022.
[4] Department of Environment, Community and Local Government, 2014. European Union (Water Policy) Regulations 2014 (S.I. No. 350 of 2014). Available online here: S.I. No. 166/2022 - European Union (Water Policy) (Amendment) Regulations 2022. (irishstatutebook.ie) Accessed January 2023.

- European Communities Environmental Objectives (Surface Waters) Regulations, 2009 (S.I. No. 77 of 2019)[5].
- European Communities Environmental Objectives (Groundwater) Regulations, 2016 (S.I. No. 366 of 2016)[6].
- European Communities (Good Agricultural Practice for Protection of Waters) Regulations 2022 (S.I. No. 113 of 2022)[7].
- European Communities (Technical Specifications for the Chemical Analysis and Monitoring of Water Status) Regulations, 2011 (S.I. No. 489 of 2011)[9].

Water Framework Directive Waterbody Status

The European Communities Environmental Objectives (Surface Water) Regulations 2009 (S.I. No. 272 of 2009)[8] (the Surface Water Regulations), implement the criteria and standards used for classifying surface waters in accordance with the WFD. There are five categories of surface water status: 'High', 'Good', 'Moderate', 'Poor' and 'Bad'.

A surface waterbody must achieve both good ecological status and good chemical status before it can be considered to be of good status. The chemical status of a waterbody is assessed based on certain chemical pollutants. The ecological status is assessed based on Biotic Indices or Quality (Q) Values. The EPA Biological Quality Rating System for Rivers (Q Rating System) and its relationship with the WFD Status is shown in Table 7.1:

[5] Department of Environment, Heritage and Local Government, 2009. European Communities Environmental Objectives (Surface Waters) Regulations, 2009 (S.I. No. 272 of 2009) Amended in 2012 (S.I. No. 327/2012) and 2015 (S.I. No. 386/2015), 2019 (S.I. No. 77/2019), 2022 (S.I. No. 288/2022). Available online here: S.I. No. 77/2019 - European Communities Environmental Objectives (Surface Waters) (Amendment) Regulations 2019 (irishstatutebook.ie). Accessed January 2023.

[6] Department of Environment, Heritage and Local Government, 2010. European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010). Amended in 2011 (S.I. No 389/2011), 2012 (S.I. No 149/2012) and 2016 (S.I. No 366/2016). Available online here: https://www.irishstatutebook.ie/eli/2010/si/9/made/en/print. Accessed August 2022.

[7] Department of Environment, Heritage and Local Government, 2010. European Communities (Good Agricultural Practice for Protection of Waters) Regulations 2010 (S.I. No. 610 of 2010). Amended in 2014 (S.I. 31/2014), 2017 (.S.I. No. 605/2017), 2020 (S.I. No. 40/2020), 2022 (S.I. No. 113 of 2022). Available online here https://www.irishstatutebook.ie/eli/2010/si/610/made/en/print. Accessed August 2022.

[8] Department of Environment, Community and Local Government, 2011. European Communities (Technical Specifications for the Chemical Analysis and Monitoring of Water Status) Regulations, 2011 (S.I. No. 489 of 2011).
Amended in 2012 (S.I. No. 327 of 2012) and 2015 (S.I. No. 386 of 2015). Available online here: https://www.irishstatutebook.ie/eli/2011/si/489/made/en/print. Accessed August 2022.

Table 7-1: EPA Q Rating System and WFD Status[9]

Q Value*	WFD Status	Pollution Status	Condition**
Q5, Q4-5	High	Unpolluted	Satisfactory
Q4	Good	Unpolluted	Satisfactory
Q3-4	Moderate	Slightly polluted	Unsatisfactory
Q3, Q2-3	Poor	Moderately polluted	Unsatisfactory
Q2, Q1-2, Q1	Bad	Seriously polluted	Unsatisfactory

* These Q Values are based on the relative proportions of pollution-tolerant to pollution-sensitive macroinvertebrates (the young stages of insects primarily but also snails, worms, shrimps etc.) resident at a river site.

** "Condition" refers to the likelihood of interference with beneficial or potential beneficial uses.

In accordance with the Surface Water Regulations, water classified as having 'High' or 'Good' status must not be allowed to deteriorate. Water classified as less than good must be restored. The Surface Water Regulations also state that, for the purpose of classification, a status of less than Good is assigned in the case of a waterbody where the environmental objectives are not met.

7.2.1.2 The Priority Substances Directive (2008/105/EC)

Directive 2008/105/EC[vii] of the European Parliament and Council of 16 December 2008 refers to the requirement to set environmental quality standards in the field of water policy, amended and subsequently repealed Council Directives 82/176/EEC, 83/513/EEC, 84/156/EEC, 84/491/EEC, 86/280/EEC and amended Directive 2000/60/EC of the European Parliament and Council. It is also known as the Priority Substances Directive (2008/105/EC) and was developed in response to the requirements of Article 16 of the WFD (2000/60/EC). The Priority Substances Directive requires the identification of priority substances to set Environmental Quality Standards (EQSs) for the concentrations of the priority substances in surface waterbodies and to review periodically the list of priority substances.

7.2.1.3 Relevant Guidance

The following guidelines were considered in the development of this chapter to identify relevant objectives relating to hydrology and surface water quality:

- Guidelines on the information to be contained in Environmental Impact Assessment Reports, Environmental Protection Agency (EPA), May 2022[10];

[9] Environmental Protection Agency, 2022. Available online here: Environmental Protection Agency (epa.ie) Accessed August 2022.
[10] Environmental Protection Agency, 2022. Available online here: Monitoring & Assessment: Assessment Publications | Environmental Protection Agency (epa.ie) Accessed August 2022.

- Draft Revised Wind Energy Development Guidelines- Department of the Environment, Heritage and Local Government, December 2019[11];
- Best Practice Guidelines for the Irish Wind Energy Industry - Irish Wind Energy Association, 2012[12];
- Good Practice Note on Strategic Environmental Assessment for the Energy Sector, Environmental Protection Agency (EPA), March 2021[13].

In addition to considering the documents above, the methodology for the impact assessment has been devised with due consideration of the following guidelines:

- The Planning System and Flood Risk Management - Guidelines for Planning Authorities - Department of Environment, Heritage and Local Government (DoEHLG) and the Office of Public Works (OPW), November 2009[14]
- Environmental good practice on site guide (fourth edition) (C741) - Construction Industry Research and Information Association (CIRIA), January 2015
- River Basin Management Plan 2018-2021 (Department of Housing, Planning and Local Government)[15]
- Best Practice Guide BPGCS005 Oil Storage Guidelines (Enterprise Ireland)
- Guidelines for the Crossing of Watercourses During the Construction of National Road Schemes (National Roads Authority, 2005)
- Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters (Inland Fisheries Ireland, 2016)[16]
- Good Practice During Wind Farm Construction (Scottish Natural Heritage 2019)[17]
- The SuDS Manual (C753) - Construction Industry Research and Information Association (CIRIA), 2015[18]
- Control of water pollution from linear construction projects (C648) – Construction Industry Research and Information Association (CIRIA), 2006;
- Control of water pollution from construction sites. Guidance for Consultants and Contractors (C532) - Construction Industry Research and Information Association (CIRIA), December 2001

[11] Department of Housing, Planning and Local Government, 2020. Draft Revised Wind Energy Development Guidelines. Available online here: gov.ie - Draft Revised Wind Energy Development Guidelines December 2019 (www.gov.ie). Accessed August 2022

[12]Irish Wind Energy Association, 2012. Best Practice Guidelines for the Irish Wind Energy Industry. Available online here: IWEA Best Practice Guidelines (gsi.ie) Accessed August 2022.

[13] Environmental Protection Agency, 2021. Good Practice Note on Strategic Environmental Assessment for the Energy Sector, Available online here: https://www.epa.ie/publications/monitoring--assessment/assessment/strategic-environmental-assessment/EPA_GoodPractice_SEA_EnergySector.pdf Accessed August 2022.

[14] Department of Environment, Heritage and Local Government , 2009. The Planning System and Flood Risk Management - Guidelines for Planning Authorities. gov.ie - The Planning System and Flood Risk Management - Guidelines for Planning Authorities - Technical Appendices (Nov 09) (www.gov.ie)

[15] Department of Housing, Planning and Local Government, 2018. River Basin Management Plan 2018-2021. Available online here: gov.ie - River Basin Management Plan 2018 - 2021 (www.gov.ie)

[16] Inland Fisheries Ireland, 2016. Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters Available online here: Guidelines Report 2016.pdf (fisheriesireland.ie)

[17] Scotland's Nature Heritage, 2019. Guidance - Good practice during Wind Farm construction. Available online here: Guidance - Good practice during Wind Farm construction | NatureScot

[18] CIRIA, 2015. The SuDs Manual. Available online here: SuDS Manual C753 Chapter List (ciria.org).

- UK Guidance for Pollution Prevention (GPP[19]):
  - GPP2: Above ground oil storage tanks (Natural Resources Wales (NRW), Northern Ireland Environment Agency (NIEA), the Scottish Environment Protection Agency (SEPA), Energy Institute, Oil Care Campaign, June 2021)[20]
  - GPP4: Treatment and disposal of wastewater where there is no connection to the public foul sewer (NRW, NIEA, SEPA, November 2017)
  - GPP5: Works and maintenance in or near water (NRW, NIEA, SEPA, January 2017)
  - GPP8: Safe storage and disposal of used oil (NRW, NIEA, SEPA, July 2017)
  - GPP21: Pollution Incident Response Plans (NRW, NIEA, SEPA, July 2017)
  - GPP22: Dealing with Spills (NRW, NIEA, SEPA, October 2018)
  - GPP26: Safe storage of Drums and intermediate Bulk Containers (IBCs), (NRW, NIEA, SEPA, February 2019)
- GE-INT-01003- Introduction to the NRA Design Manual for Roads and Bridges (Transport Infrastructure Ireland, December 2013)[21]
- Coillte (2013): Forest Operations & Water Protection Guidelines.

7.2.1.4 Objectives of the Cork County Development Plan for Surface Water and Flooding

The Cork County Development Plan 2022 sets out objectives for Surface Water and Flooding as follows:

WM 11-8: Drinking Water Quality

(b) It is an objective to ensure that all drinking water in the County complies with the European Union Drinking Water Directive 98/83/EC and that all surface water and ground water supplies comply with the requirements of Surface Water Directive 75/440/EC and Ground Water Directive 80/68/EEC.

WM 11-8: Protection of Quantity and Sources of Drinking Water

(c) It is a general objective to conserve sources of drinking water and to minimise threats to either the quality or quantity of drinking water reserves that might result from different forms of development or development activity and other sources of pollution.

WM 11-10: Sustainable Drainage Systems (SuDS)

(a) Require that all new developments incorporate sustainable drainage systems (SuDS). Efforts should be taken to limit the extent of hard surfacing and impermeable paving.

[19] NWR, et al. UK Guidance for Pollution Prevention (GPP) Available online here: UK Guidance for Pollution Prevention
[20] Natural Resources Wales (NRW) et al., June 2021. GPP2: Above ground oil storage tanks. Available online here: guidance-for-pollution-prevention-2-2022-update.pdf (netregs.org.uk)
[21] Transport Infrastructure Ireland , 2013. GE-INT-01003- Introduction to the NRA Design Manual for Roads and Bridges Available online here: IBD24/00 (tiipublications.ie)

WM 11-11: River Channel Protection

a) Ensure adequate protection measures along watercourses, keeping them free from development by ensuring development is kept 10m or other appropriate distance from stream and river banks is line with best practice for riparian corridors. Development altering the hydromorphology of a watercourse will not normally be permitted, where it may result in the deterioration in the status of a water body through for example, impacts on water quality, quantity or flow rate, riparian habitat or protected species.

b) There will be a presumption against the use of culverts and opportunities to actively remove existing culverts and re-naturalise/ daylighting watercourses will be encouraged in development proposals.

c) Where river crossings are considered necessary, clear span river crossing structures shall be used on fisheries waters where possible. The Council will consult with Inland Fisheries Ireland in relation to any such proposals

WM 11-12 Surface Water Management

It is a general objective to manage surface water catchments and the use and development of lands adjoining streams, watercourses and rivers in such a way as to minimise damage to property by instances of flooding and with regard to any conservation objectives of European sites within the relevant catchments and floodplains.

WM 11-13: Flood plain and Wetlands

(a) It is a general objective to Protect the County's floodplains, wetlands and coastal areas subject to flooding as vital green infrastructure which provides space for storage and conveyance of floodwater, enabling flood risk to be more effectively managed and reducing the need to provide flood defences in the future.

(b) It is an objective of ensure that development does not impact on wetland sites within river / stream catchments and seek the restoration of degraded wetlands.

7.2.1.5 Desk Study

The desk study involved an examination of the hydrological aspects and water quality aspects using the following sources of information:

- Ordnance Survey Ireland mapping.
- Science and Stories about Integrated Catchment Management (https://www.catchments.ie/).
- OPW Indicative Flood Maps (https://www.floodinfo.ie/map/floodplans/).
- Geological Survey of Ireland (www.gsi.ie).
- Review of the EPA online mapping (https://gis.epa.ie/EPAMaps/).
- History of flooding and status of drainage in the vicinity of the Proposed Development (available at http://www.floodinfo.ie/map/floodmaps/).
- Environmental Protection Agency (http://www.epa.ie/hydronet).
- Met Eireann Meteorological Database (available at https://www.met.ie).

7.2.2 Field Assessment

Site walkover surveys were carried out on 11 October 2022. Key tasks undertaken included;

- Identification of existing hydrological features and recording of locations for same;
- Measurements of on-site hydrological features, such as channel width, bank height and depth of water;
- Review of existing surface drainage network on and off site; and
- A photographic record of the hydrological features observed.

The site walkover involved an initial review of available information gathered in the desk study followed by a site visit. The key observations of surface water features are presented in Appendix 7-1.

7.2.3 Evaluation Criteria

The sensitivity of receptors, the quality of impacts the magnitude of impacts, the probability and duration of the impacts are assessed for the Proposed Development to determine significance of the impacts.

Categories for assessing the sensitivity of receptors are outlined and defined in Table 7.2.

The quality of effect of an impact is either 'Positive, 'Neutral' or 'Negative' and may have influence in the 'Momentary', 'Short', 'Medium' or 'Long-term'. Impacts may also be either 'Temporary' or 'Permanent'.

The probability of impact can be either 'Likely' or 'Unlikely'.

Thresholds for assessing the significance of an effect based on the sensitivity of the receptor and magnitude of impacts are outlined in Figure 7-2.

7.2.3.1 Sensitivity of Receptors

The sensitivity of a hydrological receptor is based on its vulnerability to be impacted/altered by the development, i.e. the ability of the receptor to absorb development without perceptible change. Table 7.2 below outlines the criteria for determining receptor sensitivity.

Table 7-2: Criteria for Determining Receptor Sensitivity

Sensitivity	Criteria	Typical Examples	
		Surface Water	Hydro-ecological receptors
Very High	Receptor has a high quality and rarity on a national or regional scale and limited potential for substitution. Receptor is highly vulnerable to impacts that may arise from the project and recoverability is long-term or not possible.		
High	Receptor has a high quality and rarity on a local scale and limited potential for substitution. Receptor is generally vulnerable to impacts that may arise from the project and recoverability is slow and/or costly.	Protected under EU or Irish habitat legislation (e.g., Special Area of Conservation (SAC) or Natural Heritage Area (NHA)). Designated Salmonid / Cyprinid Waters and/or fishery present. Surface water providing a regionally important resource or supporting a site protected under EU and Irish habitat legislation (e.g., water dependent ecological receptors).	Nationally and internationally designated sites where hydrology/hydrogeology is a key factor in designation (e.g. SAC / NHA/ Special Protection Areas (SPA) sites).
Medium	Receptor has a medium quality and rarity, local scale and limited potential for substitution/replacement or receptor with a low quality and rarity, regional or national scale and limited potential for substitution. Receptor is somewhat vulnerable to impacts that may arise from the project and/or has moderate to high recoverability.	Watercourse with designated features. Large lakes and non-potable reservoirs.	Statutory designated sites where hydrology/hydrogeology is a key factor in designation (e.g.
Low	Receptor with a low quality and rarity, local scale and limited potential for substitution. Receptor is not generally vulnerable to impacts that may arise from the project and/or has high recoverability.	Watercourse with no designated features. Non-sensitive water resources (non WFD classified e.g. small lakes, ponds). Man-made feature not in hydraulic continuity (e.g. canal).	Non-statutory designated sites where hydrology / hydrogeology is a key factor in designation

Sensitivity	Criteria	Typical Examples	
		Surface Water	Hydro-ecological receptors
Negligible	Attribute has a very low environmental importance and/or rarity on local scale. Receptor is of negligible value, not vulnerable to impacts that may arise from the project and/or has high recoverability.	Man-made feature with no ecological importance (e.g. land drains).	
Note	Professional judgement based on the baseline condition of the receptor should be used to determine a receptor's sensitivity.		

The Barnadivane site lies within the Ballinhassig East groundwater body and on the Gearagh waterbody. It has a very remote groundwater linkage via Ballinhassig East ground water body and no surface water linkage with the Gearagh waterbody, for this reason, the surface hydrological environment of the Proposed Development site is to considered to be **low sensitivity.**

7.2.3.2 Assessment of Significance of Hydrological Impact

The assessment of the Significance of Effects incorporates the timing, scale, size, duration and probability of the impact in accordance with the EPA Guidelines. The significance criteria for hydrological impacts are defined in Table 7.3 :

Table 7-3: Assessment of Magnitude of Hydrological Impact[22]

Impact Significance	Criteria
Imperceptible	An impact capable of measurement but without noticeable consequences
Not significant	An impact which causes noticeable changes in the character of environment but without significant consequences
Slight impacts	An impact which causes noticeable changes in the character of the environment without affecting its sensitivities
Moderate impacts	An impact that alters the character of the environment in a manner that is consistent with existing and emerging trends
Significant impacts	An impact which, by its character, magnitude, duration or intensity significantly alters a sensitive aspect of the environment
Very Significant	An impact which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment
Profound impacts	An impact which obliterates sensitive characteristics

[22] Guidelines on the information to be contained in environmental impact assessment report, May 2022..

The scale of effect is determined in relation to the sensitivity of the receptor and the potential magnitude of change from baseline conditions, Figure 7-2, presents how comparison of the magnitude of the predicted impact to the sensitivity of the receiving environment can determine the significance of the impact. Sensitivity of the receiving environment can be 'high', 'medium', 'low' or 'negligible'. Description of impact is defined by its character, magnitude, duration, probability and consequences. The magnitude of impact can be 'high', 'medium', 'low' or 'negligible'.

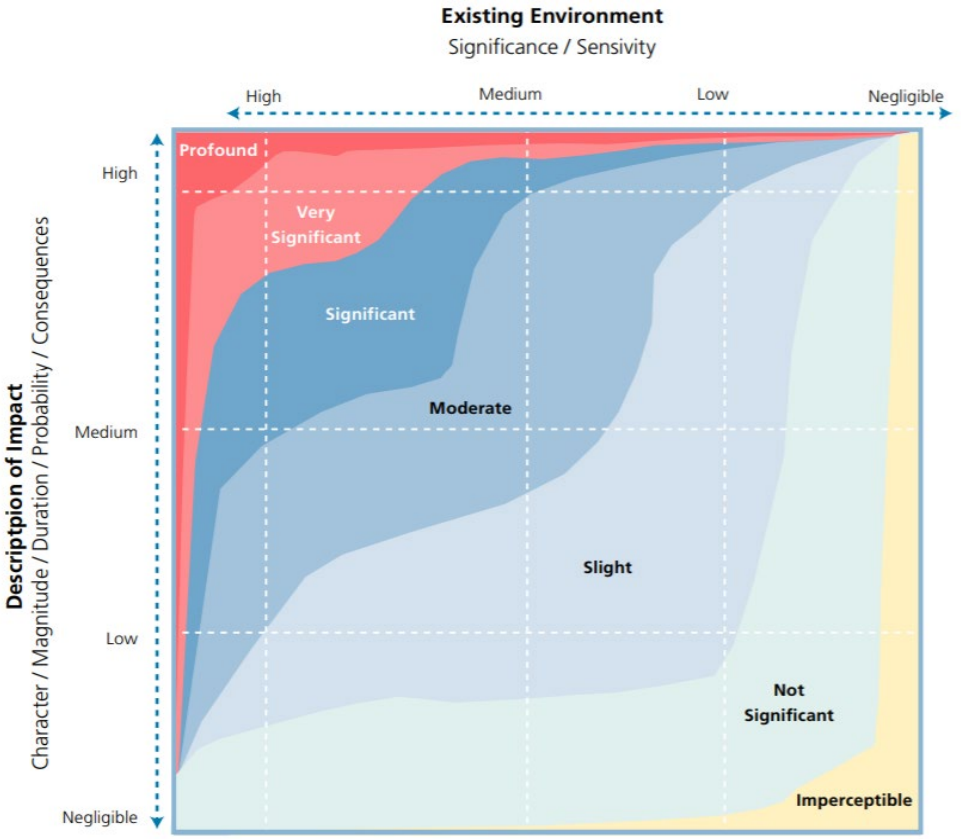


Figure 7-2: Classifications of the Significance of Impacts[23]

The conventional source-pathway-target model is applied to assess potential impacts on downstream environmental receptors resulting from the Proposed Development. The source being the activity that results in the potential impact or the potential source of pollution is described. The pathway being the route by which a potential source of impact can transfer or migrate to. The receptor being a part of the natural environment that could potentially be impacted. The pre-mitigation impact is the impact descriptors which describe the magnitude, likelihood, duration and direct or indirect nature of the potential impact before mitigation is put in place.

[23] Environmental Protection Agency - Guidelines on the information to be contained in environmental impact assessment report Draft August 2017

7.2.3.3 Assessment of Cumulative Impacts

The assessment of cumulative effects on the water environment considers the combined potential effects of other developments, with the potential to affect the water environment, within the same catchment(s) as the Proposed Development. This included consideration of other developments currently in the planning process and within the same catchment(s) as the Proposed Development, as discussed further in Section 7.4.6.

The UGC option and the works to accommodate large turbine components to the site will be assessed in Section 7.4.6 as they are permitted developments.

7.2.4 Consultation

Numerous statutory and non-statutory bodies have been consulted, which is further discussed in Section 4.2 Chapter 4 - EIA Scoping Consultation & Key Issues., lists the relevant responses relating to surface water hydrology received from stakeholders including; Inland Fisheries Ireland; the Department of Tourism, Culture, Arts, Gaeltacht, Sports and Media; and Irish Water.

Table 7-4: Summary of Relevant Consultation Scoping Comments

Organisation	Form of Consultation	Relevant comments in Outcome
Cork County Council	Meeting with Ms. Melissa Walsh, Senior Executive Planner.	A pre-planning meeting was held with Cork County Council in relation to the Proposed Development. This meeting, held with Ms. Melissa Walsh, Senior Executive Planner, Cork County Council, on 16 July 2014, was in relation to the Proposed Wind Farm development, as well as in relation to the proposed substation (which is the subject of a separate planning application, reference 14/00557). At the meeting, the planning history of the site, the proposed changes to the permitted development and the rationale for these changes were discussed. The potential for reduced impacts on the surrounding environment, as a result of these changes were also discussed. An EIA scoping report was tabled, and discussed, with reference made to the need to consult with relevant parties.
NPWS	Written consultation	Consultation with the NPWS began in 2013, when winter bird surveys were being scoped for the site, when the local NPWS ranger was consulted in relation to species of conservation concern in the area. These consultations continued through 2014, with written consultation for the AA Screening and the EIA being undertaken during the summer of 2014. Reply stated the Proposed Windfarm and associated works pose significant risk of negative impact on fisheries primarily during various elements of the construction phase including site preparation, construction and upgrading of access roads and crossings and the installation of the grid cable. IFI provided a list of planning conditions that need to be considered should permission be granted for the Proposed Development.

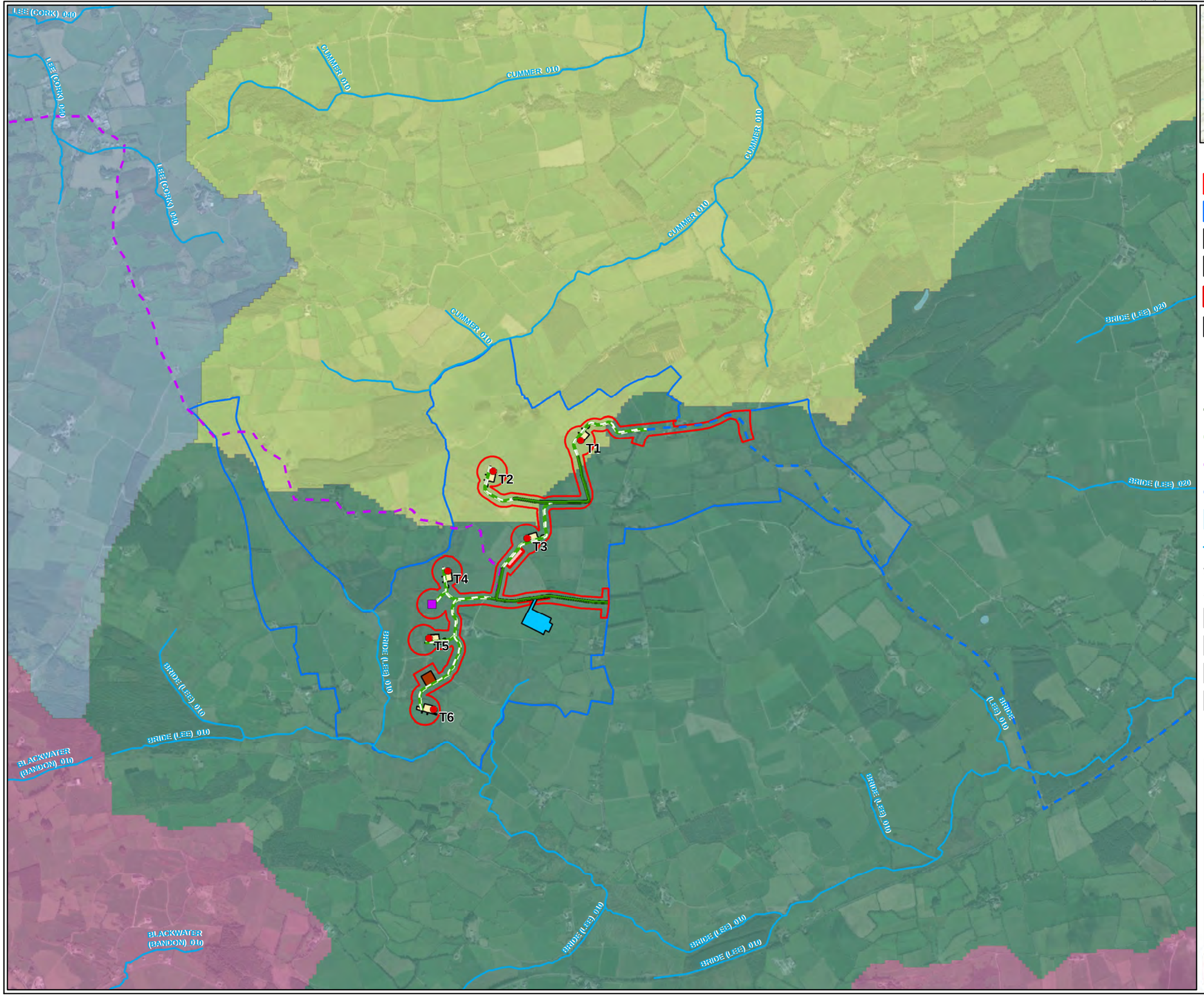
Organisation	Form of Consultation	Relevant comments in Outcome
Inland Fisheries Ireland	Date of Response – 19 December 2022 – From Michael Mc Partland.	Reply stated the Proposed Windfarm and associated works pose significant risk of negative impact on fisheries primarily during various elements of the construction phase including site preparation, construction and upgrading of access roads and crossings and the installation of the grid cable. IFI provided a list of planning conditions that need to be considered should permission be granted for the Proposed Development. Reply stated the proposed windfarm and associated works pose significant risk of negative impact on fisheries primarily during various elements of the construction phase including site preparation, construction and upgrading of access roads and crossings and the installation of the grid cable. IFI provided a list of planning conditions that need to be considered should permission be granted for the Proposed Development.
		Consultation with the Department of Agriculture, Food and the Marine (DAFM) was undertaken in June 2014. DAFM responded to the consultation letter, dated June 2014, setting out the issues which the Department wished to be considered in the EIAR. The Department requested that, if any trees are to be felled as part of the development, that the developer was cognizant of felling licence requirements and took account of the Forest Service policy in this regard. No forestry felling is proposed as part of this development. The Department also recommended that any potential impacts on agriculture/agricultural activities, such as soil stability, water quality, noise and shadow flicker are considered. Comments raised in the response have been dealt with throughout the EIAR.

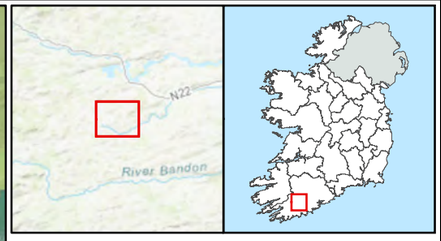
7.3 Existing Environment

7.3.1 General Description of the Catchments

The study area is located within Hydrometric Area No. 19 (HA 19) (Lee, Cork Harbour and Youghal Bay) of the Irish River Network System and is situated in the South Western River Basin District (SWRBD). The site is located within two waterbody catchments. The Water Framework Directive (WFD - 2000/60/EC) mapping shows the Proposed Development to be situated within the waterbody catchments as shown in Figure 7-3 – Waterbody Catchment Map.

Path: R:\Map Production\2021\P21-143\Workspaces\EIAR\P21-143_GIS_Fig7_3_Waterbody_Catchment_Map_A3.mxd





Legend

- Development Planning Boundary
- Study Area
- Proposed Substation
- Turbine Hardstandings
- Proposed Temporary Construction Compound
- Proposed Borrow Pit
- Proposed Met Mast
- Proposed Turbine Layout
- Tracks-Existing
- Tracks-Proposed
- Alternative Grid Connection Route
- Turbine Delivery Route
- WFD Lake Segments
- WFD River Water Bodies

WFD Sub Catchments

Sub Catchment Name

- Bandon_SC_030
- Lee[Cork]_SC_010
- Lee[Cork]_SC_030
- Lee[Cork]_SC_050

TITLE: Waterbody Catchment Map			
PROJECT: Barnadivane Wind Farm and Substation, Co. Cork			
FIGURE NO:	7.3		
CLIENT:	Barna Wind Energy Ltd. & Arran Windfarm Ltd.		
SCALE:	1:20000	**REVISION:**	0
DATE:	23/02/2023	**PAGE SIZE:**	A3

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Within the region, the surface water drainage and hydrology are delineated into three levels of hierarchy under the WFD: catchment, sub-catchment and sub-basin. Table 7.3 summarizes the delineated water drainage and hydrology within the Proposed Development.

Table 7-5: WFD delineated waterbodies within the wind farm site ad GCR

Catchment	Sub-catchment	Sub-Basin
SW_Lee228Bride_Bride_Bride_3 Upper	Lee (Cork)_SC_050	Bride (Lee_010).
		Bride (Lee_020).
SW_Lee228Main_1Buingea	Lee (Cork)_SC_030	Cummer_010

- The River Bride rises at an elevation of 220 m OD between Moneygaff East and Reanacaheragh to the southwest of the site. It flows firstly in an easterly direction along the southern boundary of the site and then turns in a south easterly direction, as it flows away from the site from the south eastern corner of the site. It then follows the R585 regional road for approximately 5 km. The River Bride continues through Beal na Blath and Crookstown and then follows the N22 eastwards to Ovens. The River Bride joins the River Lee just to the north east of Ovens, near Ballincollig.

  An area of approximately 198 ha within the site boundary drains into this waterbody. Four turbines, along with the proposed borrow pit, the met mast and approximately 3.55 km of new tracks are proposed within this catchment, of which 2 km will follow the route of an existing track, which is proposed to be upgraded.

- The River Cummer rises at an elevation of 210 m OD between Barnadivane and Knockane to the north of the site. It flows in a north easterly direction. It joins the Buingea River at Carrigdarrery. The Buingea River continues north and enters the Lee Reservoir after approximately 1.3 km. The River Lee Reservoir passes through dams at Carrigadrohid and Inishcarra and flows through Ballincollig and Cork City, before flowing out into Cork Harbour through Loughmahon.

  An area of approximately 76 ha within the site boundary drains into this waterbody. Two turbines, along with approximately 0.65 km of new tracks are proposed within this catchment, of which 0.35 km will follow the route of an existing track, which is proposed to be upgraded.

7.3.2 Rainfall

The average annual rainfall in the period 1981-2010, recorded at Cork Airport, is 1227.9mm. This long-term meteorological station is c.32 km East of the Proposed Development. The long-term average rainfall at the site of the Proposed Development may be higher than this due to relief rainfall as it is located at a higher elevation than Cork Airport.

The M5-60 predicted rainfall value (a sixty-minute storm that will occur with a frequency of once every five years) at the Proposed Development location is 18.7 mm according to the Met Éireann rainfall data.

7.3.3 Site Hydrology

There are no naturally occurring lakes or reservoirs within the site of the proposed development. There is a man-made surface water body in the eastern part of the site, located c.350 m along the access track from the entrance that is understood to be the lagoon from quarry workings.

All Proposed Wind Turbines have been located at least 50m from any main surface water receptor.

7.3.4 Historical Flooding

The national flood hazard mapping website, www.floodmaps.ie, does not indicate any record of flooding within 2.5 km of the site in either the tributaries or the main channel of the River Bride or the River Cummer. The nearest flood incident recorded by the OPW is at Teereeven, Poulanargid Ref. P4D403A – F310 – 010 – 004 – 3012, where the Area Engineer noted in the minutes of a meeting on 21 April 2005 that recurring road flooding occurs from the Cummer River (Flood ID 5173). This incident occurred just over 2.5 km to the north of the site boundary. Please Refer to Appendix 7.2 for more information.

Areas known as 'benefitting lands'[24] and a 'drainage district'[25] as defined in the OPW flood hazard mapping website have not been identified for this site.

The process for developing the pluvial flood extent maps was based on 'dropping' various depths and intensities of rainfall over a range of durations, and modelling how that rainfall would flow over the land and, in particular, pond in low-lying areas. There is no indication of pluvial flooding on the site of the proposed development.

The Lee Catchment Flood Risk Assessment and Management Study (LEECFRAMS) provides a detailed examination of the flood risk, with flood extent mapping provided in the lower section of the River Bride near Crookstown, however no studies were undertaken as part of the LEECFRAMS in the vicinity of the site.
The Geological Survey of Ireland (GSI) website www.gsi.ie provides information on subsoils for the site. The soil is topsoil and glacial till overlying sandstone/mudstone bedrock within the boundary of the site of the Proposed Development. The presence of alluvium can be an indicator of historic flooding. Alluvium is evident in the main channel of the River Bride, approximately 0.5 km to the south of the site boundary. The description of the soil, geology and hydrogeology of the site of the Proposed Development is discussed in more detail in Chapter 6 Soils, Geology and Hydrogeology.

7.3.5 Surface Water Quality

WFD water quality status and river waterbody risk associated with the Proposed Development are provided in Table 7.4.

The status of the Bride waterbody, tributary of the River Lee as shown in https://gis.epa.ie/EPAMaps/ is currently of 'good' status and is classified as 'not at risk' of failing to retain its status by 2015. The ecological status of this waterbody is monitored.

[24]A dataset prepared by the Office of Public Works identifying land that might benefit from the implementation of Arterial (Major) Drainage Schemes (under the Arterial Drainage Act 1945) and indicating areas of land subject to flooding or poor drainage.
[25]A dataset prepared on behalf of the Drainage Districts (Local Authorities with statutory responsibility for maintenance under the Arterial Drainage Act, 1925). These maps identify land that might benefit from the implementation of Arterial (Major) Drainage Schemes and indicate areas of land subject to flooding or poor drainage.

For water bodies along the Proposed Development the waterbody status is Good and Not at Risk.

Table 7-6: WFD River Status and River Waterbody Risk

Watercourses (as shown on Figure 7-3)	Waterbody	River Status	Waterbody Risk
Wind Farm			
Cummer	Cummer_010	Good	Not at Risk
Bride	Bridgetown (Clare)_010	Good	Not at Risk

Despite the current quality, surface waters will be treated the same in terms of the level of protection and mitigation measures employed (there will be no negative change in status). Strict mitigation measures in relation to maintaining a high quality of surface water runoff from the Proposed Development will ensure that the status of surface waterbodies in the vicinity of the site will be maintained, regardless of their existing status.

The EPA scheme of Biotic Indices or Quality (Q) Values was developed to determine the status of organic pollution in Irish rivers by assessing the occurrence of macro-invertebrate taxa with varying sensitivity to pollution. Biological Water Quality data was examined as part of this assessment.

Biological water quality ratings Q5, Q5-4 and Q4 relate to 'Unpolluted' status, Q3-4 relates to 'Slightly polluted', Q3 and Q2-3 relate to 'Moderately polluted' and Q2, Q1-2, Q1 relate to 'Seriously polluted' watercourse.

The nearest station, Station ID 19B040400, on the River Bride is at Hornhill Bridge, approximately 4.5 km downstream of the site boundary. The EPA's Q-values were indicated as Q4 (unpolluted) in 2020, with previous ratings of Q4 in 2017, 2014, 2011, 2008, 2005 and 2003. The ratings were considered to be mostly satisfactory with Good Ecological Quality and this trend continues further downstream. The exception to this is at the right-hand-side of the river at Crookstown (0610) where moderate pollution, due to a sewage discharge, was recorded in the 1999 report on the Biological Survey of River Quality Results. This location was seriously polluted in the previous survey of 1997. In the Interim Report on the Biological Survey of River Quality results of the 2003 Investigations, it is reported that the right-hand-side of the river at Crookstown (0610) was again seriously polluted, due to sewage discharges. There has been an improvement in 2017 and slightly deteriorated again in 2020 but under control.

Results of the 2003 Investigations, it is reported that the right-hand-side of the river at Crookstown (0610) was again seriously polluted, due to sewage discharges. There has been an improvement in 2017 but this deteriorated in 2020 but with improvements compared with the past records.

The nearest station, Station ID 19C020200, on the River Cummer is at a Bridge West of Dunmarklun, approximately 2 km downstream of the site boundary. The EPA's Q-values were indicated as Q4 (unpolluted) in 2011, with previous ratings of Q4 in 2008, Q4 in 2005 and Q4 in 2002. The ratings were considered to be mostly satisfactory with Good Ecological Quality and this trend continues downstream in other stations at Ahagearagh Bridge and Athsollis Bridge.

Table 7-7: EPA Biological Water Quality Ratings

Station ID	Station Name	1990	1994	1997	1999	2002	2003	2005	2008	2011	2014	2017	2020
19B040400	Hornhill Br	4	4	4	4	-	4	4	4	4	4	4-5	4
19B040600	Br at Crookstown LHS	4-5	4	4	4	-	4-5	4	4-5	4	4-5	4-5	4
19B040610	Br at Crookstown RHS	-	3	2	3	-	2	2-3	4-5	2-3	3-4	4-5	3-4
19B040900	Coolmucky Br	5	4-5	4	4-5	-	4-5	4-5	5	4-5	4-5	4-5	4
19C020200	HBr W of Dunmarklun (Br W of Elmglyn)	-	4	4-5	4	4	-	4	4	4	4	4	4
19C020300	Br SW of Teereeven	5	4	4	4	4	4-5	4-5	4-5	4-5	4-5	3-4	3-4
19B020500	Ahageragh Br (Br NNE of Teereevan)	-	4-5	4-5	4-5	3-4	-	4	-	4-5	4-5	4-5	4-5

7.3.6 Internal Main Wind Farm Site Drainage

Due to the rural nature of the site and the mild slope, there is minimal formal drainage within the site area, with natural runoff dispersing naturally via a combination of infiltration, evapotranspiration and overland flow.

7.3.7 Drains and existing road drainage

Existing tracks run through the site. Some of these tracks are agricultural tracks and are approximately 2-3 m wide. It is proposed to utilize existing tracks, in so far as possible to access the Proposed Turbines. The existing tracks will require strengthening and widening to achieve a track width of 5 m (minimum).

7.3.8 Drain Crossing Infrastructure

Where existing on-site access roads cross streams and drains, flows are generally conveyed within 450mm diameter culverts. The proposed infrastructure on site will not cross any existing water features.

7.4 Potential Impacts

The main potential hydrological impact of the Proposed Development is an increase in silt laden run-off to watercourses in the vicinity of the Proposed Development and to a lesser extent a very minor increase in runoff from a storm event, due to the change in land use and an increase in impermeable ground conditions.

During the construction period the development has the potential to introduce the following impacts on the existing hydrology and drainage at the site:

- spoil heaps from the excavations for the turbine foundations will be stored temporarily; if left exposed, this could lead to an increase in silt-laden run-off draining off site.
- excavations for drainage systems could disturb underlying soils.
- small diameter cross-drains could lead to blockages and consequent flooding and concentration of flows.
- drainage carrying overland flow from upslope could lead to high volumes of run-off eroding the drainage.
- crushing of stone in access tracks by heavy vehicles, creates fines and consequent oozing of soluble material in very wet weather out from the tracks and into the drainage conduits.
- standing water in the excavations will contain an increased concentration of suspended solids as a result of the disturbance to the underlying soils.
- silt carried on the wheels of vehicles leaving the site could be carried onto the public road.
- an increase in impermeable surfaces could result in an increase in surface water run-off from the Proposed Development.
- wet concrete operations could lead to contamination of receiving waters.
- suspended solids could potentially lead to siltation and consequent effects on flora and fauna in aquatic habitats.

- siltation arising from excavations at the site could impact on the water quality status of the receiving waters.
- refuelling activities could result in fuel spillages.
- sanitary waste could lead to contamination of groundwater.
- there is the potential for fuel spill/leaks from refuelling activities and storage tanks which will be stored on site for plant machinery.
- cable trenches could act as a conduit for surface water flows.
- open bodies of water present a risk to the safety of site personnel and the public.
- incorrect site management of excavations or material storage areas could lead to the release of suspended solids to surface waters.

There are no in-stream works or stream crossings required for this development.

The magnitude of the impact does not take into account the proposed mitigation measures, as detailed in Section 7.7.

7.4.1 Do Nothing Impact

If the Proposed Development does not proceed, the site will remain as the current land use for the foreseeable future. The hydrology of the site would remain as it is described in the baseline characterization. Surface water drainage and infiltration to ground will continue as it is occurring currently with no impact on either surface or groundwater.

7.4.2 Potential Impacts During Construction

7.4.2.1 Unmitigated Increase in Surface Runoff

Activities which change the land use to less permeable surfaces all have the potential to contribute to the increase in runoff due to changes in the finished surfaces. Planned project components such as, the construction of new access tracks, turbine hardstanding areas, the on-site substation and associated compound will increase surface runoff if unmitigated.

Pathway / Mechanism: Site drainage network, tributaries on site, access tracks.

Receptor: Waterbodies within and down gradient from the site of the Proposed Development, River Lee (Cork), regarding the Sub Catchments_030 and 050. All the relevant waterbodies are named in Section 7.3.

Pre-mitigation Impact: Direct, Negative, Reversible, Likely.

The significance of the effect of the increase in runoff at the site of the Proposed Development is **Moderate - Significant** on receiving waters due to the relatively small infrastructure footprint, predicted increases in the peak runoff is relatively low compared to the flows of receiving waters. This is without taking account of mitigation measures that will be put in place to slow runoff down to mimic pre-development conditions within the proposed wind farm drainage system.

7.4.2.2 Suspended Solids

The activities associated with construction of the Proposed Development will require earthworks. Potential sources of sediment laden water include:

- Standing water in excavations could contain an increased concentration of suspended solids as a result of the disturbance of the underlying soils.
- Haul roads passing close to watercourses could allow the migration of silt laden runoff into watercourses.
- Silt carried on the wheels of vehicles leaving the site could be carried onto the public road and enter associated highways drainage.
- A blockage in the proposed roadside drains could allow a breakout of silt laden runoff to reach adjacent watercourses or streams.
- Overland flow entering excavations could increase the quantity of surface water to be treated for sediment removal.
- Inappropriate management of excavations could lead to loss of suspended solids to surface waters.
- Inappropriate storage and management of the excavated material could lead to loss of suspended solids to surface waters.
- Surface water inflows and minor groundwater seepages may occur in turbine base excavations. Surface water inflows can occur following a rainfall event. Pumped water from the pits will most likely contain suspended solids.

Pathway / Mechanism: Drainage and surface water discharge routes.

Receptor: Waterbodies within and down gradient from the site of the Proposed Development, River Lee (Cork), regarding the Sub Catchments_030 and 050.

Pre-mitigation Impact: Direct, Negative, Short Term, Likely.

These activities can result in the release of suspended solids to surface watercourses and could result in an increase in the suspended sediment load. This could result in increased turbidity that in turn could affect the water quality, aquatic ecology and fish stocks of downstream water bodies. Suspended solids, in small amounts, can have potentially serious effect on the spawning sites of salmonids.

The significance of the effect of the release of suspended solids into the receiving waters is "**Significant**" considering the sensitivity of the surface water body and the likelihood of occurrence.

7.4.2.3 Release of Cement-Based Products

Cement based product will be used in turbine foundation construction, substation and precast concrete structures.

- Cement-based products could lead to contamination of receiving waters in close proximately to the activity.

Pathway / Mechanism: Site drainage network, surface water bodies within the site/ downstream of the construction activity involving cement.

Receptor: Surface water bodies

Pre-mitigation Impact: Indirect, Negative, Brief, Unlikely.

Cement-based products are highly alkaline and corrosive, therefore leachate from these can have significant negative impacts on water quality. These generate very fine, highly alkaline silt (pH 11.5) and leachate that can physically damage fish by burning their skin and blocking their gills.

Entry of cement-based products into the site drainage system, into surface water runoff, and hence to surface watercourses or directly into watercourses represents a risk to the aquatic environment. Wet concrete and wash out of transport and placement machinery are the activities most likely to generate a risk of cement-based pollution.

7.4.2.4 Release of Hydrocarbons

Vehicles or generators could be a source of hydrocarbons during, for instance;

- Refueling activities that could result in fuel spillages, which could pollute groundwater and surface water.
- There is the potential for fuel spill/leaks from storage tanks which will be stored in the wind farm site compound. The risk is present on site throughout the lifespan of the windfarm though the risk is lower. Fuel spill/leaks could infiltrate underground and pollute underground water. Fuel spills/ leaks could pollute downstream watercourses.
- Tree felling processes require trafficking of heavy machinery that can lead to pollution of watercourses due to spillage of fuels and hydrocarbons.

Pathway / Mechanism: Site drainage network and groundwater flow paths.

Receptor: Surface water and groundwater.

Pre-mitigation Impact: Direct, Negative, Temporary, Unlikely.

Hydrocarbons have a high toxicity to aquatic ecology, including fish, and is persistent in the environment. It is also a nutrient supply for adapted micro-organisms, which can rapidly deplete dissolved oxygen in waters, resulting in death of aquatic organisms.

The significance of the effect of the release of the hydrocarbons into the receiving waters is **Moderate** due to the low likelihood and low quantities involved.

7.4.2.5 Contamination from Wastewater

Biological contamination from sanitary waste by leaking welfare units could lead to contamination of receiving waters.

Pathway / Mechanism: Leakage from a storage tank or tanker, site drainage network

Receptor: Surface water bodies within and down gradient of the site, in the vicinity of the substation compound area and welfare units

Pre-mitigation Impact: Indirect, Negative, Temporary, Unlikely.

Release of effluent from domestic wastewater has the potential to impact surface water quality.

The significance of the effect of the release of sanitary waste into the receiving waters is **Not Significant** because it is highly unlikely that sanitary waste could be released into the environment due to proposed location and management of welfare facilities during the construction stage and during the operational stage.

The significance of the effect of the release of suspended solids into the receiving waters is **Slight** because the excavation area for the grid connection, open at any one moment, are short (c.50m). With increasing proximity to a surface water body, the significance increases. Therefore, the quantities that can get into the receiving water are small as well.

7.4.3 Potential Impacts During Operation and Maintenance

Site access by vehicle/foot are the main likely sources of potential impact during the operational phase by pollution from spills and leaks of fuel, oil and chemicals from vehicles and maintenance works. Additionally, transformer oil will be used in cooling the transformers associated with the facility which creates potential for oil spills during any oil replacement activity or leaks during the operational phase, although the likelihood of this is low. There is no significant risk of sediment release to cause increase suspended solids in surface waters during the operational phase as vegetation will not be disturbed during this phase.

Pathway / Mechanism: Site drainage network and surface water bodies.

Receptor: Surface water bodies.

Pre-mitigation Impact: Indirect, Negative, Short-Term, Unlikely.

The significance of the effect of the release of the hydrocarbons into the receiving waters is **Not Significant** due to the low likelihood and low quantities involved.

7.4.4 Potential Impacts During Decommissioning

The potential impacts during decommissioning would be similar to those listed above for the Construction phase. There will be some disturbance to underlying soils during decommissioning works and therefore a resultant risk of silt laden run-off entering the receiving watercourse. The drainage and treatment facilities will remain in place and will serve to reduce any potential for a release of sediment. Any potential impacts would be likely to be less than during the construction stage as the drainage swales would be fully mature and would provide additional filtration of runoff. Any diesel or fuel oils stored on site would be bunded. It is not envisaged therefore that decommissioning will involve any significant impacts on the hydrological regime or on surface water quality.

Potential hydrocarbon and sediment release.

Pathway / Mechanism: Site drainage network and surface water bodies.

Receptor: Surface water bodies.

Pre-mitigation Impact: Indirect, Negative, Short-Term, Unlikely.

As the hard standing infrastructure will remain in place the sediment disturbance is not significant during the disassembly. Potential impacts are similar to the construction phase but less significant as there is no invasive works breaking ground and it is mainly associated with the dis-assembly of the above ground components of the turbines. The potential receptors are the same as the construction phase. The significance of the effect of the release of the hydrocarbons into the receiving waters is **Slight** due to the low likelihood and low quantities involved.

7.4.5 Potential Impacts from Flooding

It is unlikely that flooding will have a potential impact to the development and areas downstream of it.. The area of the Proposed Development is not located in any Flood Zone, there's no potential risk to have potential impacts from Flooding for all the infrastructures provided.

Potential impacts of flooding to downstream areas as a result of the Proposed Development include:

- Increased rate and volume of surface water runoff as a result of increased impermeable area flowing off site;
- Loss of flood storage within a river catchment when new buildings, infrastructure and areas of raised ground are present within the flood plain;
- Diversion of natural river and overland flow flood flow routes, caused by new structures and modified ground levels, increasing flood risk to downstream areas previously unaffected; and
- Mobilisation of sediments and pollutants within surface water runoff from the Proposed Development.

7.4.6 Potential Cumulative Impact

7.4.6.1 General cumulative impact from Other Developments

As part of the assessment of cumulative impacts, planning searches were undertaken using the following online planning enquiry portals to search for large scale developments within 20km of the site:

- Cork County Council
- Kerry County Council
- An Bord Pleanála

Relevant projects, that are likely to have an impact on Hydrology, in proximity to the proposed project are listed in Table 7.5

Table 7-8 Potential Cumulative Impact from Other Developments

Development (Named Developer)		Distance from the Site (km)	Status	Interface	Potential Cumulative Impact
Construction of 96 no. residential units, a creche and all ancillary works (CEPL Ltd.)		8.5km N	Further Information	Groundwater Runoff	Negligible Small Adverse
Construction of 106 no. residential buildings and creche (Massey Development Ltd.)		8.5km N	Application Finalised	Groundwater Runoff	Negligible Small Adverse
Wastewater treatment scheme (Irish Water)		11.5km WNW	Conditional	Groundwater Percolation	Negligible Small Adverse
Carrigarierk Wind Farm – planning application does not include construction of turbines (Keel Energy Ltd.)		13km WSW	Conditional	Runoff	Negligible Small Adverse
Cleanrath Windfarm (Cleanrath Windfarm Ltd.)		14.5km WNW	Conditional	Groundwater Runoff	Negligible Small Adverse
Cahernafulla Wind Farm (Michael Murnane)		15km NNE	Conditional	Groundwater Runoff	Negligible Small Adverse
Cahernafulla Wind Farm (Burren Energy Ltd.)		15km NNE	Application Finalised	Groundwater Runoff	Negligible Small Adverse

The cumulative developments summarized in Table 7.7 Potential Cumulative Impact from Other Developments have been permitted with the exception of CEPL Ltd.'s application where a request for further information has been made. If construction for these projects overlap or run concurrently with the Proposed Development there may be a supply issue with local quarries providing imported aggregate.

7.4.6.2 AGCR Potential Cumulative Impact

The alternative grid connection route (AGCR) will generally run within, or adjacent to, existing public highways which are assumed to be served by formal drainage systems or shed surface water to adjacent verges. Any agricultural land crossed by the cable trench will presently drain naturally via infiltration, evaporation and overland runoff.

The following potential impacts could result from the construction activities related to grid route installation and associated watercourse crossings:

- Suspended solids drained to watercourse could potentially lead to siltation and physical effect on flora and fauna.
- Excavated soil could be mobilized in the surface water runoff during an extreme rainfall event.
- The excavation of trenches for cable laying, and the launch and reception areas for directional drilling, could lead to silt-laden surface water run-off.
- Inadequate storage of fuels and oils could lead to contamination of surface water.
- Refuelling activities could result in fuel spillage.
- Works leading to erosion of the riverbanks/bed could negatively impact on the fisheries habitat.
- Drilling fluids (e.g. bentonite) associated with HDD works at the four locations could pollute watercourses either from poor management of bentonite or breakout into the channel during drilling.
- Sediment-laden runoff during the launch pit and reception pit excavation works.

The key potential impacts are related to suspended solids and spillage of hydrocarbons;

Suspended Solids

Grid connection and HDD activities can result in the release of suspended solids to surface watercourses and could result in an increase in the suspended sediment load, resulting in increased turbidity which in turn could affect the water quality, aquatic ecology and fish stocks of downstream water bodies.

Pathway / Mechanism: Surface water discharge routes or HDD breakout.

Receptor: Waterbodies down gradient from the grid connection and HDD.

Pre-mitigation Impact: Direct, Negative, Temporary, Low Probability.

Hydrocarbons

Similar to construction on site during construction, hydrocarbon pollution from spills or leakage of fuel and oil from use of machinery has the potential to occur from sources such as from machinery leakage.

Pathway / Mechanism: Site drainage network and groundwater flow paths.

Receptor: Waterbodies downstream from the grid connection and waterbodies at Horizontal Directional Drilling locations.

Pre-mitigation Impact: Direct, Negative, Temporary, Low Probability.

The significance of the effect of the release of the hydrocarbons into the receiving waters is **Not Significant** due to the low likelihood and low quantities involved and there is no direct hydrological connectivity between the grid connection and River Lee SAC.

The AGCR crosses 15 watercourses as shown in Carrigerierk Wind Farm, Co. Cork, in 15730 EIS Appendix 3-1 application.

Good industry practice such as pollution prevention measures detailed in Pollution Prevention Guidelines / Guidance for Pollution Prevention (PPG/GPP) PPG1, GPP21 and GPP22 would reduce the risk and the overall impact if a spill or leakage were to occur. The increase in runoff due to AGCR is not anticipated because the finished surfaces are not changed. The impact of the ACGR is anticipated to be **Not Significant** to the hydrological environment as existing roads will be used and only temporary, minor vegetation trimming is anticipated to be required.

The majority of the cable route will be located away from areas of Flood Zone A, B and C as Shown in Section 7.5.5.1 - Figure 7.5, and it is considered that there would be no impact on fluvial flooding in these locations as a result of the Proposed Development.

Where the cable route crosses smaller watercourses, this will generally be done within an excavated trench. For larger watercourses, horizontal directional drilling (HDD) will be used to pass the cable beneath the channel.

With appropriate control measures in place during construction there will, therefore, be no impact on flood plain storage or fluvial flood flow routes as a result of the consented AGCR.

Where the cable route crosses agricultural land the trench will be infilled and reinstated as per the existing condition. There will be no increase in impermeable area or changes in topography and it is considered that there will be no impact on surface water flooding as a result of the consented AGCR.

The risk of surface water and groundwater flooding is considered to be low during the installation of the underground AGCR cable. Installation methods during the construction phase, utilising HDD or the damming and temporary diversion of watercourses, will mean that the underground cable route will also be at a very low risk of fluvial flooding during the construction phase. Trenches will be back-filled and restored to their existing pre-construction surface condition and ground level, meaning that there will be no impact on the rate of surface water runoff, flood plain storage or flood flow routes

TDR Potential Cumulative Impact

The TDR will follow existing the existing Knockboy road and cross the Bride Lee River SAC just south of Hornhill and then running along the R585 Road.

The following potential impacts could result from the construction activities related to delivery route installation and associated watercourse crossings:

- Suspended solids drained to watercourse could potentially lead to siltation and physical effect on flora and fauna.
- Excavated soil could be mobilized in the surface water runoff during an extreme rainfall event.
- The excavation of trenches for cable laying, and the launch and reception areas for directional drilling, could lead to silt-laden surface water run-off.
- Inadequate storage of fuels and oils could lead to contamination of surface water.
- Refuelling activities could result in fuel spillage.

- Works leading to erosion of the riverbanks/bed could negatively impact on the fisheries habitat.
- Drilling fluids (e.g. bentonite) associated with HDD works at the four locations could pollute watercourses either from poor management of bentonite or breakout into the channel during drilling.
- Sediment-laden runoff during the launch pit and reception pit excavation works.

The key potential impacts are related to suspended solids and spillage of hydrocarbons;

Suspended Solids

Grid connection and HDD activities can result in the release of suspended solids to surface watercourses and could result in an increase in the suspended sediment load, resulting in increased turbidity which in turn could affect the water quality, aquatic ecology and fish stocks of downstream water bodies.

Pathway / Mechanism: Surface water discharge routes or HDD breakout.

Receptor: Waterbodies down gradient from the grid connection and HDD.

Pre-mitigation Impact: Direct, Negative, Temporary, Low Probability.

Hydrocarbons

Similar to construction on site during construction, hydrocarbon pollution from spills or leakage of fuel and oil from use of machinery has the potential to occur from sources such as from machinery leakage.

Pathway / Mechanism: Site drainage network and groundwater flow paths.

Receptor: Waterbodies downstream from the grid connection and waterbodies at Horizontal Directional Drilling locations.

Pre-mitigation Impact: Direct, Negative, Temporary, Low Probability.

The significance of the effect of the release of the hydrocarbons into the receiving waters is **Not Significant** due to the low likelihood and low quantities involved and there is no direct hydrological connectivity between the delivery connection and River Lee SAC.

It is highly unlikely there will be replacement of any large wind turbine components during the operational phase therefore the TDR will not be affected during this time.

There is potential risk of the spillage of hydrocarbon pollutants. Good industry practice such as pollution prevention measures detailed in Pollution Prevention Guidelines / Guidance for Pollution Prevention PPG1, GPP21 and GPP22 would reduce the risk and the overall impact if a spill or leakage were to occur during the turbine delivery along the TDR.

The increase in runoff due to TDR is not anticipated because the finished surfaces are not changed. The impact of the TDR is anticipated to be **Not Significant** to the hydrological environment as existing roads will be used and only temporary, minor vegetation trimming is anticipated to be required.

7.4.6.3 Potential Impact of Cumulative Developments

The magnitude of the impact from these works on the water receptors is considered to be 'Small Adverse' in nature. The importance is considered to be 'Medium'. The rating of this potential cumulative impact is considered to be of **Slight significance.** The Impact Classification is negative, shot-term, indirect and has unlikely effects.

The rating of this potential cumulative impact is considered to be of **Imperceptible significance.** The Impact Classification is negative, shot-term, indirect and has unlikely effects.

7.4.7 Summary of Unmitigated Hydrological Impacts on Sensitive Receptors from Cumulative Developments

Considering the scale of change, relatively short timescales of construction and decommissioning activities, localized nature of change and footprint of the turbines and infrastructure on site, the unmitigated impacts on downstream sensitive receptors, the unmitigated hydrological impacts are **Slight to Not Significant.**

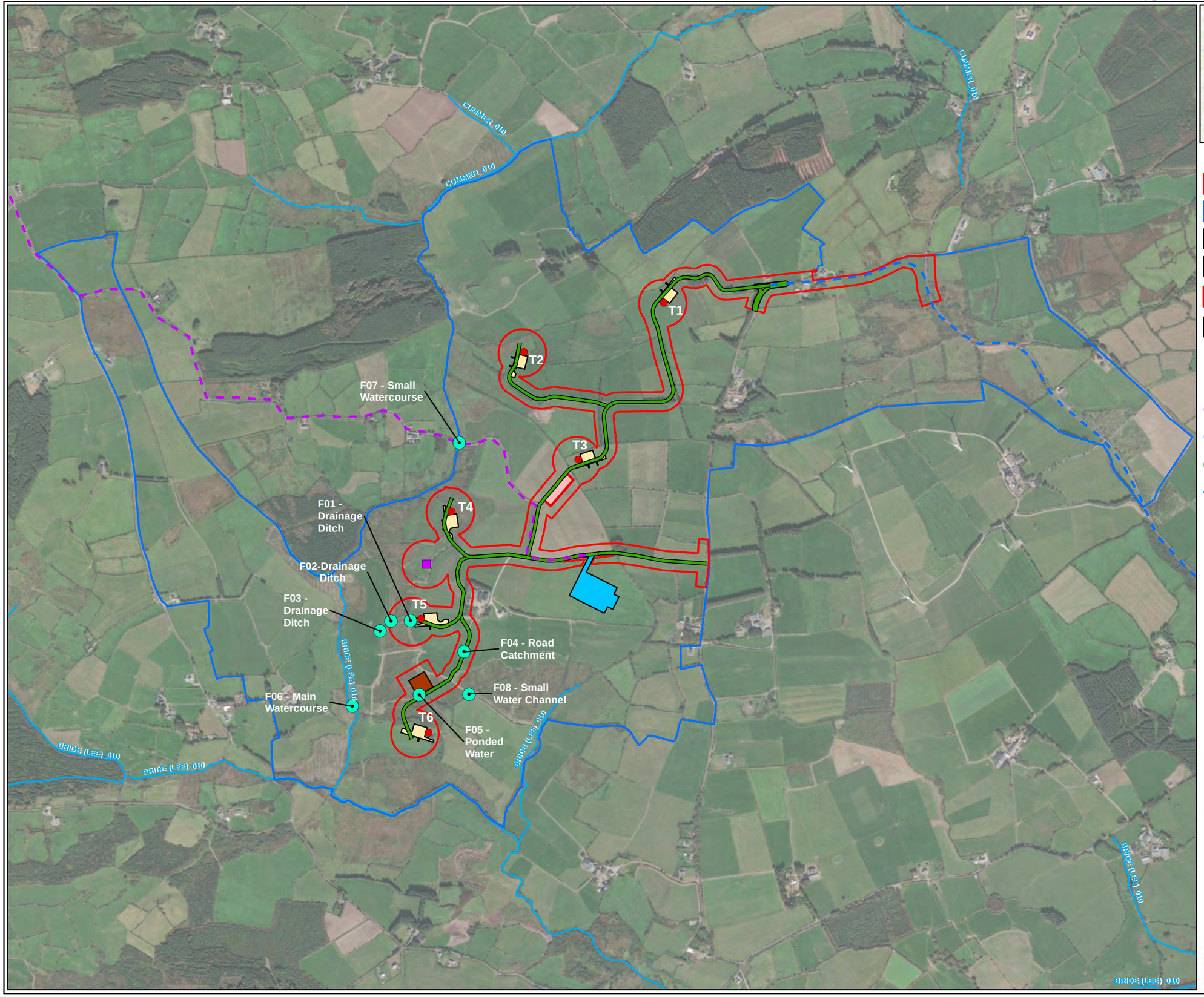
7.5 Flood Risk Identification

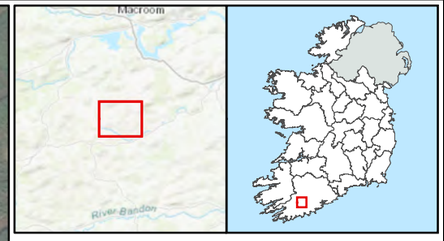
As part of the flood risk identification the following elements of the project have been assessed:

7.5.1 Site of the Proposed Development

The risk of an increase in flooding is of a very low significance and therefore a failure in mitigation measures provided by a blockage for instance in the stilling ponds would not have a significant effect on the receiving watercourses.

Path: R:\Map Production\2021\P21-143\Workspaces\EIAR\P21-143_GIS_Fig7_4_Surface_Water_Features_in_Vicinity_of_Wind_Farm_Site_A3.mxd





- Development Planning Boundary
- Study Area
- Proposed Substation
- Turbine Hardstandings
- Proposed Temporary Construction Compound
- Proposed Borrow Pit
- Proposed Met Mast
- Proposed Turbine Layout
- Alternative Grid Connection Route
- Turbine Delivery Route
- Roads - Proposed
- WFD River Water
- Hydrological Features

N W E S

0 0.25 0.5 1 Kilometers

TITLE: Surface Water Features in the Vicinity of the Wind Farm Site

PROJECT: Barnadivane Wind Farm and Substation, Co. Cork

FIGURE NO:	7.4		
CLIENT:	Barna Wind Energy Ltd. & Arran Windfarm Ltd.		
SCALE:	1:12500	**REVISION:**	0
DATE:	3/7/2023	**PAGE SIZE:**	A3

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The Proposed Development will comprise six wind turbines in northern and southern eastern areas, constructed on 25m diameter circular concrete foundations with adjacent areas of hardstanding to allow for the construction and assembly of the turbines. The Proposed Substation will be sited underneath the existing 110kv overhead line within an agricultural field in the central area of the Proposed Development, allowing for a loop-in loop-out connection to the existing grid network. The temporary construction compound will be located in the centre of the Proposed Development.

Internal access tracks will be used to provide access for vehicles during the construction, operation and decommissioning phases. Approximately 2.4km of new site access tracks are proposed at the development site. Access tracks will be 5m wide along straight sections, with wider sections on bends and turning areas.

7.5.2 AGCR

The Proposed AGCR will have a total length of approximately 18.75km and will be constructed within the public road corridor. The route follows unnamed road and reaches the site from the western part. The cable route then follows the existing unnamed road to the power station.

The cable will be installed in trenches within or adjacent to the public highways, with some sections crossing agricultural land. Trenches will be approximately 600mm wide and 1.2m deep and backfilled with concrete. The existing finished surface of the highway, verge and agricultural land will be reinstated as per its original condition.

7.5.3 Methodology

National Planning Policy

The Planning System and Flood Risk Management Guidelines for Planning Authorities (PSFRM Guidelines) was published in 2009 by the Office for Public Works (OPW). These outline the core objectives for the management of flood risk, including those for new planning applications. Flood risk is defined as a combination of two components:

- The likelihood/probability of flooding; and
- The consequences of flooding.

The PSFRM Guidelines divide geographical areas into three flood zones based on the probability of flooding:

- Zone A (High Risk): a probability of greater than 1 in 100 (1% Annual Exceedance Probability) for river flooding or 1 in 200 (0.5% AEP) for coastal flooding;
- Zone B (Moderate Risk): a probability of between 1 in 1000 and 1 in 100 (0.1% - 1.0% AEP) for river flooding and 1 in 1000 and 1 in 200 (0.1% - 0.5% AEP) for coastal flooding; and
- Zone C (Low Risk): a probability of less than 1 in 1000 (0.1% AEP) for both river and coastal flooding.

The PSFRM Guidelines are based on a 'sequential' approach to ensure that new development is directed towards land at a low risk of flooding. If a Proposed Development lies within a higher risk area, appropriate justification is required and measures for mitigating the flood risk are to be identified via the Justification Test.

The consequences of flooding depend on the hazards caused by flooding (e.g. depth of water, speed of flow, rate of onset and water quality) and the vulnerability of the receptor. Table 3.1 of the Guidelines, reproduced as Table 7.6 below, outlines the three vulnerability classifications and examples of the types of development included.

Table 7-9: Vulnerability Class and Development Types

Vulnerability Class	Example Land Use and Types of Development
Highly Vulnerable Development (including Essential Infrastructure)	• Garda, ambulance and fire stations and command centres required to be operational during flooding; • Hospitals; • Dwellings, student halls of residence, hostels, residential institutions (care homes, children's homes and social services homes), dwellings designed/constructed/adapted for the elderly or people with impaired mobility; • Caravans and mobile home parks; Essential infrastructure including primary transport and utilities distribution, electricity generating power stations and sub-stations, water and sewage treatment, and potential significant sources of pollution in the event of flooding.
Less Vulnerable Development	• Buildings used for retail, leisure, warehousing, commercial, industrial and non-residential institutions • Land and buildings used for holiday or short-let caravans and camping (subject to specific warning and evacuation plans) • Land and buildings used for agriculture and forestry • Waste treatment (except landfill and hazardous waste) • Mineral working and processing Local transport infrastructure
Water-Compatible Development	• Flood control infrastructure • Docks, marinas and wharves • Water-based recreation and tourism Amenity open space, outdoor sports and recreation and essential facilities

Table 3.2 of the Guidelines, reproduced in Table 7-10 below, states what types of development would be appropriate within each Flood Zone and those that would be required to meet the criteria of the Justification Test.

Table 7-10: Appropriate Development within Flood Zones

Vulnerability	Flood Zone A	Flood Zone B	Flood Zone C
Highly Vulnerable development (Including Essential Infrastructure)	Justification Test	Justification Test	Appropriate
Less Vulnerable Development	Justification Test	Appropriate	Appropriate
Water-Compatible Development	Appropriate	Appropriate	Appropriate

The OPW published the Flood Risk Management Climate Change Sectoral Adoption Plan for Flood Risk Management in 2015 (updated in 2019) and provides information on the potential changes in flood hazard as a result of climate change. The Plan outlines two potential future scenarios:

- Mid-Range Future Scenario (MRFS) -typical or near to the general average of future climate projections; and
- High-End Future Scenario (HEFS) – a more extreme future based on the upper end of the range of projections of future climatic conditions.

Table 5-1 of the Plan (reproduced as Table 7.11 below) shows the changes to flood-related parameters under both scenarios.

Table 7-11: Allowances Flood Parameters for Mid-Range and High-End Future Scenarios

Vulnerability	Mid-Range Future Scenario	High-End Future Scenario
Extreme Rainfall Depths	+20%	+30%
Peak Flood Flows	+20%	+30%
Mean Sea Level Rise	+500mm	+1000

A series of flood maps were produced in 2015 as part of the National Catchment based Flood Risk Assessment and Management (CFRAM) program. The mapping shows the extent of fluvial and coastal flooding in the present-day scenario, and the Mid-Range and High-End future scenarios.

A further series of flood maps were produced in 2019 as part of the National Indicative Fluvial Mapping (NIFM) project. The mapping extends to areas not covered by the 2015 CFRAM program and includes the present-day scenario, and the Mid-Range and High-End future scenarios.

7.5.4 Local Planning Policy

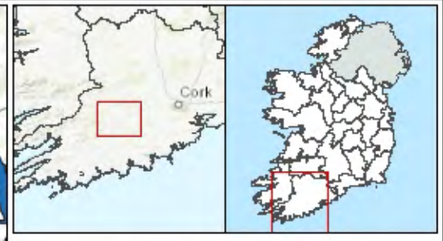
The County Cork Strategic Flood Risk Assessment (SFRA) provides a broad assessment of all types of flood risk to inform strategic land-use planning decisions within County Cork. The SFRA contains flood mapping, a Flood Risk Management Plan, and advice on zoning and land use proposals within settlements.

7.5.5 Flood Risk Identification – Risk to the Development

7.5.5.1 Proposed Development

Online CFRAM fluvial flood mapping shows that the site is not located in an area with a High, Medium or Low probability of fluvial flooding in the present day scenario (see Figure 7-5).

The NIFM fluvial mapping also shows that the site is not at risk of fluvial flooding in the present-day scenario (see Figure 7-6).



Legend

- Development Planning Boundary
- Study Area Boundary
- Proposed Substation
- Proposed Turbine Layout
- Alternative Grid Connection Route
- Turbine Delivery Route
- River - High Probability
- River - Medium Probability
- River - Low Probability

TITLE:	CRFRAM Flood Extents - Present Day		
PROJECT:	Barnadivane Wind Farm and Substation, Co. Cork		
FIGURE NO:	7.5		
CLIENT:	Barna Wind Energy Ltd. & Arran Windfarm Ltd.		
SCALE:	1:75000	**REVISION:**	0
DATE:	23/02/2023	**PAGE SIZE:**	A3

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Kilometers
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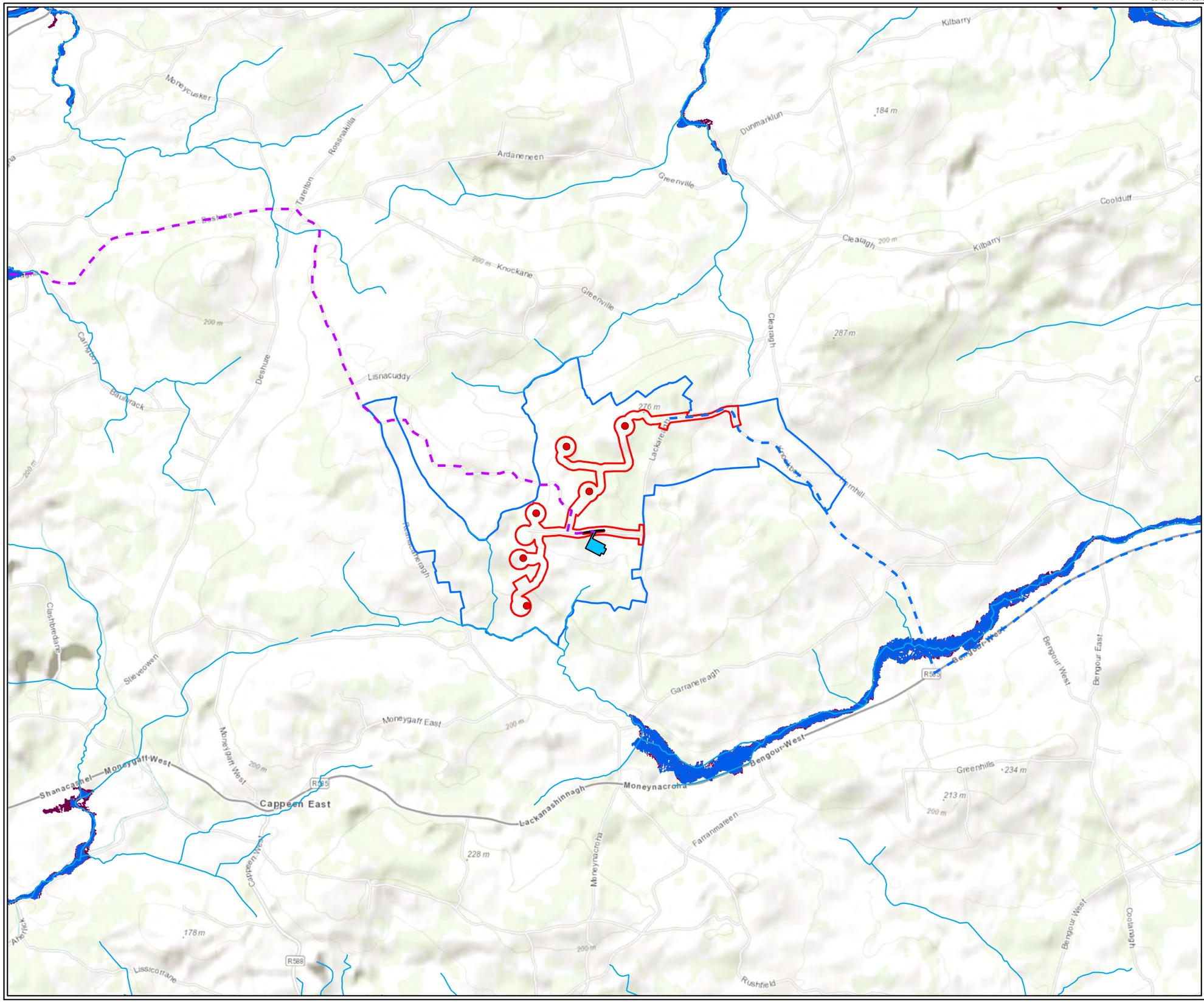
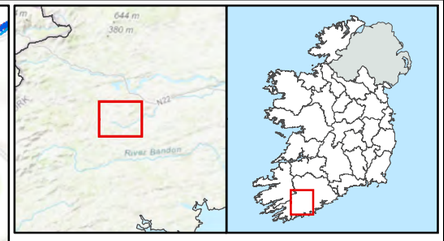
Path: R:\Map Production\2021\P21-143\Workspaces\EIAR\P21-143_GIS_Fig7_6_NIFM_Present_Day_A3.mxd





Legend

- Development Planning Boundary
- Study Area
- Proposed Substation
- Proposed Turbine Layout
- Alternative Grid Connection Route
- Turbine Delivery Route
- National Indicative Fluvial Mapping (NIFM) River Flood Extents - Present Day - Low Probability
- National Indicative Fluvial Mapping (NIFM) River Flood Extents - Present Day - Medium Probability

N W E S

0 1.25 2.5 5 Kilometers

TITLE: NIFM Flood Extents - Present Day			
PROJECT: Barnadivane Wind Farm and Substation, Co. Cork			
FIGURE NO:	7.6		
CLIENT:	Barna Wind Energy Ltd. & Arran Windfarm Ltd.		
SCALE:	1:30000	**REVISION:**	0
DATE:	23/02/2023	**PAGE SIZE:**	A3

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Whilst the NIFM project modelled smaller watercourses, which were not modelled as part of the CFRAM project, it is considered unlikely that the watercourses within the site were assessed. Due to the steep topography of the site, however, it is considered unlikely that there would be large areas of low-lying open ground where fluvial flooding could accumulate.

The Geological Survey Ireland (GSI) Groundwater Flooding Probability Maps show that the Proposed Development is not located in an area with an increased level of groundwater flooding.

7.5.6 Flood Risk Identification – Risk from the Development

7.5.6.1 Site of the Proposed Development

The site is not located within areas of Flood Zone A, B or C and it is considered that there will be no impact on flood plain storage or fluvial flood flow routes as a result of the Proposed Development.

The majority of site areas consist of agricultural land, with the only development being the series of access tracks extending through the site.

There will, therefore, be an increase in impermeable area as a result of the Proposed development. The rate and volume of surface water runoff could, therefore, increase during storm events. However, when compared to the total area of the site it is considered that the increase in impermeable area and subsequent impact on surface water runoff will be minimal.

Climate change could also impact on the risk of flooding as a result of the proposed development. Increases in rainfall intensity could increase the rate and volume of surface water runoff and flows within watercourses. As shown in Table 7.11, rainfall intensity could increase by between 20% and 30% in the mid-range and high-end future scenarios respectively.

Mitigation will, therefore, be required to ensure that the risk of fluvial flooding and surface water flooding to downstream areas is not increased as a result of the Proposed Development.

7.5.7 Summary of Flood Risk Identification and Assessment

It is considered that the site of the Proposed Development is at a very low risk of flooding from fluvial sources, surface water runoff or groundwater. Mitigation will be required to ensure that the Proposed Development does not increase the risk of flooding as a result of increased impermeable area, or impact on existing watercourses and overland flow routes resulting from the construction of access tracks.

The risk of flooding from all sources is also considered to be very low along the turbine delivery route.

7.6 Proposed Drainage During the Construction and Operational Phases

7.6.1 Overview

The Surface Water Management Plan for the construction, operational and decommissioning stages of the proposed development is contained in Appendix 7.3. The proposed drainage regime at the site will mitigate for any increase in flood risk and potential impacts on water quality as a result of the Proposed Development.

Surface water drainage features will be installed as part of the construction phase and retained where required during the decommissioning phase, ensuring that there would be no increase in the risk of surface water flooding to off-site areas during any phase of the Proposed Development.

The drainage strategy within internal areas of the Proposed Development will incorporate three main components of Sustainable Drainage Systems (SuDS):

- Interceptor drains;
- Swales; and
- Settlement Ponds

A conceptual plan of the proposed drainage regime is included as Figure 7.7 below.

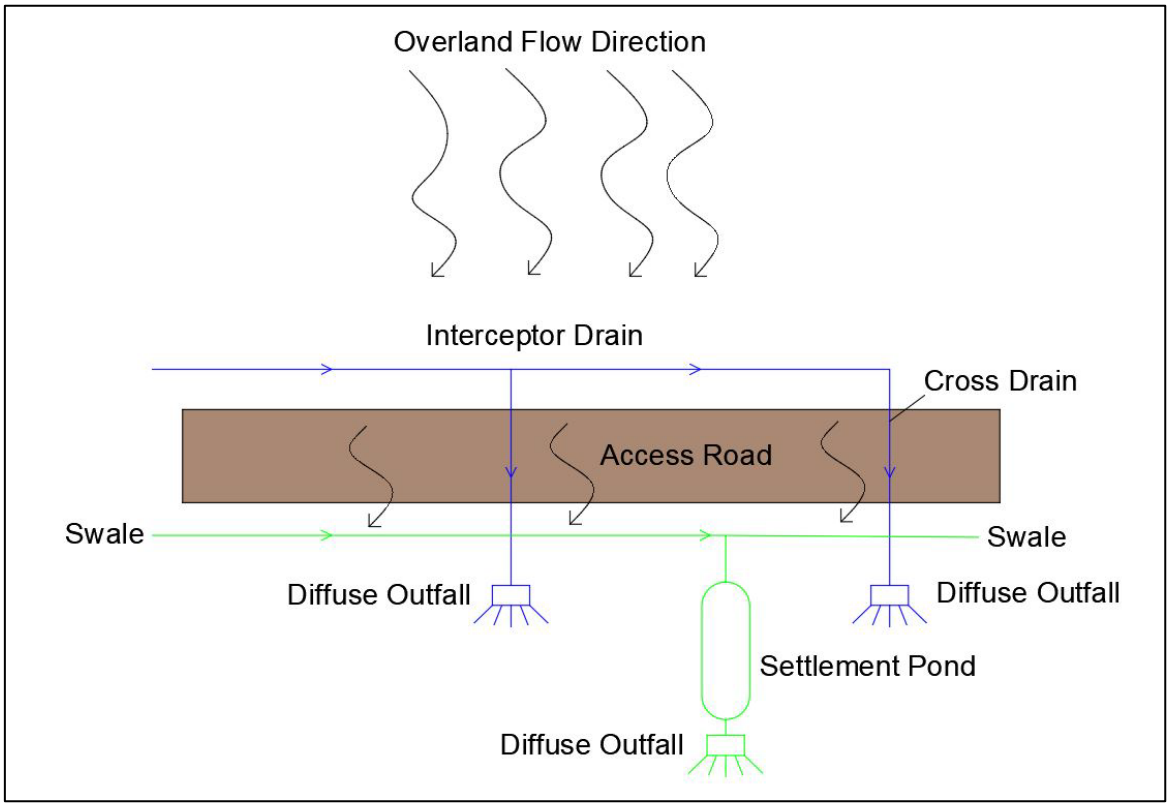

Figure 7-7: Drainage Design Principles

7.6.2 Existing Undeveloped Areas

Interceptor drains will be constructed upslope of areas of hard standing and new sections of access tracks. These will intercept overland flows from areas of undeveloped land, preventing mixing with runoff from access tracks and hard surfaces. These channels will direct flows around areas of hardstanding and across access tracks via cross drains at regular intervals. Flows will then be discharged diffusely across vegetated areas to minimize erosion and encourage evapotranspiration and infiltration to groundwater as per the existing drainage regime at the site. Interceptor drains will be installed as part of the construction phase.

Where interceptor drains have a gradient of greater than 2%, crushed rock 'check dam' structures will be installed at regular intervals to reduce the velocity of the flows and prevent erosion.

7.6.3 Existing Tracks and Surfaced Access Roads

Existing access tracks are generally drained by adjacent drainage ditches and swales. These drainage features will be retained and upgraded where necessary to the same standard as the proposed drainage design. Where existing tracks are widened, existing drainage will be realigned or replaced. The replacement sections of drain shall have a similar gradient and width as existing channels to ensure the flow rate and capacity of the existing channel is retained and adequate for the contributing area.

All track widening will be undertaken using clean, uncrushable aggregate to allow for some dispersal of surface water runoff via infiltration and, therefore, reduce the rate of surface water runoff generated.

7.6.4 Proposed Access Tracks and Hard Surfaces

The proposed internal access tracks will also generally be constructed using unbound aggregate materials which will allow a portion of surface water runoff to disperse via infiltration.

Vegetated swales will be installed adjacent to new access tracks and areas of hardstanding. These swales will be 0.3m in depth with 1 in 3 side slopes. Swales will be installed downslope of access tracks and hardstandings where coincident with the topography and will provide some attenuation for the surface water runoff during storm events.

Geotextile silt traps will be installed across the swales during the construction phase to prevent the ingress of silt into the watercourse and will remain in place until the vegetation has been established.

Where swales are constructed on slopes of greater than 2%, check dams will be installed at regular intervals to reduce flow velocities. By reducing flow rates, the check dams can also provide upstream storage within the swale allowing some dispersal via infiltration close to source rather than conveying all flows to a single larger downstream drainage feature, in accordance with the principals of SuDS.

Settlement ponds will be installed as construction progresses in order to provide mitigation during construction works, and will be designed in accordance with CIRIA C648 (Control of water pollution from linear construction projects). Ponds will be less than 1.5m deep with 1 in 3 side slopes. Runoff from roads and infrastructure within the proposed swale networks will be discharged to these ponds and will be temporarily retained to allow for the settlement of sediment and suspended solids. During the construction phase, standing water from excavations will be pumped to settlement ponds and there will be no direct discharge to the existing drainage network prior to treatment.

Settlement ponds will not discharge directly to watercourses. Treated water will be discharged diffusely via an outfall to disperse via overland flow or into natural drainage features as per the existing regime. Discharge will be restricted to a rate at or below the existing greenfield runoff rate during storm events, and the ponds will be sized to accommodate flows for all storm events up to and including the 1 in 100 year event.

The settlement ponds will also contain surface water runoff in the event of a spill or leak, and the outflow can be closed off to retain any potential pollutants within the settlement ponds prior to any necessary treatment.

7.6.5 Drainage of Temporary Site Compound

The proposed construction compound will be drained in a similar manner as the Proposed Wind Farm, with surface water runoff from undeveloped areas intercepted and dispersed naturally, and surface water runoff from areas of hardstanding intercepted by swales and conveyed to settlement ponds as shown in Figure.7.8.

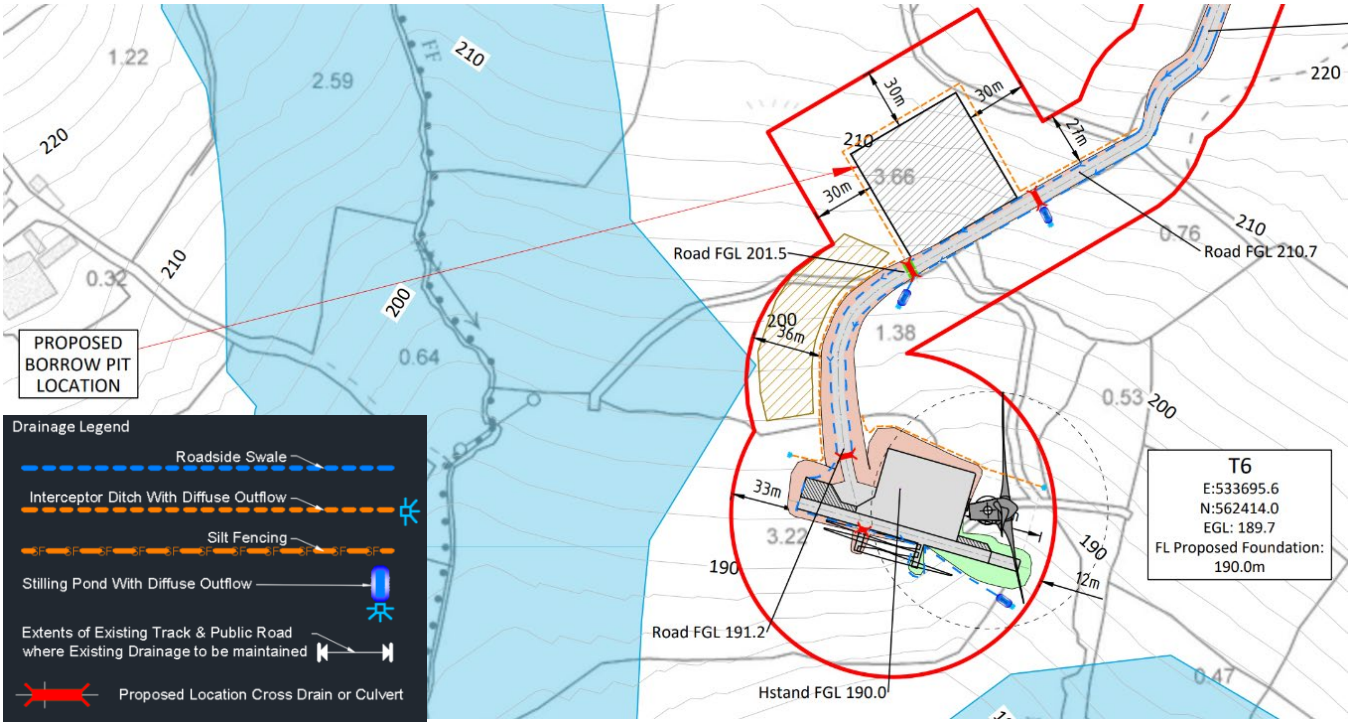

Figure 7-8: Proposed Drainage Layout

There will be no discharge of foul flows from welfare units, with water retained in holding tanks and removed from site by a contractor.

7.6.6 Drainage of Proposed Substation

The Proposed Substation will be drained via free surface water drainage swales on the substation's Eastern and Southern perimetral area into a stilling pond with a diffusor. The network will also utilise linear drainage channels and filter drains. The network will discharge overland via drainage ditches to a settling pond.

Following SuDS best practice, it is proposed to include a rainwater harvesting tank from the roof area of the control Buildings. Rainwater will be filtered and stored within the underground tank for reuse.

There will also be no discharge of foul flows from welfare units within the Proposed Substation, with water stored in underground tanks and managed by the contractor.

7.6.7 Proposed Watercourse Crossings

There will be no watercourse crossings within the Proposed Development.

7.7 Proposed Mitigation Measures

7.7.1 Overview

The proposed surface water drainage strategy and construction techniques will also provide mitigation to ensure that there is no impact on water quality downstream of the site as a result of the Proposed Development.

The surface water management plan will include a Surface Water Quality Monitoring Programme. Monitoring will be undertaken at least 12 months prior to construction commencing to enable baseline conditions of surface water quality to be locally well established on the surface water receptors. This will be undertaken in co-ordination with aquatic ecology surveys to understand the baseline biodiversity.

Surface water sampling will be carried out to establish a baseline for water quality for the receiving waters of the Proposed Development. Water sampling will be coordinated with the aquatic ecological assessment to ensure comparability. Regarding acceptable water quality, as guidance, European Communities Environmental Objectives (Surface Water) Regulations S.I. 272 of 2009, (EOSWR 272/09) thresholds are shown in Table 7.12.

The following parameters will be measured in order to provide a comprehensive baseline of the biological water quality:

- pH.
- Alkalinity (mg $CaCO_3$/l).
- Total Ammonia (mg N/l).
- Molybdate Reactive Phosphorus MRP (mg P/l).
- Total Oxidised Nitrogen TON (mg N/l).
- Dissolved Organic Carbon DOC (mg C/l).
- Biological Oxygen Demand BOD (mg O_2/l).
- Chemical Oxygen Demand COD (mg O_2/l).
- Suspended solids (mg/l).

Table 7-12: Acceptable Chemical Conditions (European Communities Environmental Objectives (Surface Water) Regulations S.I. 272 of 2009, (EOSWR 272/09))

Parameter	Threshold Values (mg/L)
BOD	High status ≤ 1.3 (mean)
	High status ≤ 2.2 (95%ile)
	Good status ≤ 1.5 (mean)
	Good status ≤ 2.6 (95%ile)
Total Ammonia	High status ≤ 0.040 (mean)
	High status ≤ 0.090 (95%ile)
	Good status ≤ 0.065 (mean)
	Good status ≤ 0.14 (95%ile)
Molybdate Reactive Phosphorus (mg/l P)	High Status < 0.025 (mean) or <0.045 (95%ile) Good Status <0.035 (mean) or < 0.075 (95%ile)

7.7.2 Proposed Mitigation Measures for the Construction Stage

Best practice construction methods will be used during the construction stage to minimise impacts on water quality. Examples of further mitigative measures for key parts of the construction phase are identified below. These are outlined in more detail in the CEMP Chapter. For instance, regarding good practice associated with mitigating the risk of hydrocarbon release during construction, as stated in the SWMP, construction vehicles will be refuelled off-site, wherever possible. This will primarily be the case for road vehicles such as vans and trucks. Refuelling of mobile plant during construction will be carried out at the temporary construction compound. Any additional fuel containers, other than the fuel bowser, used for smaller equipment (such as generators, lights etc.) will be stored within additional secondary containment e.g. bund for static tanks or drip trays for smaller mobile containers. Taps/nozzles for fuels and storage containers for oils will be fitted with locks to ensure their use is controlled. Only designated trained and competent operatives will be authorised to refuel plant on site.

All tank and drum storage areas shall, as a minimum, be bunded, either locally or remotely, to a volume not less than the greater of the following:

a. 110% of the capacity of the largest tank or drum within the bunded area; or
b. 25% of the total volume of substance which could be stored within the bunded area.

Despite the area of the site delineated by the boundary, the footprint of the infrastructure and associated buffer of land changed on site is significantly less. This means the vast majority of the site will remain as its current land use. For instance, regarding the foundations of each turbine, each foundation is circular, with relatively narrow (25 m) diameter and (3.5m) depth. This is an inherent mitigation in design.

7.7.3 Proposed Mitigation Measures for Operation and Maintenance Stage

The proposed surface water management plan (SWMP) will ensure that there is no impact on water quality as a result of the Proposed Development. The proposed drainage system will provide several stages of treatment to surface water runoff from constructed areas, which follows the concept of a multi-stage SuDS 'treatment train'.

Interceptor drains installed upslope of access tracks and areas of hardstanding will divert surface water runoff from undeveloped land around the constructed areas to disperse naturally within open ground without mixing with the construction drainage.

The proposed swales will intercept surface water runoff from access tracks and areas of hardstanding. The grass within the swales will provide some filtration to remove a portion of silt and suspended solids. Silt traps will be provided upstream of outfalls from roadside swales.

The settlement ponds will be designed to provide sufficient retention time and a low velocity environment to allow suspended solids of a very small particle size to fall out of suspension prior to discharge. Additional treatment will be provided upstream of the settlement pond with the use of drainage stone at the inlet to provide filtration. In an emergency, the outfall from a settlement pond can be blocked to provide a temporary holding area for accidental spillages on site.

As stated in the SWMP, to adhere to CIRIA C753, part of the maintenance routine that will mitigate issues relating to surface water is to inspect the following: drains, cross-drains and culverts for blockages; outfalls to existing field drains and watercourses, existing roadside swales for obstructions; progress of re-vegetation.

The water quality will also be tested at outfalls at appropriate intervals (to be defined when informed) for 12 months to comprise the baseline monitoring regime pre-construction.

7.7.4 Proposed Mitigation Measure for Decommissioning Stage

The access tracks would remain in situ for land management purposes, after the end of the operational period. Additionally, the turbine foundations and hardstanding will remain in situ and be covered over with soil from the site to re-vegetate naturally. This inherently mitigates disturbance through decommissioning process. Silt protection procedures, similar to during construction will be re-instated for decommissioning. If there is perceived to be risk of erosion during inspection of the revegetated hardstandings then erosion control measures will be taken.

7.7.5 Proposed Mitigation Measures for Flooding

The Proposed Turbine Bases, new access tracks, widened existing access tracks and new compound areas will all increase the impermeable area within the site potentially increasing the rate and volume of surface water runoff during storm events.

All access tracks will be constructed from aggregate which will allow a portion of rainfall to infiltrate and, therefore, reduce surface water runoff. Adjacent swales will also intercept and retain surface water runoff allowing this to disperse naturally via infiltration and evapotranspiration. Where swales are installed on sloped ground, check dam structures will be used within the channels to provide storage, allowing a portion of the flows to disperse naturally.

Swales and drainage channels will discharge runoff from access roads and areas of hardstanding to settlement ponds. These will be suitably size to accommodate flows from storm events up to and including the 1 in 100-year storm event.

Settlement ponds will not discharge to a watercourse and flows from the ponds will disperse naturally within the catchment.

Watercourse crossings will be suitably sized to accommodate flows during the 1 in 100-year storm event, with no risk of impeding flows during extreme storm events and causing flooding upstream of the crossing.

The cable trenches will be excavated in dry weather where possible and infilled and revegetated where appropriate. There will, therefore, be no increase in the risk of flooding.

The surface water management system at the site will ensure that there will be no increase in the risk of fluvial or surface water flooding downstream as a result of the Proposed Development.

7.8 Residual Impacts

7.8.1 Residual Impacts during Construction Stage

As discussed in Section 7.4, the potential pre-mitigation impacts associated with construction of the six turbines and associated infrastructure are as follows:

- Increased surface runoff from change in surface.
- Release of suspended solids into surface water bodies via runoff from disturbed ground and tree felling.
- Release of cement-based products into surface water bodies via runoff.
- Release of hydrocarbons, such as fuel into surface water bodies via runoff.
- Contamination from wastewater such as temporary sanitary storages.

The effect of the impacts on hydrology and water quality will be mitigated with measures outlined in Section 7.7. This will ensure that the residual impacts of the construction stage are Not significant and there will be no perceivable impact on the receptors that are hydrologically connected to the

The significance of the effect of the release of the cement-based products into the receiving waters is **Moderate** because following best practice pollution prevention measures, it is unlikely that a huge amount of cement-based products could be released into the environment.

7.8.2 Residual Impacts during Operation and Maintenance Stage

The unmitigated potential impact during the operational phase of the site was not significant. Visual monitoring and water quality monitoring at appropriate intervals should be undertaken as precautionary measures to inform any required contingency mitigation measures during operation. The main risk to surface water is the release of hydrocarbons, such as fuel into surface water bodies via runoff. The residual risk is maintained as **Not Significant.**

7.8.3 Residual Impacts during Decommissioning Stage

The unmitigated potential impact during decommissioning is similar, although less than during the construction including:

- Increased surface runoff from change in surfaces to hard standings and other impermeable surfaces.
- Release of suspended solids from ground disturbance when covering hard standings with soil.
- Release of hydrocarbons, such as fuel into surface water bodies via runoff.
- Contamination from wastewater such as temporary sanitary storages.

Mitigated with measures outlined in Section 7.7 will ensure that the residual impacts of the construction stage are **Not significant** and there will be no perceivable impact, which are highly sensitive receptors that are hydrologically connected to the site.

7.9 Conclusion

The existing risk of flooding to the Proposed Development, will be minimal. The Proposed Development is not located within an area at risk of fluvial flooding. The site is not located in an area of groundwater flooding risk and the sloped topography means there would be few locations where large volumes of surface water runoff could accumulate.

Any increases in surface water runoff as a result of additional impermeable areas within the site will be managed at all stages of development by a surface water drainage network incorporating swales, drainage channels and settlement ponds. The network will be designed to retain high flows during storm events and allow these to disperse naturally, with no uncontrolled discharge to downstream areas.

The drainage features will also provide water quality benefits during all stages of works allowing for the filtration and settlement of suspended solids and a means of isolating runoff from pollution incidents.

The residual and cumulative impacts of the Proposed Development are overall **Not significant**. This will be achieved with the proposed mitigation measures detailed in Section 7.7.

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