7 AQUATIC ECOLOGY

7.1 INTRODUCTION

This chapter of the EIAR assesses the likely significant direct and indirect effects of the Project (**Figure 1.2, Figure 7.1 & Figure 7.2**) on Aquatic Biodiversity. The 'Project' refers to all elements of the application for the construction, operation and decommissioning of the Garrane Green Energy Project (**Chapter 2: Project Description**). In accordance with Article 3(1) of the EIA Directive (*i.e.,* the 2011 Directive as amended by the 2014 Directive (2014/52/EU), this chapter will identify, describe and assess the direct and indirect effects of the proposed Project on "(*b) biodiversity, with particular attention to species and habitats protected under [the Habitats] Directive 92/43/EEC and Directive [the Birds] 2009/147/EC*" in relation to the receiving aquatic environment during the construction, operation and decommissioning phases. The assessment will consider the potential for cumulative impacts on aquatic biodiversity arising from other existing, approved, or proposed developments in the surrounding area, to ensure a comprehensive evaluation of likely significant effects. Where adverse effects are predicted, the chapter identifies appropriate mitigation strategies therein. The assessment will consider the potential effects during the following phases of the Project:

- Construction of the Project
- Operation of the Project
- Decommissioning of the Project

Common acronyms used throughout this EIAR can be found in **Appendix 1.4**. This chapter of the EIAR is supported by Figures provided in **Volume III** and the following Appendix documents provided in **Volume IV**:

- Baseline Aquatic Ecology Survey Report in **Appendix 7.1**; and
- Fisheries Assessment Report in **Appendix 7.2**

A Construction and Environmental Management Plan (CEMP) is appended to the EIAR in **Appendix 2.1**. This document will be a key construction contract document, which will ensure that all mitigation measures, which are considered necessary to protect the environment during the construction and decommissioning phase are implemented. It will include and apply all of the construction and decommissioning phase mitigation described within the EIAR and incorporate any additional considerations or work programs required by planning conditions, if permitted. For the purpose of this application, a summary of the mitigation measures is included in **Appendix 18.1**.

7.1.1 Statement of Authority

This chapter has been written by Dr. Eddie McCormack and Aisling Hearty, M.Sc. (AQUAFACT). Dr McCormack has over 19 years in environmental consultancy specialising in freshwater and marine ecology. Aisling Hearty has over 6 years of work in environmental consultancy and has experience in multiple different areas of marine biology including taxonomy, sampling work, data analysis and ecological report writing.

AQUAFACT is an environmental consultancy based in Galway City. It has been in operation for almost 40 years, specialising in monitoring and managing resources in marine, freshwater and terrestrial environments. In February 2022 AQUAFACT joined the APEM group. APEM was founded more than 30 years ago and is one of Europe's largest specialist environmental consultancy companies. It offers high quality scientific expertise covering the investigation, monitoring and management of water and terrestrial environments with services including aquatic & ecological consultancy, field surveys, ornithological surveys, fisheries science, laboratory services, and aerial surveys. Furthermore, APEM has helped the environment industry to identify responses to issues such as invasive non-native species, recognised the importance of the natural capital approach and river restoration. Additionally, APEM has employed technological solutions including aerial surveys and digital data collection. In Ireland the APEM Group comprises AQUAFACT, Woodrow, APEM Ireland, and Macro Works.

7.1.2 Assessment Structure

In line with the revised EIA Directive and EPA guidelines (2022a) the structure of this Aquatic Ecology chapter is as follows:

- Assessment Methodology and Significance Criteria
- Description of baseline conditions at the Site
- Identification and assessment of significant effects to Biodiversity associated with the Project during the construction, operational and Decommissioning phases of the Project
- Identification of cumulative significant effects if and where applicable
- Mitigation measures to avoid or reduce the significant effects identified
- Identification and assessment of residual significant effect of the Project considering mitigation measures.

7.1.3 Assumptions and Limitations

Some general assumptions that have been made during preparation of this EIAR are set out below:

- In undertaking cumulative assessments, consented, but as yet un-built, developments have been assumed to have been built in accordance with and within the duration permitted by the associated grant of permission;
- Information provided by third parties, including publicly available information and databases, is correct at the time of publication;
- Local Authority and An Coimisiún Pleanála public planning registers reviewed as part of the assessment process are up to date; and
- Baseline conditions and assessments are accurate at the time of the surveys.
- Limitations are set out in their respective sections. While certain limitations were encountered during the assessment process, these have not compromised the overall comprehensiveness of the evaluation. All available data and best scientific knowledge were applied to ensure that the assessment remains robust. These limitations have not prevented the formulation of reasoned conclusions, nor have they affected the ability to determine the significance of potential effects with confidence.

7.2 ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

7.2.1 Assessment Methodology Aquatic Biodiversity

The general approach used for the evaluation of ecological receptors and assessment of significant likely effects for this current assessment is based on the '*Guidelines for Ecological Impact Assessment in the UK and Ireland*' (Chartered Institute of Ecology and Environmental Management, 2018 (Updated 2022)). The evaluation of ecological receptors contained within this report uses the geographic scale and criteria defined in the *Guidelines for Assessment of Ecological Impacts of National Road Schemes* (National Roads Authority, 2009).

7.2.1.1 Desktop Study

A desktop study review was carried out in August 2022 and again in April 2024 of existing data and records for fish, protected aquatic species and habitats (including Annex II & IV aquatic species and aquatic Annex I habitats), and invasive species listed under the Third Schedule of S.I No. 477 of 2011, European Communities (Birds and Natural Habitats) Regulations 2011 (as amended)) on watercourses at or hydrologically connected (*i.e.,* downstream) to the Project on the National Biodiversity Data Centre (NBDC) and National Parks and Wildlife Service (NPWS) websites.

The 'River Maigue Instream Biodiversity: Crayfish & Otters 2018' report, commissioned by the Maigue Rivers Trust and authored by Pascal Sweeney, provides a comprehensive biological assessment of instream habitats and species within the River Maigue catchment, County Limerick. The study focuses on freshwater macroinvertebrates, aquatic macrophytes, the white-clawed crayfish (*Austropotamobius pallipes*), and the Eurasian otter (*Lutra lutra*), both of which are protected under Annex II of the EU Habitats Directive.

The survey encompassed 30 sampling stations across the Maigue and its tributaries, extending from upland headwaters to the freshwater tidal zone at Adare with some stations in proximity to the Project Site. Key methodologies included kick-sampling for macroinvertebrates, quadrat-based macrophyte assessments, and licensed crayfish hand searches. Otter surveys involved spraint and print searches over 100m transects.

The biodiversity recorded included 110 macroinvertebrate taxa, with seven being new records for County Limerick, and 40 macrophyte taxa, although no rare plants were identified. The ecological status, assessed using EPA Q-values, indicated that only 10% of sites achieved High status, while two-thirds were rated as Moderate or Poor, primarily due to past arterial drainage works and diffuse agricultural runoff. Despite this, some recovery in habitat quality has occurred in recent years.

Crayfish were recorded at 22 of 30 sites, with population health rated from low to very high. The population displayed a healthy age structure, including juveniles, and no signs of disease such as crayfish plague or porcelain disease were detected. However, in more recent studies carried out in proximity to the Project Site, Crayfish Plague was detected (NPWS, 2022). There was no noted presence of white-clawed crayfish in the recent surveys carried out in **Section: 7.3.2.**

Otter presence was confirmed at 14 sites through field evidence, including spraints, prints, and a holt. There was no noted presence of otter in the recent surveys carried out in **Section: 7.3.2.**

7.2.1.2 Field Survey

Zone of Influence

The Zone of Influence (ZOI) differs for different habitats and species. Within terrestrial habitats, the ZOI may be confined to the study area, whereas for aquatic habitats, the ZOI will be more extensive, and the surveys undertaken were scoped accordingly for the proposed Project. This entailed establishing the baseline conditions in aquatic habitats at a range of points upstream and downstream in the various watercourses draining the Site the Grid Connection Route and the Turbine Delivery Route and is reflected in the range and extent of surveys undertaken. The SPR (Source-Pathway-Receptor) model was used to establish the ZOI. The source being the Site and associated works (taking into account soil type and settling characteristics), the pathway being the watercourses and the receptors being aquatic fauna downstream of the source. The ZOI for aquatic ecology followed a catchment-level approach.

All freshwater watercourses which could be affected directly or indirectly by the Project were considered with riverine sites discussed in **Section 7.3.2** targeted for detailed aquatic assessment. These sites drained the site boundary, grid connection route, and turbine delivery route (see **Figure 10-2 Local Hydrology Map**).

The surveys are summarised below and are described in more detail within the baseline survey reports (**Appendix 7.1 - 7.2**). These allow the assessment of any significant effects while being mindful of unrelated discharges and tributaries further downstream that may contribute pollution to or dilute any potential effects.

An **Appropriate Assessment Screening Report and Natura Impact Statement** have been prepared for the proposed Project which assesses any significant likely effects on European designated sites (the Natura 2000 network).

Baseline Sampling

The baseline surveys focused on aquatic habitats in relation to fisheries potential (including both salmonid and lamprey habitat), white-clawed crayfish, macroinvertebrates (biological water quality), macrophytes and aquatic invasive species, and species of conservation value which may use the watercourses in the vicinity of the proposed Project. Full details of the survey methodologies are included in **Appendix 7.1** and discussed further below. Site visits were initially undertaken in July and October 2022 and again in April and August 2024 where it was confirmed that habitat conditions at the survey sites remained broadly consistent, further supporting the validity and reliability of the original survey data and findings.

Walkover Survey

A walkover survey was carried in 2024. The sampling station locations for this survey can be seen in **Figure 7.1** and are listed in **Table 7-4**. The aim of the survey was to identify the general riparian habitats in the ZOI of the proposed Project along with any sensitive or invasive species that may be present. Images were taken at each station on the walkover survey (listed in **Section 7.3.2**) facing both upstream and downstream directions and a record was made of any notable species, general watercourse hydromorphology, and aquatic vegetation on the watercourses draining the proposed Project. The suitability of the habitats for protected species such as white-clawed crayfish, river lamprey (*Lampetra fluviatis*), freshwater pearl mussel (*Margaritafera margaritafera*) and salmonids was considered. **Section 7.3.2** shows the survey locations visited as part of this assessment. None of the stations surveyed during the walkover were found to be suitable habitats for freshwater pearl mussel.

Macroinvertebrate Diversity Sampling

Macroinvertebrate surveys were conducted in both 2022 and 2024 in response to changes in the proposed Project layout that occurred between these periods. The repetition of the surveys was necessary to ensure that ecological baseline data remained current and robust, in accordance with the Chartered Institute of Ecology and Environmental Management (CIEEM) 2019 guidance.

A total of four macroinvertebrate sampling events were carried out: on 17th August 2022, 10th November 2022, 26th April 2024, and 23rd–24th July 2024. These dates were selected to provide seasonal coverage and to ensure representative data across different flow and biological conditions. The survey sites were located on the River Maigue (EPA code: 24M01), Loobagh River (24L28), Charleville Stream (24C02), Graigues River (24G37), Creggane Stream (23C50) and Broghill North Stream (24B96). The surveys were undertaken using standard kick sampling techniques in line with Environmental Protection Agency (EPA) methodologies. The macroinvertebrate communities sampled were assessed using the EPA Q-value rating system, which is a widely accepted metric for evaluating biological water quality in Irish freshwater systems. The sampling station locations for this survey can be seen in and are listed in **Table 7-4.**

Full details of the sampling approach, site selection, and assessment outcomes are provided in **Section 3.2.2.2** of the Baseline Aquatic Report. This section includes descriptions of the methodologies employed, habitat conditions, and the results of the Q-value assessments, which collectively inform the ecological evaluation of the receiving aquatic environment.

The aquatic habitat assessment conducted at all sites was based on the Environment Agency's *'River Habitat Survey in Britain and Ireland Field Survey Guidance Manual 2003'* (Environment Agency, 2003) and the Irish Heritage Council's *'A Guide to Habitats in*

Ireland' (Fossitt, 2000). The EPA Biotic Index Biological River Quality Classification System (Q-value) (Toner *et al.,* 2005) () has been used to monitor the ecological quality of streams and rivers in Ireland since 1971. It is routinely employed by the EPA. All sites were assessed in terms of:

- Stream width, depth, and other physical characteristics
- Substrate type, listing substrate fractions in order of dominance, *i.e*., bedrock, boulder, cobble, gravel, sand and silt
- Flow type, listing percentage of riffle, glide and pool in the sampling area
- In-stream macrophyte, bryophytes occurring and their percentage coverage of the stream bottom at the sampling sites
- Riparian habitats and species composition

This method remains fully compliant with the most up-to-date EPA guidance (EPA, 2022b), which aligns Q-value assessments with the EU Water Framework Directive (WFD) through the use of Ecological Quality Ratios (EQRs). Each Q-value is now mapped to a WFD ecological status category to ensure compatibility with European-wide assessment standards.

Table 7-1: EPA Water Quality and Status Summary.

Biotic Index	Quality Status	Water Quality	WFD Ecological Status
Q5	Unpolluted	Good	High
Q4-5	Unpolluted	Fair-to-Good	High
Q4	Unpolluted	Fair	Good
Q3-4	Slightly Polluted	Doubtful-to-Fair	Moderate
Q3	Moderately Polluted	Doubtful	Poor
Q2-3	Moderately Polluted	Poor-to-Doubtful	Poor
Q2	Seriously Polluted	Poor	Bad
Q1-2	Seriously Polluted	Bad-to-Poor	Bad

A Biosecurity protocol was rigidly followed to avoid the potential for transfer of invasive alien species to or from the Site in accordance with guidance produced by Invasive Species Ireland and Inland Fisheries Ireland (IFI, 2010). A specific Biosecurity Method Statement was produced for the survey operation.

This Aquatic Ecology Chapter will be referring to watercourses by the local river names identified using the "Indicative Flow" layer [e.g. the Maigue] on EPA maps website to assess potential effects on each stretch rather than the river catchment as a whole. For the Hydrology and Hydrogeology Chapter local river names have been included as well as the Water Framework Directive (WFD) river section ID [Maigue_030 for example] which aligns with the overall WFD catchment or sub-catchment name.

Physicochemical Water Quality Sampling

Physicochemical water quality sampling was carried out in 2022 and repeated in 2024. Four separate water physicochemical sampling events took place (17th of August 2022, 10th of November 2022, 26th of April 2024, 6th of August 2024). The physicochemical survey sites were located on the River Maigue (EPA code: 24M01), Loobagh River (24L28), Charleville Stream (24C02), Graigues River (24G37), Creggane Stream (23C50) and Broghill North Stream (24B96). The parameters assessed included temperature, dissolved oxygen, pH and turbidity recorded using a Yellow Springs Instruments (YSI) EXO2 probe. Water samples were also taken and tested for BOD (Biological Oxygen Demand), COD (Chemical Oxygen Demand), suspended solids, Total Nitrogen, Nitrate, Nitrite, Phosphate, and TPH (Total Petroleum Hydrocarbons). Two bottles were used for collection. A plastic water sampling bottle was washed out and then slowly filled with water while facing downstream, taking care to minimise air bubbles forming in the sampling bottle. The process was repeated using a glass sampling bottle for testing TPH in the water. Samples were delivered to Complete Laboratory Solution (CLS) in Galway within 24hrs of sampling. In-situ probe readings were not taken at F3 during the April 2024 and August 2024 sampling period due to a low water level. The sampling station locations for this survey can be seen in and are listed in **Table 7-4.**

White-Clawed Crayfish Survey

Prior to carrying out field surveys of white-clawed crayfish, a check for previous records in the catchment was carried out using data from the NBDC and NPWS. Licences for white-clawed crayfish surveys were secured from NPWS prior to commencement of the survey (Licence No. C164/2024).

The crayfish survey sites were located on the River Maigue (EPA code: 24M01), Loobagh River (24L28) and Charleville Stream (24C02). Surveys were carried out at five sites F1, F2, F4, F8 and F10 (**Table 7-4**, **Table 7-9**,) on the 22nd and 23rd of July 2024 according to the standard methodology used by Reynolds *et al*. (2010), and Gammell *et al*. (2021). Hand-searching of 50 potential refuges at each of the five sampling sites F1, F2, F4, F8 and F10 was carried out over a 100m stretch at each location. Potential refuges were defined as any suitable substrate (*e.g.*, gravel, cobble, woody debris) that would be resistant to high flows and capable of providing cover for white-clawed crayfish.

Sites F1, F2, F4 and F8 were unsuitable for hand-searching due to the deep silt and muddy substrate, so a string of four trappy funnel baited crayfish traps were laid out on the 22nd of July 2024 and left overnight within an area of suitable habitat (**Appendix 7.1** - **Figure 3.3**). Traps were left overnight and checked early the following morning on the 23rd of July 2024**.** Deploying four traps has proven sufficient for determining crayfish presence or absence at sites where hand-searching is not feasible, based on consistent results from previous surveys. While IWM 131 recommends ten traps for estimating abundance (CPUE), this higher effort is not necessary for presence/absence surveys.

Fisheries Assessment

An assessment of the watercourses within the vicinity of the proposed Project was carried out by Triturus Environmental Ltd. to determine their fisheries value. A catchment-wide electro-fishing survey across 19 riverine sites in total, with locations upstream and downstream of the proposed windfarm site, was undertaken during July and August 2024. The fisheries survey sites were located on the River Maigue (EPA code: 24M01), Loobagh River (24L28), Charleville Stream (24C02), Graigues River (24G37), Creggane Stream (23C50), Broghill North Stream (24B96), Rathnacally Stream (18R32), Foxhall East River (24F13), Rathluirc Stream (24R11) and the Garrynderk Stream (24G33). Survey sites C1 and C2 on the River Maigue downstream of the River Loobagh confluence were added at the request of Inland Fisheries Ireland. The sampling station locations for this survey can be seen in and are listed in **Table 7-4.**

Whilst fisheries data for the watercourses within the survey area was not available prior to this survey, the River Maigue, a major tributary of the Lower River Shannon, is known to support a range of fish species including Atlantic salmon (*Salmo salar*), brown trout (*Salmo trutta*), lamprey (*Lampetra* sp.), European eel (*Anguilla anguilla*), stone loach (*Barbatula barbatula*), minnow (*Phoxinus phoxinus*) and three-spined stickleback (*Gasterosteus aculeatus*) (Holmes et al., 2022; Kelly et al., 2017; IFI, 2015). Dace (*Leuciscus leuciscus*), an invasive cyprinid, have been known in the lower reaches of the Maigue since 1990 (Caffrey et al., 2007). The River Loobagh, a tributary of the Maigue (to which it joins within the survey area), is known to support Atlantic salmon, brown trout, lamprey (*Lampetra* sp.), European eel, minnow and stone loach (IFI, 2015; Triturus data).

A single anode Smith-Root LR24 backpack (12V DC input; 300V, 100W DC output) was used to electro-fish the 5 locations. Electro-fishing was conducted in an upstream direction for a 10-minute CPUE (Matson *et al*., 2018). A total of approx. 40-100m channel length was surveyed at each site, where feasible, in order to gain a better representation of fish stock assemblages. Electro-fishing methodology followed accepted European standards (CEN, 2003) and adhered to best practice (e.g., CFB, 2008).

Water temperatures were closely monitored throughout the survey to ensure temperatures did not exceed 20°C to minimise the stress caused by low levels of oxygen on fish that were caught. A portable battery-powered aerator was also used to further reduce stress to any captured fish contained in the holding tank. Captured fish species were placed in an oxygenated container. No anaesthesia was given to the fish after capturing. All fish were measured to the nearest millimetre and released in-situ following a suitable recovery period. A strict biosecurity protocol following IFI (2010) and the Check-Clean-Dry approach was adhered to during surveys for all equipment and PPE used. Disinfection of all equipment and PPE before and after use with Virkon™ was conducted to prevent the transfer of pathogens or invasive propagules between survey sites. Surveys were undertaken at sites in a downstream order to minimise the risk of upstream propagule mobilisation. Any aquatic invasive species or pathogens recorded within or adjoining the survey areas were geo-referenced.

7.2.1.3 Ecological Evaluation and Impact Assessment Methodology

The evaluation of the key ecological receptors and the criteria used to assess the significance of effects are derived from the *Guidelines for Assessment of Ecological Impacts on National Road Schemes* (National Roads Authority, June 2009), *Guidelines on the Information to be contained in Environmental Impact Assessment Reports* (Environmental Protection Agency, 2022) and the *Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal* (CIEEM, 2018 (Updated 2022)).

Effects were considered to be either significant or not significant at a geographic scale equivalent to or less than the conservation importance of the ecological feature being assessed (CIEEM, 2018). The duration of significant effects is considered according to Environmental Protection Agency (EPA) guidance (EPA, 2022). The magnitude of an effect will depend on the nature and sensitivity of the ecological features and will be influenced by intensity, duration (temporary/permanent), timing, frequency and reversibility of the significant likely effect (Chartered Institute of Ecology and Environmental Management, 2018 (Updated 2022)).

The criteria used for assessment of the value of the ecological resources sets out the context for the determination of value on a geographic basis with a hierarchy assigned in relation to the importance of any particular receptor. The NRA (2009) guidelines provide a basis for determination of whether any particular site is of importance on a scale presented in **Table 7-2**.

Table 7-2: Valuation of Ecological Resources.

Scale of Importance	Determination of Value on a geographic basis

International Importance	• 'European Site' including Special Area of Conservation (SAC), Special Protection Area (SPA) or Site of Community Importance (SCI)
	• Proposed Special Area of Conservation
	• Proposed Special Protection Area
	• Site that fulfils the criteria for designation as a 'European Site' (see Annex III of the Habitats Directive, as amended)
	• Features essential to maintaining the coherence of the Natura 2000 Network
	• Site containing 'best examples' of the habitat types listed in Annex I of the Habitats Directive
	• Resident or regularly occurring populations (assessed to be important at the national level) of the following:
	  ◦ Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; and/or
	  ◦ Species of animal and plants listed in Annex II and/or IV of the Habitats Directive.
	• Ramsar Site (Convention on Wetlands of International Importance Especially Waterfowl Habitat 1971).
	• World Heritage Site (Convention for the Protection of World Cultural & Natural Heritage, 1972)
	• Biosphere Reserve (UNESCO Man & The Biosphere Programme)
	• Site hosting significant species populations under the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals, 1979)
	• Site hosting significant populations under the Berne Convention (Convention on the Conservation of European Wildlife and Natural Habitats, 1979)
	• Biogenetic Reserve under the Council of Europe
	• European Diploma Site under the Council of Europe
	• Salmonid water designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988, (S.I. No. 293 of 1988)

National Importance	• Site designated or proposed as a Natural Heritage Area (NHA) • Statutory Nature Reserve • Refuge for Fauna and Flora protected under the Wildlife Acts • National Park • Undesignated site fulfilling the criteria for designation as a Natural Heritage Area (NHA); Statutory Nature Reserve;

Scale of Importance	Determination of Value on a geographic basis

	Refuge for Fauna and Flora protected under the Wildlife Act; and/or a National Park
	• Resident or regularly occurring populations (assessed to be important at the national level) of the following:
	  • Species protected under the Wildlife Acts; and/or
	  • Species listed on the relevant Red Data list
	• Site containing 'viable areas' of the habitat types listed in Annex I of the Habitats Directive

County Importance	• Area of Special Amenity
	• Area subject to a Tree Preservation Order
	• Area of High Amenity, or equivalent, designated under the County Development Plan
	• Resident or regularly occurring populations (assessed to be important at the County level) of the following:
	  • Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive;
	  • Species of animal and plants listed in Annex II and/or IV of the Habitats Directive
	  • Species protected under the Wildlife Acts; and/or
	  • Species listed on the relevant Red Data list
	• Site containing area or areas of the habitat types listed in Annex I of the Habitats Directive that do not fulfil the criteria for valuation as of International or National importance
	• County important populations of species, or viable areas of semi-natural habitats or natural heritage features identified in the National or Local BAP, if this has been prepared
	• Sites containing semi-natural habitat types with high biodiversity in a county context and a high degree of naturalness, or populations of species that are uncommon within the county
	• Sites containing habitats and species that are rare or are undergoing a decline in quality or extent at a national level

Local Importance (higher value)	• Locally important populations of priority species or habitats or natural heritage features identified in the Local BAP, if this has been prepared
	• Resident or regularly occurring populations (assessed to be important at the Local level) of the following:
	  • Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive
	  • Species of animal and plants listed in Annex II and/or IV of the Habitats Directive
	  • Species protected under the Wildlife Acts; and/or
	  • Species listed on the relevant Red Data list
	• Sites containing semi-natural habitat types with high biodiversity in a local context and a high degree of naturalness, or populations of species that are uncommon in the locality
	• Sites or features containing common or lower value habitats, including naturalised species that are nevertheless essential

Scale of Importance	Determination of Value on a geographic basis
	in maintaining links and ecological corridors between features of higher ecological value
Local Importance (lower value)	• Sites containing small areas of semi-natural habitat that are of some local importance for wildlife • Sites or features containing non-native species that are of some importance in maintaining habitat links

The Chartered Institute of Ecology and Environmental Management (CIEEM) Guidelines define a significant effect as, "*an effect that either supports or undermines biodiversity conservation objectives for 'important ecological features'...or for biodiversity in general*". The criteria used for assessment of significant effects are as follows while the Criteria for Assessing Effect Significance are presented in **Table 7-3**:

Positive or Adverse: Positive and adverse effects should be determined according to whether the change is in accordance with nature conservation objectives and policy.

Extent: Extent should be predicted in a quantified manner and relates to the area over which the significant effect occurs.

Magnitude: Magnitude refers to size, amount, intensity and volume. It should be quantified if possible and expressed in absolute or relative terms *e.g.,* the amount of habitat lost, percentage change to habitat area, percentage decline in a species population.

Duration: Duration is intended to refer to the time during which the significant effect is predicted to continue, until recovery or re-instatement (which may be longer than the effect-causing activity). Duration should be defined in relation to ecological characteristics (such as a species' lifecycle).

Frequency and Timing: The timing of significant effects in relation to important seasonal and/or life-cycle constraints should be evaluated. Similarly, the frequency with which activities (and associated effects) would take place can be an important determinant of the effect on receptors and should also be assessed and described.

Reversibility: An irreversible effect is one from which recovery is not possible within a reasonable timescale or there is no reasonable chance of action being taken to reverse it. A reversible effect is one from which spontaneous recovery is possible or which may be counteracted by mitigation.

Likelihood:

- Certain/Near Certain: >95% chance of occurring as predicted.
- Likely: 50-95% chance as occurring as predicted.
- Unlikely: 5-50% chance as occurring as predicted.
- Extremely Unlikely: <5% chance as occurring as predicted.

Table 7-3: Criteria for Assessing Effect Significance (EPA, 2022).

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

7.2.2 Relevant Guidance

- *Water Quality - Sampling of Fish with Electricity. Document* CEN (2003).
- *Methods for the Water Framework Directive. Electric Fishing in Wadeable Reaches. Central Fisheries Board.* CFB (2008).
- *Guidelines on the Information to be Contained in Environmental Impact Assessment Reports* (EPA, 2022)
- *Integrated Biodiversity Guidelines for Planning and Development* (EPA, 2022)
- *Appropriate Assessment of Plans and Projects in Ireland - Guidance for Planning Authorities (DEHLG 2009, Revised February 2010).*
- *Guidelines for Ecological Impact Assessment in the UK and Ireland – Terrestrial, Freshwater and Marine* (CIEEM, 2018)
- *Advice Note on the Lifespan of Ecological Data* (CIEEM, 2019)
- *River Habitat Survey in Britain and Ireland Field Survey Guidance Manual 2003.* (Environment Agency 2003).
- *A guide to habitats in Ireland. Heritage.* (Fossitt, J.A., 2000).

- *Managing Natura 2000 Sites: The provisions of Article 6 of the 'Habitats' Directive 92/43/EEC. Office for Official Publications of the European Communities, Luxembourg.* (European Commission 2000).
- *Guidelines for Assessment of Ecological Impacts on National Road Schemes* (National Roads Authority, June 2009)
- *Invasive Species Ireland and Inland Fisheries Ireland* (IFI, 2010)
- Site-specific Conservation Objectives and Standard Data Forms for relevant SACs/SPAs
- Sub-basin Management Plans for Freshwater Pearl Mussel (as per Water Framework Directive)
- *Water Action Plan 2024* (DHLGH, 2024)
- *EU Habitats Directive* (92/43/EEC) *and Birds Directive* (2009/147/EC)
- *The Planning and Development Act 2000 (as amended)*
- *4th Irish Biodiversity Action Plan* (NPWS)
- *IFI Biosecurity Protocol for Field Survey Work.* (Inland Fisheries Ireland 2010)
- *Best Practice Guidelines for the Irish Wind Energy Industry. Guidance prepared by Fehily Timoney & Company for the Irish Wind Energy Association.* IWEA (2012).

7.3 BASELINE DESCRIPTION

7.3.1 Project Description

Wind Farm Site

The Site area is located in the proximity of the townlands of Ballynagoul, Creggane and Garrane, Co. Limerick. The Site is located 22.9km south of Limerick City, 46.9km north of Cork City and 2.5km (closest turbine) north of Charleville, Co. Cork (**Figure 7.1 & 7.2**). The proposed Project includes, 9 No. wind turbines, a permanent meteorological mast, a permanent on-site 110 kilovolt (kV) substation with a 'loop in' grid connection to the existing 110kV overhead line to the south of the site, 6no. Temporary spoil storage areas, 1no. permanent spoil storage area (berm) and the construction of a temporary compound for use during construction. There are several watercourses within/ draining the proposed Project Site which could potentially be effected by the Project, i.e., the River Maigue (EPA code: 24M01), Loobagh River (24L28), Charleville Stream (24C02), Graigues River (24G37), Creggane Stream (23C50), Broghill North Stream (24B96), Rathnacally Stream (18R32), Foxhall East River (24F13), Rathluirc Stream (24R11) and the Garrynderk Stream (24G33). The Site has a total area of 158.75ha (392 acres). The areas designated for spoil storage extend to 2.19ha. All spoil storage areas fall within the Redline Boundary. The land is private property and the principal land use in the general area is comprised of agricultural pasture grazing farmland. There are 2 watercourse crossings required on the proposed Site Access Tracks. Water Crossing 1 is located on the Maigue River on the access track northwest of T7 and Water Crossing 2 is located on the Charleville (Stream) on the access track east of T3. These will be a clear span bridge type construction. The Maigue River and Charleville (Stream) crossings are shown on **.**

There will be 2 entrances for the Site. Site Entrance 1 on the N20 will be used for the construction of the Site Access Track to construct the bridge over the Maigue River.

The turbine components will be transported on the public road network using abnormal load vehicles between the landing port and Site Entrance 1 on the N20.

Abnormal loads will enter the Site via an existing entrance on the N20 (Site Entrance 1) which will be upgraded to allow vehicles to turn into the Site. Due to the fact that the N20 is a very busy National Road, the Site Entrance 1 off the N20 will only be used for the transportation of abnormal loads to the Site. These vehicles will enter the Site via this entrance and exit the Site via Site Entrance 2 on the L1537 as they will have unloaded and shortened and will no longer be oversize and will therefore be able to exit onto the L1537. The two Site Entrances are shown on **Figure 2.2**. The proposed Turbine Delivery Route is shown on **Figure 2.3**.

The proposed Project is not within or bordering any Natura 2000 sites. The closest Natura 2000 sites are the Blackwater River (Cork/Waterford) SAC (site code: 00216) and the Ballyhoura Mountains SAC (site code: 004007) which are approximately 6.5km south and 9km south-east of the proposed Project respectively at the closest point, and both within the Blackwater Catchment (WFD Catchment 18) and not hydrologically connected to the Garrane watercourses. The closest hydrologically connected Natura 2000 sites are the Lower River Shannon SAC (site code: 002165) and River Shannon and River Fergus Estuaries SPA (site code: 004077) over 25 km downstream.

Proposed Grid Connection Route (GCR)

Connection will be sought from the national electricity network operators by application to the transmission operator Eirgrid. Possible grid connection options for the Project were assessed, and it was found that a 'loop in' Grid Connection to the existing 110kV OHL between Charleville substation and Killonan substation was the most viable option. Grid connection options are assessed in **Chapter 3: Alternatives**.

The Grid Connection can be summarised as follows:

- Underground ducting Grid Connection from the on-site 110kV Substation to the lattice end masts (as shown on Drawing No. **3337-SUIR-SS-DR-C-2411**) with a 'loop in' Grid Connection to the existing 110kV OHL between Charleville substation and Killonan substation.

The above Grid Connection design is shown in **Figure 2.4.**

The preferred Grid Connection Route (GCR) connects the proposed Project to the onsite Substation using overhead lines and does not cross any watercourses.

The proposed Substation is located c. 170m (in a straight line) west of the existing Charleville-Killonan overhead electricity transmission line. In order to connect the Project and provide the 'loop in/loop out' infrastructure, it is proposed to install two new end masts and a double circuit of underground 110kV electricity transmission line to each end mast. The underground cable (UGC) will be located fully within the Redline Boundary, within or alongside the proposed Access Tracks. The UGC will be installed within ducting in excavated trenches of approximately 1.3m deep and 0.6m wide. Cables will be pulled through the ducting in a single length thus eliminating the requirement for joint bays. Ground levels will then be reinstated. Further details can be found in the Suir Engineering grid construction methodology report **Appendix 2.2**

Turbine Delivery Route (TDR)

A preferred TDR for delivery of blades and turbine components- has been identified from Foynes Port to the Site, with an alternative route involving blade delivery from the Port of Galway and all other components still transported from Foynes. The preferred TDR, assessed in **Chapter 17: Traffic and Transport**, includes temporary accommodation requirements at six locations, outside the redline boundary and one location within the redline boundary. Importantly, no road works or accommodation requirements are proposed in proximity to water crossings along the TDR. As such, no negative impacts to marine or aquatic ecology are anticipated as a result of the proposed transport route modifications.

7.3.2 Aquatic Habitat Assessment

Table 7-9 presents a list of the watercourses and the survey station locations for the current ecological data sampled in 2024. Several water courses flow through the site, all converging ultimately into the Maigue (EPA code: 24M01). EPA watercourse names, EPA codes and EPA segment codes are also presented. All recent and historic station references along with the respective surveys are shown in **Table 7-4** below locations are presented in **Figure 7.1**.

Table 7-4: Sampling stations for various aquatic survey elements.

Station	August 2022	November 2022	July 2023	April 2024	July/Aug 2024
F1			Fisheries	Sweep (Fauna)	Physicochemical (Water), Crayfish
F2			Fisheries	Kick Sampling (Fauna), Physicochemical (Water)	Kick Sampling (Fauna), Physicochemical (Water), Crayfish
F3			Fisheries	Kick Sampling (Fauna), Water (No Probe Info)	Sweep (Fauna)
F4			Fisheries		Crayfish
F5			Fisheries		
F6			Fisheries		
F7			Fisheries	Kick Sampling (Fauna), Physicochemical (Water)	Kick Sampling (Fauna), Physicochemical (Water)
F8			Fisheries		Crayfish
F9			Fisheries		
F10 (HF10)	Kick Sampling (Fauna), Physicochemical (Water)	Kick Sampling (Fauna), Physicochemical (Water)	Fisheries	Kick Sampling (Fauna), Physicochemical (Water)	Kick Sampling (Fauna), Physicochemical (Water), Crayfish
F11				Kick Sampling (Fauna), Physicochemical (Water)	Kick Sampling (Fauna), Physicochemical (Water)
HF1	Kick Sampling (Fauna), Physicochemical (Water)	Physicochemical (Water)			
HF2	Kick Sampling (Fauna), Physicochemical (Water)	Kick Sampling (Fauna), Physicochemical (Water)			
HF3	Kick Sampling (Fauna), Physicochemical (Water)	Kick Sampling (Fauna), Physicochemical (Water)			
HF5	Kick Sampling (Fauna), Physicochemical (Water)	Kick Sampling (Fauna), Physicochemical (Water)			
HF6	Kick Sampling (Fauna), Physicochemical (Water)	Kick Sampling (Fauna), Physicochemical (Water)			
HF7	Kick Sampling (Fauna), Physicochemical (Water)	Kick Sampling (Fauna), Physicochemical (Water)			
HF8	Kick Sampling (Fauna), Physicochemical (Water)	Physicochemical (Water)			
HF9	Kick Sampling (Fauna), Physicochemical (Water)	Kick Sampling (Fauna), Physicochemical (Water)			

Station	August 2022	November 2022	July 2023	April 2024	July/Aug 2024
A1			Fisheries		
A2			Fisheries		
A3			Fisheries		
B1			Fisheries		
B2			Fisheries		
B3			Fisheries		
B4			Fisheries		
C1			Fisheries		
C2			Fisheries		

7.3.2.1 Walkover Survey

Six stations were visited during the 2024 surveys and assessed as part of the walkover surveys (**Appendix 7.1**). The sample stations assessed during 2024 were:

- F1- River Maigue
- F2- Loobagh River
- F3- Loobagh River
- F7- Charleville Stream
- F10-Charleville Stream
- Sample site adjacent to the Proposed Substation

All stations were classified as (FW2) Depositing/lowland rivers under the Fossitt (2000) classification system. The area surrounding the sample stations was defined as a mosaic of (GA1) Improved Agricultural Grassland and (GS4) Wet Grassland, with some (WN5) Riparian Woodland and (WS1) Scrub present at certain stations. Potential sources of nutrient pollution through runoff from adjacent farmland was noted as a cause of eutrophication across each watercourse. The watercourses present within the site are subject to maintenance by the Office of Public Works (OPW). A synopsis of the walkover survey results as detailed in the Baseline Aquatic Ecology report (AQUAFACT, 2024) is provided below.

F1-River Maigue (24M01), Ballynagoul

Site F1 was located on the River Maigue (24M01) approximately 100m upstream of the River Loobagh confluence. The morphology of the Lowland/Depositing River (FW2) was modified with steep 200cm tall banks cut at a 45° angle and a straightened channelised stream. The bank width was approximately 700cm while the river was 300cm wide. The 100cm deep water consisted entirely of slow-flowing glide with a heavily silted muddy bottom. The station had abundant common clubrush (*Schoenoplectus lacustris*) in the stream and banks overgrown with dense Scrub (WS1) mostly taking the form of nettle (*Urtica dioica*), bramble (*Rubus fructicosus* agg.), hedge bindweed (*Calystegia sepium*) and great willowherb (*Epilobium hirsutum*) with some scattered poplar (*Populus* spp.) Treelines (WL2) in adjacent fields. The surrounding fields were noted as a mosaic of Improved Agricultural Grassland (GA1) and Wet Grassland (GS4). Station F1 is shown in **Figure 7-4** below. Based on the NRA (2009) guidance, Site F1 is assessed as being of Local Importance (Lower Value) due to its modified river morphology, dominance of common species, and absence of protected habitats or species. While it retains some semi-natural features, its overall ecological value is limited by significant anthropogenic alteration and surrounding intensive agricultural land use.

Figure 7-1: Representative photo of station F1 on the River Maigue showing abundant vegetation.

F2- Loobagh River (24L01), Ballynagoul

The station was noted as heavily poached, with imperceptible flow in places due to the channel being used as a previous water access point for cattle. The banks were approximately 50cm high and 350cm wide, while the channel was 150cm at its widest point and at most 20cm deep with highly turbid muddy water. The sampling station was located four metres upstream of a stone cattle bridge, classified under (BL1) Stone Walls and other Stonework, with more dense Riparian Woodland (WN5) consisting of willow (*Salix* spp.) and hawthorn (*Crataegus monogyna*). The channel was surrounded by common club-rush (*Schoenoplectus lacustris*) with yellow iris (*Iris pseudacorus*), nettle (*Urtica dioica*), and bramble (*Rubus fructicosus* agg.). Station F2 can be seen in **Figure 7-5** below. This site is assessed as being of Local Importance (Lower Value) under the NRA (2009) guidelines. This is due to its heavily degraded condition, lack of protected species, and dominance of common riparian and wetland vegetation. While adjacent features like the riparian woodland and stonework add limited interest, they do not elevate the site above this classification.

Figure 7-2: Representative photo of station F2 on the Loobagh River

F3- Loobagh River (24L28), Ballynagoul

Station F3 was located approximately 630m upstream of Station F2. It consisted of a small Depositing Lowland channel (FW2), which had been straightened and deepened, resulting in poor hydromorphology and an almost stagnant flow, with water collecting in a few deep pools produced by cattle poaching. The banks were steeply cut and approximately 150cm high and 500cm wide, and the channel itself approximately 150cm wide and 40cm deep, though broken up into small discontinuous pools. The water was turbid and heavily silted with very deep fine mud at the bottom. The banks were overgrown with Scrub (WS1), with common club-rush (*Schoenoplectus lacustris*), yellow iris (*Iris pseudacorus*), nettle (*Urtica dioica*) and bramble (*Rubus fructicosus* agg.). There was a stone cattle bridge upstream of the station, classified under Stone walls and other Stonework (BL1), and a linear Hedgerow (WL1) consisting of willow (*Salix* spp.) and hawthorn (*Crataegus monogyna*). Station F3 is assessed as being of Local Importance (Lower Value) in line with the NRA (2009) guidelines, due to its poor hydromorphology, heavy siltation, common vegetation, and absence of any protected or notable species. While minor features such as the stone bridge and hedgerow add structural variety, they do not elevate the site's ecological value beyond a locally degraded level.

Figure 7-3: Representative photo of station F3 on the Loobagh River

F7- Charleville Stream (24C02), Garrane

Station F7 was located approximately 600m downstream of Station F10. This Lowland/Depositing River (FW2) was bordered by steep 200cm tall, modified banks cut at a 45° angle. The bank width was approximately 400cm, while the river was 200cm wide and at most 35cm deep. There were a few riffle sites areas over cobbles, though most of the river was slow-flowing glide. Cattle access from adjacent grassland was noted, however the banks were not heavily poached. The banks were bordered by dense Scrub (WS1). Station F7 is assessed as being of Local Importance (Lower Value) under the NRA (2009) guidelines, owing to its modified channel structure, dominance of common riparian scrub, and minor livestock disturbance. While the presence of occasional riffles introduces some habitat variation, it is insufficient to elevate the site’s overall ecological significance. Station F7 is shown in **Figure 7-7** below.

Figure 7-4: Representative photo of station F7 on the Charleville Stream.

F10- Charleville Stream, (24C02), Ballynagoul

This Lowland/Depositing River (FW2) was bordered by steep 200cm tall, modified banks cut at a 45° angle. The bank width was approximately 400cm while the river was 200cm wide and at most 35cm deep. The substrate consisted of mud over cobble and gravel as well as dead wood and leaves. The flow was relatively fast in comparison to the other stations with developing riffle and glide areas and undercut banks with shading tree roots. The river was heavily shaded by dense Riparian Woodland (WN5) consisting of willow (*Salix* spp.), and the overgrown banks covered in nettle (*Urtica dioica*), ivy (*Hedera helix*), and bramble (*Rubus fructicosus* agg.). This site is assessed as being of Local Importance (Higher Value) under the NRA (2009) guidelines, due to its structural complexity, developing riffle-glide sequences, and the presence of riparian woodland with undercut banks and shading roots. These features contribute to increased habitat diversity and support a wider range of aquatic and terrestrial biodiversity compared to other more degraded sites. Station F10 is shown in **Figure 7-8** below.

Figure 7-5: Representative photo of station F10 on the Charleville Stream, with crayfish traps in-situ

Sample Station F11 Adjacent to the Proposed Substation Location

This station was located east of F10, at the border of an agricultural field. A sample was taken from a narrow Drainage Ditch (FW4) within a small patch of Riparian Woodland (WN5) near the proposed substation location. The steep modified banks were trapezoidal in shape with irregular edges and approximately 200cm high and 400cm wide. The channel itself was 150cm wide at most and 35cm deep. The substrate was mud over stone with a high density of fallen leaves and decomposing vegetation and a sluggish flow. The river was heavily shaded by dense Riparian Woodland (WN5) consisting of willow (*Salix* spp.), and the overgrown banks covered in nettle (*Urtica dioica*), ivy (*Hedera helix*), and bramble (*Rubus fructicosus* agg.). This station is assessed as being of Local Importance (Lower Value) under the NRA (2009) guidelines due to the artificial nature of the drainage ditch, limited aquatic habitat quality, and dominance of common species. While the presence of riparian woodland provides some ecological interest, the site's overall biodiversity potential remains limited due to its hydrological and structural modifications.

Figure 7-6: Representative photo of Proposed Substation Location

7.3.2.2 Physicochemical Water Sampling

Regulation parameters for surface waters and salmonid waters are provided in the table below. Full results and tables for physicochemical are available in **Appendix 7.1.**

Table 7-5: Regulation parameters for surface waters and salmonid waters.

Test	Unit	Surface water regulations 2019(amended)		Salmonid waters
Biological Oxygen Demand (BOD)	mg/l	High </= 2.2	Good </= 2.6	</= 5
Suspended solids	mg/l			</= 25
Nitrate as N	mg/l	High </= 0.17	Good 0.25	
Nitrite as NO_2	mg/l			</= 0.05
Phosphate as P	mg/l	High </= 0.025	Good </= 0.035	

Water Sampling 2022

In August 2022 dissolved oxygen was highest at HF1 (84.2%; 8.19 mg/l) and lowest at HF5 (39.8%; 4 mg/l). The BOD was highest at HF3 (2 mg/l), while HF5, HF8, and HF9 had BOD <1. Suspended solids were highest at HF6 (11 mg/l) and lowest at HF8 and HF9 (2 mg/l). Nitrate as N was highest at HF10 (3.9 mg/l) and lowest at HF6 (0.2 mg/l). Nitrite as NO_2 was highest at HF10 (0.159 mg/l) and lowest at HF2 (0.019 mg/l). Phosphate as P filtered was highest at HF8 (0.173 mg/l) and lowest at HF5 (0.06 mg/l).

In November 2022 dissolved oxygen and the other parameters measured by the in-stream probe were not recorded. The BOD was <1 for all sampling stations. Suspended solids were highest at HF3 (8 mg/l) and lowest at HF5 (<2 mg/l). Nitrate as N was highest at HF9 and HF10 (2.53 mg/l) and lowest at HF7 (<0.099 mg/l). Nitrite as NO_2 was highest at HF10 (0.371 mg/l) and lowest at HF7 (<0.017 mg/l). Phosphate as P filtered was highest at HF8 (0.145 mg/l) and lowest at HF7 (0.46 mg/l).

Water Sampling 2024

In April 2024 YSI probe data was not available for F3 and turbidity was not recorded for all stations save for the Proposed Substation Location due to a low water level. Dissolved Oxygen was highest at the Proposed Substation location (94.1%; 9.12 mg/l) and lowest at F2 (65.8%; 6.79 mg/l). The BOD was highest at F1, F7, and F10 (2 mg/l), while F2, F3, and the Proposed Substation Location had BOD of 1 mg/l. Suspended solids were highest at F7 (12 mg/l) and lowest at F3 and the Proposed Substation Location (<2 mg/l). Nitrite as NO_2 was highest at F7 (0.27 mg/l) and lowest at F3 (0.02 mg/l). Phosphate as P filtered was highest at F7 (0.27 mg/l) and lowest at F3 (0.02 mg/l).

In August 2024 station F3 could not be sampled due to a low water level. Dissolved Oxygen was highest at the Proposed Substation location (100.9%; 10.21 mg/l) and lowest at F2 (23.78%; 2.3 mg/l). The BOD was highest at F2 (26 mg/l), while F1 and the Proposed Substation location had the lowest BOD of <1 mg/l. Suspended solids were highest at F2 (441 mg/l) and lowest at F1 and the Proposed Substation location (<2 mg/l). Nitrite as NO_2 was highest at F10 (0.195 mg/l) and lowest at F1 and the Proposed Substation location (<0.017 mg/l). Phosphate as P filtered was highest at F2 (0.173 mg/l) and lowest at the Proposed Substation location (0.044 mg/l).

The water sampling results from 2022 and 2024 can be compared against the physico-chemical standards outlined in the European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2019 (S.I. No. 77/2019), which establish thresholds to support good ecological status under the Water Framework Directive. For Biochemical Oxygen Demand (BOD), a key indicator of organic pollution, the standard for "Good" status is ≤1.5 mg/L. While most sites in 2022 and early 2024 met this threshold, notably elevated BOD levels were recorded in August 2024 at station F2 (26 mg/L), far exceeding the acceptable limit and indicating possible localised organic enrichment or pollution. Similarly, suspended solids levels at F2 in August 2024 (441 mg/L) significantly surpassed typical background levels and far exceed the indicative threshold of 25 mg/L suggested under related EU guidance for protection of freshwater ecosystems, suggesting excessive sediment input or disturbance.

Nutrient parameters also show concerning variability. The EU regulations specify a Good status threshold of ≤0.035 mg/L for orthophosphate (as filtered P), yet concentrations in several instances (e.g. 0.173 mg/L at HF8 in 2022 and F2 in 2024) exceed this limit, which could contribute to eutrophication risks if persistent. Similarly, nitrite as NO_2, though not specifically limited in S.I. No. 77/2019, is typically found at very low concentrations in uncontaminated waters; observed peaks up to 0.371 mg/L at HF10 (Nov 2022) and 0.27 mg/L at F7 (April 2024) may indicate intermittent pollution events. Nitrate levels at certain sites also exceeded 2 mg/L, which, while below the Nitrates Directive threshold of 50 mg/L, may contribute cumulatively to nutrient loading in sensitive catchments.

7.3.2.3 Macroinvertebrate diversity assessment

Water quality was assessed using the Q-Value biotic index system. The Biological River Quality Classification System (Q-Scheme) has been in use in Ireland since 1971. For the purpose of this assessment, benthic invertebrates have been divided into five indicator groups according to the tolerance of pollution, particularly organic pollution.

In order to determine the biological quality of the river, the Q-scheme index is used whereby the analyst assigns a Biotic Index value (Q-Value) based on macroinvertebrate results. The Biotic Index is a quality measurement for freshwater bodies that range from Q1 – Q5 with Q1 being of poorest quality and Q5 being pristine/unpolluted (see).

The latest available Q value data for the River Maigue in this area was recorded in 2023 by the Environmental Protection Agency (EPA) and showed Q-scores of Q3-4 ("Slightly Polluted") and Q3 ("Moderately Polluted") in the vicinity of the site (EPA, 2023). The Loobagh had a Q-score of 4 ("Good") upstream from the site. Approx. 3 km downstream of the site the Maigue had a Q of 3-4 ("Slightly Polluted"). The most recent Q-values are displayed in **Table 7-6**.

Table 7-6: Historical Q-value data from stations on the proposed wind farm site[1] (upstream (u/s) and downstream (d/s))

River Name	Station Name	Q-Value	Year
CHARLEVILLE STREAM_020	Just u/s Maigue R. confluence	Q3-4 "Slightly Polluted"	2023
CHARLEVILLE STREAM_020	~200m d/s Charleville confluence	Q3 "Moderately Polluted"	2014

[1] https://epawebapp.epa.ie/qvalue/webusers/PDFS/HA24.pdf?Submit=Get+Results

River Name	Station Name	Q-Value	Year
CHARLEVILLE STREAM_020	MAIGUE – Creggane Br (M43)	Q3-4 "Slightly Polluted"	2002
LOOBAGH_030	Garroose Br	Q4 "Good"	2023
MAIGUE_030	Bruree Br	"Slightly Polluted"	2023

August and November 2022

Eight stations were sampled for macroinvertebrates in August 2022. Station HF4 was not sampled as there was no safe access point, due to steep banks and thick vegetation. A water sample was taken at station F6, but no macroinvertebrate sample. The stream at HF6 was heavily overgrown with deep mud which was unsafe to walk on. Overall, the stations surveyed had excessive instream vegetation growth and significant siltation and mud accumulation. Nitrogen and phosphate levels were elevated at most stations. Oxygen Levels were relatively low at all sites. In November 2022, HF1 and HF8 could not be sampled due to flooding conditions at the rivers.

Q-values for the stations are provided in **Table 7-7**. All stations except for HF7 in August obtained a Q-value of 3 which is classified as "Moderately Polluted" under the scheme, while HF7's score of Q2 is considered "Seriously Polluted". All species found are listed in **Appendix 7.1**.

Table 7-7: Biological sampling results for the 2022 period with river name and segment number.

Location	Q-value August 2022	Q-value November 2022
HF1 – Maigue, 24_190	Q3	No data
HF2 – Loobagh 24, 24_12989	Q3	Q3
HF3 - Maigue & Loobagh 24 confluence, 24_173 & 24_12989	Q3	Q3
HF5 – Graigues24, 24_1155	Q3	Q3
HF7 – Creggane24, 24_1151	Q2	Q3
HF8 – Maigue, 24_171	Q3	No data
HF9 – Broghill_North, 24_1152	Q3	Q3
HF10 - Charleville Stream, 24_119	Q3	Q3

April and July 2024

Stations surveyed in 2024 can be seen in **Table 7-9.** Sweep nets were carried out for the F1 station and for the F3 station in July 2024. As the Q-value system is intended to be used only on samples obtained by the kick method, Q scores cannot be assigned to samples obtained by sweep net. However, the sweep net technique provided a qualitative indicator of macroinvertebrates present at the site. Site F1 could not be sampled in July 2024 due to the depth of siltation and Site F3 could not be sampled as the conditions were too dry for kick sampling. Kick sampling requires shallow running water, if running water is not present it is not possible to carry out a kick sampling survey. These stations are therefore excluded from the survey, however this did not significantly alter the survey results as stations downstream were sampled. Q-values for the 2024 sampling events are provided in **Table 7-8**. All stations received a Q-value of Q3 save for F3 which received Q2-3 ("Moderately Polluted") in April, and F2 which received Q2-3 in April and Q2 ("Seriously Polluted") in July. All species found are listed in **Appendix 7.1**.

Table 7-8: Biological sampling results for the 2024 period.

Location	Q-value April 2024	Q-value July 2024
F1 – Maigue, 24_172	Q3	No data
F2 - Loobagh 24, 24_821	Q2-3	Q2
F3 – Loobagh 24, 24_567	Q2-3	No data
F7 – Charleville (stream), 24_119	Q3	Q3
F10 - Charleville (stream), 24_119	Q3	Q3
F11 - Proposed Substation Location	Q3	Q3

In 2022, all sites surveyed were awarded a Q value of Q3 (moderately polluted), apart from HF7 in August 2022. A combination of high nitrate as Ammonia and Phosphate (See **Appendix 7.1, Table 4.5**) from agricultural fertiliser addition and surface run off may have resulted in a poorer Q value score and lower incidence of species sensitive to pollution.

In 2024, abundances of pollution-tolerant taxa differed between sampling events, with overall much greater abundance during the July 2024 sampling period. Sites F2 and F3 had the lowest Q values, with scores of Q2-3 in April 2024. F2 dropped further in August 2024 to a Q2 score. At both F2 and F3 there was an evident, heavy impact of agriculture on the area. Both sites were saturated with organic matter from cattle herds with free access to the water courses. In agreement with this, Dissolved Oxygen was lowest in F2 at 65.8% in April and in August was at 23.78%. A probe reading for Dissolved Oxygen concentration could not be detected at F3. All other sites in 2024 with values recorded had Dissolved Oxygen above 80%.

HF1 is located upstream to all the 2024 sample points on the main river Maigue and is hydrologically connected to F2 and F3. The Maigue is a larger river, still surrounded by farmland but not as apparently impacted by organic matter enrichment. The distinction between the Q values corresponds with the differing levels of cattle faecal matter present in the watercourses. F1, F7 and F10 were all on the same watercourse downstream from HF7. Q values were consistent across years apart from HF7.

In 2022, all samples were categorised as moderately to seriously polluted with no change except for HF7 which improved from Q2 (seriously polluted) in August to Q3 (moderately polluted) in November (**Table 7-7**). HF3 had the lowest species richness in 2022 with a total of three species found in November 2022 (See **Appendix 7.1** for full species list and abundances).

In 2024 all sites were categorised as moderately to seriously polluted with no change at most of the sampling stations between April and July 2024 apart from F2 which declined from Q2-3 to Q2 (**Table 7-8**).

Limitations

Access was limited during surveys conducted by environmental conditions such as vegetation e.g. scrub, for example surveys were not possible at some sites during the kick sampling survey as they were inaccessible due to local conditions which are listed in the description above. Although two sites could not be accessed during the most recent surveys, the availability of historical data, including detailed field surveys conducted in 2022, has provided sufficient ecological information to ensure that the assessment remains comprehensive and supports reasoned conclusions regarding the significance of potential effects.

Table 7-9: List of stations surveyed in 2024.

Site Survey Stations	EPA Name	EPA Code	EPA Watercourse Segment Code	
F1	Maigue	24M01	24_172	 
F2	Loobagh 24	24L28	24_821	 

Site Survey Stations	EPA Name	EPA Code	EPA Watercourse Segment Code	
F3	Loobagh 24	24L28	24_567	 
F7	Charleville (Stream)	24C02	24_119	 

Site Survey Stations	EPA Name	EPA Code	EPA Watercourse Segment Code	
F10	Charleville (Stream)	24C02	24_119	 
Proposed Substation Location	N/A	N/A	N/A	 

7.3.2.4 White-clawed Crayfish Survey

No white-clawed crayfish were found during surveys and the traps laid overnight were empty when retrieved. Of the 5 sites surveyed (), only site F10 had extensive areas of suitable habitat in the form of large cobble, boulders, and woody debris as well as along river margins with tree roots being present within the water channel and overhanging vegetation.

Notably Crayfish plague, caused by the water mould *Aphanomyces astaci*, is present in the Maigue subcatchment, with the most recent records from the National Crayfish Plague Surveillance Programme during 2020/2021 (NPWS, 2022) and updates from Fish Health Unit at the Marine Institute. The presence of Crayfish plague may have been responsible for the absence of white-clawed crayfish.

7.3.2.5 Fisheries Assessment

Nineteen sites were selected for survey at locations upstream and downstream of the site. The fisheries survey sites were located on the River Maigue (EPA code: 24M01), Loobagh River (24L28), Charleville Stream (24C02), Graigues River (24G37), Creggane Stream (23C50), Broghill North Stream (24B96), Rathnacally Stream (18R32), Foxhall East River (24F13), Rathluirc Stream (24R11) and the Garrynderk Stream (24G33). Survey sites C1 and C2 on the River Maigue downstream of the River Loobagh confluence were added at the request of Inland Fisheries Ireland. The full fisheries assessment is supplied in **Appendix 7.2.**

It was noted that despite historical modifications and significant water quality pressures (i.e. siltation, eutrophication), the watercourses in the vicinity of the proposed Garrane Green Energy Project were found to support fish species of high conservation value, namely Annex II Atlantic salmon and Red-listed European eel. Additionally, brown trout were also recorded in addition to more widespread pollution and eutrophication-tolerant stone loach, minnow and three-spined stickleback.

Atlantic salmon were recorded at sites F7, F8 and F10 and C1. () The highest value salmonid habitats were present on the River Maigue and its tributary the Charleville Stream. Whilst both watercourses had been historically deepened and locally straightened in vicinity of the proposed Project, some instream recovery had occurred, and several areas provided good quality nursery habitat and holding habitat. However, siltation pressures significantly reduced the spawning capacity of both watercourses. Salmonids were absent from all other watercourses surveyed (i.e. Loobagh River, Graigues River, Creggane Stream, Broghill North Stream, Rathnacally Stream, Foxhall East River, Rathluirc Stream & Garrynderk Stream), reflecting high siltation and eutrophication pressures in addition to poor hydromorphology.

Brown trout were recorded at sites F1, F4 F7, F8, F10, B1 and C1 ().

Three-spined stickleback were recorded at sites F1, F2, F5, F8, F9 and B3. Stone loach were recorded at sites F1, F8 and C1. Minnow were recorded at sites F1, F4, F7, F8, F9, F10 and C1.

Electrofishing did not take place at Site C2 due to prohibitive depths. However, the site was of high value as a salmonid holding habitat given the dominance of deep glide and pool with scattered macrophyte refugia and overhanging marginal vegetation. Suitability for European eel was also high in these areas. The site was also of some lower value as a salmonid nursery area. Salmonid and lamprey spawning opportunities were largely absent given siltation pressures.

Despite suitability elsewhere, European eel was only recorded from the River Maigue (Sites F1 and C1). Here, deeper glide and pool areas with high macrophyte cover and broader prey resources provided superior eel habitat compared with other survey watercourses. At both a national and global scale, the European eel is listed as 'critically endangered' exemplifying the species high conservation value (Pike et al., 2020; King et al., 2011).

No lamprey ammocoetes were recorded during the survey. Soft sediment accumulations were typically very compacted, shallow and dominated by clay particles that are considered sub-optimal for ammocoete burial. Poor hydromorphology (as a result of historical modifications) and siltation pressures further reduced the suitability for *Lampetra* sp. in terms of spawning within the survey area. Despite poor suitability for lamprey in the study area, *Lampetra* sp. are known from the River Maigue further downstream (Holmes et al., 2022; Kelly et al., 2017; IFI, 2015).

Sites on the Loobagh River (F3), Creggane Stream (F6), Rathnacally River (A1), Foxhall East River (A2), Broghill North River (A3), Charleville Stream (A4) and Garrynderk South Stream (B4) did not support fish at the time of survey and thus were not of fisheries value.

Table 7-10 : Fish species densities and abundances recorded at sites in the vicinity of the proposed Garrane Green Energy Project via electro-fishing in July 2023.

				Fish density (no. per m^2)					
Site	Watercourse	CPUE (elapsed time)	Approx. area fished (m^2)	Atlantic salmon	Brown trout	European eel	Three-spined stickleback	Stone loach	Minnow
F1	River Maigue	5	150	0.000	0.033	0.013	0.033	0.013	0.040
F2	Loobagh River	5	75	0.000	0.000	0.000	0.080	0.000	0.000
F3	Loobagh River	5	60	0.000	0.000	0.000	0.000	0.000	0.000
F4	Charleville Stream	10	225	0.000	0.022	0.000	0.000	0.000	0.004
F5	Graigues River	5	75	0.000	0.000	0.000	0.213	0.000	0.000
F6	Creggane Stream	5	80	0.000	0.000	0.000	0.000	0.000	0.000
F7	Charleville Stream	10	250	0.004	0.024	0.000	0.000	0.000	**0.368**
F8	River Maigue	10	280	0.004	0.021	0.000	0.011	0.007	0.054
F9	Broghill North Stream	10	200	0.000	0.000	0.000	0.015	0.000	0.030
F10	Charleville Stream	10	280	0.004	0.029	0.000	0.000	0.000	0.150
A1	Rathnacally River	5	40	0.000	0.000	0.000	0.000	0.000	0.000
A2	Foxhall East River	5	30	0.000	0.000	0.000	0.000	0.000	0.000
A3	Broghill North Stream	5	40	0.000	0.000	0.000	0.000	0.000	0.000
B1	Charleville Stream	5	50	0.000	**0.100**	0.000	0.000	0.000	0.000
B2	Charleville Stream	5	45	0.000	0.000	0.000	0.000	0.000	0.000
B3	Rathluirc Stream	5	40	0.000	0.000	0.000	0.100	0.000	0.000
B4	Garrynderk South Stream	5	45	0.000	0.000	0.000	0.000	0.000	0.000
C1	River Maigue	5	150	**0.060**	0.007	**0.040**	0.000	**0.040**	0.040
C2	River Maigue	n/a	Too deep	n/a	n/a	n/a	n/a	n/a	n/a

7.4 ASSESSMENT OF LIKELY SIGNIFICANT ENVIRONMENTAL EFFECTS

A more in-depth discussion of water quality is provided in **Chapter 10: Hydrology and Hydrogeology**. This section is focused on the effects on aquatic species and ecology.

7.4.1 The 'Do-Nothing' Scenario

If the Project does not proceed, lands at and in the vicinity of the Site will continue to be used for agricultural purposes. This 'do-nothing' scenario would result in no significant change to aquatic ecology and habitats within or downstream of the Site, subject to the continuation of current activities and practices. It should be noted however, that current agricultural activities (incl. drainage works) are having some effects on water quality within the catchment as evidenced by the results of the surveys undertaken. The natural flooding regime that occurs at the Site will continue. In the 'Do Nothing' scenario, there may be a slight change in average annual rainfall (AAR) at the Site as a result of climate change. This is discussed in **Chapter 10: Hydrology and Hydrology** and any change in AAR will result in changes in local recharge and runoff volumes.

If the Project were not to proceed, the opportunity to generate renewable energy and electrical supply to the national grid would be lost, as would the opportunity to further contribute to meeting Government and EU targets for the production and consumption of electricity from renewable sources and the reduction of greenhouse gas emissions and compliance with the Climate Change and Low Carbon Emissions Act 2015-21 would be impeded.

7.4.2 Construction Phase Potential Effects

A full description of the project is given in **Chapter 2: Project Description**. An in-depth assessment of water quality during the construction phased is discussed in **Chapter 10 Hydrology and Hydrogeology Section 10.5.2**. A summary of potential sources of significant effects on aquatic ecology during the Construction Phase are:

- Clearance of vegetation (including hedgerow) and other associated earthworks causing the release of suspended solids/nutrients, dissolved substances, concrete and hydrocarbons into the drainage network and site run-off, resulting in adverse effects on water quality within the watercourses onsite and downstream.
- Pollution from debris caused by vehicles during the crossing of watercourses within the Site on the site access track.
- Pollution to Natura 2000 sites that are hydrologically connected downstream from the site

- Potential for accidental spillage of hydrocarbons and other pollutants including concrete laitance.
- Risk of chemical carryover in post treatment water from use of Siltbuster which could result in negative effects on downstream water quality.
- The loss of natural watercourses due to 2 no. new watercourse crossings and the placement of bridges and culverts.
- Potential for storage (high clay content in spoil deposition) and transport of soil to be released into environment and contaminate watercourses.
- Unlikely risk of pollution of water courses through groundwater and surface water quality being negatively impacted by the release of effluent from on-site temporary wastewater treatment systems has the potential if site conditions are not suitable for an on-site percolation unit.

The principal potential construction phase effects of the Project relate to the release of sediments into the drainage network arising from construction related Site works including the access track network, turbine foundations and associated hardstands, drainage network, electrical sub-station building and spoil storage areas. These are considered to be short-term and localised to the zone of Influence (ZOI). The pre-mitigation potential effect on the downstream surface water quality, and thus the aquatic ecology, is negative, indirect, short-term, and likely and is considered to be significant.

The quantities of spoil likely to be generated at the proposed Project have been calculated by Jennings O'Donovan & Partners and Whiteford Geoservices Ltd. It is estimated that the amount of spoil predicted to be generated during construction of the wind farm is 46,405m^3 of spoil. This is detailed further in **Chapter 9: Soils & Geology**.

The watercourses in proximity to the project have moderate to poor status under the WFD, most likely due to anthropogenic activities such as land drainage and forestry. Further water quality degradation in surface water from siltation or other forms of pollutants causing potential decrease in biodiversity of flora and fauna in the area, especially regarding the more sensitive species present, is the main result of the potential effects listed above. Release of suspended solids into watercourses can result in eutrophication and reduced oxygen levels due to minerals and nutrients such as phosphorus and nitrogen, which can adversely affect the local ecosystem. However, water quality degradation is considered to be short term during the construction phase and not permanent.

The proposed Project could potentially cause further reduction in water quality and therefore increase ecological pressures on aquatic macroinvertebrate diversity. Potential impacts on water quality and ensuing impacts on macroinvertebrates in the absence of mitigation are considered short-term, negative, and unlikely. In the absence of mitigation, the proposed Project could result in a significant effect on pollution sensitive taxa at a local level.

7.4.3 Operational Phase Potential Effects

The applicant is applying for a 35-year operational lifespan for the Wind Farm and a permanent permission for the Substation.

An in-depth assessment of water quality during the construction phased is discussed in **Chapter 10 Hydrology and Hydrogeology Section 10.5.3.** A summary of potential sources of significant effects on aquatic ecology during the Operational Phase can be described as follows:

- Downstream flood risk
- Runoff resulting in contamination of surface waters
- Wastewater contamination

It should be noted that the main potential effects on the receiving aquatic environment and sensitive aquatic receptors downstream will occur during the construction phase as detailed above.

This section below is a summary of the flood risk assessment (FRA) undertaken by HES for the proposed Project. The full FRA report is attached **Appendix 10.1**.

Identifiable text on local available historical 6" or 25" mapping does not identify any lands that are "liable to flood" in the vicinity area of the Site.

The OPW Past Flood Events Map (www.floodinfo.ie) records the occurrence of 2 no. historic and 1 no. recurring flood instances in the vicinity of the Site. The mapped flood events all occur at the same location along the N20 National Road on the western side of the Site. The historic flood events include the fluvial flood events at Maigue Creggane Bridge in August 1986 (Flood ID-205) and November 1982 (Flood ID-503). A recurring flood event is also mapped at this location (Flood ID-747). The Kilmallock Area Engineer's Report, available to view at www.floodinfo.ie, notes that "*the road is rendered impassable and major traffic chaos is caused on average once every 5 years*."

Meanwhile, ~6.3km downstream of the Site along the River Maigue, at the town of Dromacommer, a historic and recurring flood incident is recorded at Howardstown Bridge Co. Limerick.

The GSI Winter 2015/2016 Surface Water Flood Map (www.floodinfo.ie) shows surface water flood extents for this winter flood event. This flood event is recognised as being the largest flood event on record in many areas across the country. The flood map for this event records localised areas of surface water flooding to the west of the Site. No infrastructure is proposed in these areas.

CFRAM fluvial mapping has been completed for the area of the Project Site (**Appendix 10.1 -Figure G**). CFRAM River Flood Extents for the Present-Day scenario are mapped extensively along the River Maigue and its tributaries in the vicinity of the Site. CFRAM River Flood extents cover large areas of the Site. In terms of the Project infrastructure, a total of 6 no. turbines are mapped within or in proximity to CFRAM fluvial flood zones. T5, T8 and T9 are mapped in proximity to the low probability flood zone (Flood Zone B) associated with the 1 in 1,000-year fluvial flood event. Meanwhile, T4, T6 and T7 are mapped in the high probability fluvial flood event (flood Zone A) associated with the 1 in 100-year flood event. 3 turbines (T1, T2 and T3) in the south of the Site are mapped in Fluvial Flood Zone C and are distant from any CFRAM fluvial flood zones.

The proposed substation and Grid Connection is located in Fluvial Flood Zone C, *i.e.* away from any mapped flood zones with a risk of flooding.

There are no National Indicative Fluvial Mapping (NIFM) for the Present-Day Scenario mapped within the Site. NIFM flood zones are mapped immediately upstream and to the west of the Site along the River Maigue.

The Site is mapped as Benefited Land, associated with an Arterial Drainage Scheme (ADS). Benefited land is land that was drained as part of a scheme. All watercourses in the vicinity of the Site are mapped as ADS channels and are maintained by the OPW. A Stage III level site-specific FRA was carried out for the Site to assess the capacity and design flood levels of the river channel network (River Maigue and its tributaries). In the base modelled scenario, the modelled flood zone mapping is very similar to the flood mapping included in www.floodinfo.ie. Proposed turbines T4, T5, T6, T7, T8 and T9 are inundated by flood water in the 100-yr and 1000-yr DFs (design flood (DF) events). The modelled flood level for the 100-year flow (1% AEP) for the Site ranges between 57.09mOD at the northern downstream end, approximately 57.5mOD in the central area of the Site (i.e. where the 3 reaches join/confluence) and 57.98 at the southern end of the Site. The modelled flood level for the 1000-year flow (0.1% AEP) for the Site ranges between 57.28mOD at the northern downstream end, 57.66 mOD in the central area of the Site and 58.0mOD at the southern end of the Site. The 1,000-year level is approximately 0.17m higher than the 100-year level.

- Within the FRA a Justification Test has been completed for the proposed Project infrastructure within and in proximity to the mapped fluvial flood zones (*i.e.* T4, T5, T6, T7, T8 and T9, and associated hardstand and Access Tracks). Flood resilience measures have been proposed which include the reinstatement of the turbine hardstand within the floodplain to reduce the area of less permeable surfaces within the flood zone, the reduced area operational hardstands and Access Tracks will be set at the 1 in 20-year flood level, the placement of sensitive electrical components and transformers well above flood levels.

Design measures to minimise any increase in flood risk (upstream and downstream) include:

- Turbine locations are located outside of 50m watercourse buffers, and 10m buffers for drains.
- The layout design is intended to minimise earthworks requirements, for hardstands, turbine bases, drainage management, and access tracks.
- Minimise access roads and hardstands buildups (in flood zones, by keeping them as close to existing ground level as possible) during the construction phase and increase to 20-yr flood levels for operational phase.
- The final operational phase hardstand area at each of the turbines in the flood zones will be as small as possible.
- All existing flood zone drainage pathways will be maintained.
- A bespoke construction phase and operational phase drainage system has been designed to maximise water quality protection and minimize flooding effects.
- Detailed emergency response procedures have been outlined for potential flood events during the construction phase and during the operational phase.
- Critical electrical components at turbines, such as transformers in nacelles, and other sensitive electrical components are proposed above 1000-yr flood levels.

Refer to **Appendix 10.1** for a full description of the flood resilience proposals.

All other key Project infrastructure including the permanent 110kV Substation, site compound, designated spoil storage areas, site entrances, and 3 no. turbines (T1, T2, T3) are outside the modelled 100-year and 1,000-year flood zones and are therefore located in Flood Zone C (Low Risk).

There is the potential for adverse effects during maintenance events at the turbine site or GCR, during which the risks would be similar to the construction phase such as water quality degradation and eutrophication from the release of suspended solids.

The main conclusion to the SSFRA is that the Project can be implemented, and while there is a loss of floodplain storage, that loss does not have the potential to significantly increase upstream or downstream flood risk, this is important as it confirms that there is no potential to alter existing or future downstream flood risk at Croom AFA and Adare AFA.

7.4.4 Decommissioning Phase Potential Effects

The decommissioning phase poses similar risks of potential significant effects on the aquatic environment as listed above the construction phase, with the risk of pollution in the waterways causing a reduction in biodiversity of flora and fauna, especially the more sensitive species. Though in view of the presence of the road network and associated infrastructure, the resultant scale of effects is considered to be much lower. After 35 years the Site will be revegetated and natural drainage management will be resumed, it is not expected that the decommissioning phase will disturb this. In the absence of mitigation, the potential effect on the aquatic environment is considered much the same as the construction phase, due to the same potential sources to cause a significant short-term adverse effect at the local scale.

The Grid Connection and the Substation will become an asset of the national grid under the management of ESB and& EirGrid and will likely remain in place upon decommissioning of the Project as required by ESB/EirGrid. Given that no direct discharges to watercourses are proposed and that wastewater from the substation will continue to be treated as underlined in **Section 7.5.3**, no significant long-term effects on aquatic habitats or species are anticipated as a result of its permanent retention. However, regular maintenance of the drainage infrastructure will be necessary to ensure ongoing protection of downstream water quality and aquatic ecological receptors.

7.4.5 Effects on Natura 2000 Sites

Effects of the construction, operational and decommissioning phases on Natura 2000 sites within the ZOI are outlined in the accompanying NIS document.

The two identified European sites are both associated with the River Shannon estuary system and are at considerable distances (approximately 20 km for SAC & 25 km for SPA) from the Site of the Garrane Green Energy Project.

On the basis of geographical separation, there is no potential for direct effects, such as disturbance of habitats and/or species, on these European sites during any of the phases of the proposed Project.

The potential indirect effects on European Sites as referenced in the accompanying NIS are listed below.

Construction phase

- Release of suspended solids (and associated nutrients) to drains and surface water discharge routes during earthworks for Project infrastructure including site entrances, access tracks, upgrades to existing access tracks, turbine base/hardstanding construction, substation compound, construction compound constructions, met mast construction and wind farm internal cabling and grid connection excavations.
- Release of cementitious materials from construction works throughout the site, and particularly at turbine bases and the substation compound, into the drainage system and hence to local watercourses. Concrete and other cement-based products are highly alkaline and corrosive and can have significant negative effects on water quality and associated aquatic life.
- Release of hydrocarbons from accidental spillage during refuelling of construction plant with petroleum hydrocarbons and/or from the accumulation of small spills of fuels and lubricants during routine plant use. Hydrocarbons can cause significant pollution risk to groundwater, surface water and associated aquatic ecosystems.

Operational Phase

Although the operational phase of the Project presents significantly lower environmental risks than the construction phase, some residual and infrequent impacts to designated sites have been identified in the NIS. Here is a summary below:

- Residual suspended solids runoff:

- Disturbed soil surfaces remaining from the construction phase may produce silt-laden runoff during rainfall, particularly before full vegetation re-establishment.
- Runoff could enter site drains and reach local watercourses, temporarily increasing sediment load.

- Minor maintenance-related impacts:
    - Occasional maintenance of site entrances, internal roads, and turbine hardstands may involve limited ground disturbance.
    - These works, although minor and infrequent, could result in localized suspended sediment releases.
- Low risk of hydrocarbon release:
    - Site vehicles used for maintenance could present a small risk of leakage (e.g., engine oil, lubricants).
    - However, no refuelling will occur on-site, significantly reducing hydrocarbon-related pollution risks.
- Chemical and hydrocarbon storage:
    - A limited amount of chemicals or fuels may be stored on-site during operation (e.g., for turbine maintenance).
    - Without proper storage, accidental leaks could occur and migrate to local watercourses via on-site drainage.
- No recognised pollution from wind farm operation:
    - The wind turbines themselves do not produce wastewater or pollutants and therefore are not considered a direct pollution source.

Decommissioning Phase

- Disturbance to soils and sediment mobilisation:
    - Ground disturbance during turbine removal and minor civil works (e.g. reinstatement, cabling cut-off) could generate suspended solids that enter local drainage routes and watercourses.
- Groundwater and surface water contamination risk:

  Excavation and reinstatement works, if poorly managed, could lead to:
    - Localised contamination of groundwater
    - Release of hydrocarbons from construction plant
    - Increased sediment loads entering watercourses, especially during wet weather conditions
- Potential for soil compaction:

  - Heavy machinery operation could compact soils, leading to reduced infiltration and increased runoff, potentially transporting sediment and pollutants toward aquatic receptors.
- Chemical and hydrocarbon spill risk:
  - Although limited, the use of on-site plant and vehicles still presents a risk of accidental fuel or oil leakage if mitigation is not properly implemented.
- Revegetation and infrastructure left in place:
  - Turbine foundations will remain buried and revegetated, reducing excavation needs and associated runoff risks.
  - Site roads retained for agricultural use and underground cabling left in situ will avoid further soil disturbance, thereby limiting additional impacts.

Conclusion of the Natura Impact Statement

For the reasons set out in detail in the NIS, in the light of the best scientific knowledge in the field, all aspects of the proposed Project, by itself or in combination with other plans or projects, which may affect the relevant European Sites have been considered.

The NIS contains information that the Commission, as competent authority, may consider in making its own complete, precise and definitive findings and conclusions as to the effects of the proposed Project. It is respectfully submitted that the information contained in this NIS is such that the competent authority will be capable of determining that all reasonable scientific doubt has been removed as to any adverse effects of the proposed Project on the integrity of the relevant European sites.

In conclusion, on the basis of the assessment set out in this NIS, it is respectfully submitted that the competent authority is able to determine that no reasonable scientific doubt remains that the proposed Project will not adversely affect the integrity of any European site, in view of the conservation objectives of that site.

7.5 MITIGATION MEASURES

The following sections describe the appropriate mitigation measures for the potential effects, outlined in the previous section, that will be adopted at the construction, operational and decommissioning stages of the proposed Project.

7.5.1 Embedded Mitigation

The proposed Project incorporates embedded mitigation aimed at minimising the potential significant effects during the design phase. This includes the design principle of maintaining set-backs of 50m for turbines and associated infrastructure from watercourses (IWEA, 2012) and 10 m from artificial drainage.

7.5.2 Construction Phase Mitigation

7.5.2.1 Mitigation by Avoidance

The greatest risk of significant adverse effects on the aquatic environment will occur during the construction phase of the proposed Project. The key to minimising this risk is the siting of all turbine locations and other key infrastructure at a minimum set-back of 50 m from watercourses and 10 m from drains, following best practice guideline of the Irish Wind Energy Authority (IWEA, 2012). The only exception to this rule will be where there are works to access tracks that are located within the 50m buffer zone are required, where unavoidable stream crossings are required. In designing the layout of the access tracks careful consideration has been given to minimise the number of watercourse crossings, and in choosing locations where crossing design can readily achieve the objective of maintaining the potential for unimpeded fish pass and ecological connectivity.

The large setback distance from sensitive hydrological features means that adequate room is maintained for the proposed drainage mitigation measures (discussed below) to be properly installed and operate effectively. The proposed buffer zone will:

- Avoid physical damage (river/stream banks and river/stream beds) to watercourses and the associated release of sediment.
- Avoid excavations within close proximity to surface watercourses.
- Avoid the entry of suspended sediment from earthworks into watercourses.
- Avoid the entry of suspended sediment from the construction phase drainage system into watercourses, achieved in part by ending drain discharge outside the buffer zone and allowing percolation across the vegetation of the buffer zone.

The Project layout was specifically designed to reduce the number of watercourse crossings to the absolute minimum, with only two (WC01 on the Maigue River and WC02 on the Charleville Stream) retained, both located where clear-span bridge designs can maintain hydrological and ecological continuity for an unimpeded fish pass.

No construction activity will occur within the active watercourse. All water crossings will be clear-span bridges constructed from the bank using machinery operating outside the channel, thereby avoiding any disturbance to aquatic habitats or sediment release.

7.5.2.2 Mitigation by Design

A comprehensive suite of drainage measures has been developed to protect all receiving waters from potential significant effects during the construction of the Project in the catchment, and along the proposed TDR. They are outlined in full in **Chapter 10: Hydrology and Hydrogeology** and are also referenced in the accompanying NIS document. These measures are aimed at preventing sediments or other pollutants from entering watercourses through the containment and treatment of all surface water run-off from areas of works. The developer will appoint an Ecological Clerk of Works (ECoW) to ensure compliance during the construction stage with all mitigation measures, planning conditions and legislative requirements related to ecology. They will consult and assist with the Client in evaluating compliance with applicable legislation by means of a monthly Environmental Audit.

The mitigation measures have been incorporated into a Construction and Environmental Management Plan (CEMP) in **Appendix 2.1** of the EIAR, for the Project which includes construction method statements for key works. The CEMP includes a Surface Water Management Plan (SWMP). The CEMP and SWMP will require mandatory adherence by all parties involved in the construction of the Project (including any sub-contractors) in order to protect aquatic conservation interests within the Study Area. The development of the mitigation measures and all method statements for watercourse crossings follows all relevant guidance and current best practice as detailed in:

- Construction Industry Research and Information Association (CIRIA) (2006) Control of Water Pollution from Construction Sites - Guidance for Consultants and Contractors. CIRIA C532. London.
- CIRIA (2006) Guidance on 'Control of Water Pollution from Linear Construction Projects' (CIRIA Report No. C648, 2006).
- COFORD (2004) Forest Road Manual – Guidelines for the Design, Construction and Management of Forest Roads.
- CIRIA (2015) SuDS Manual, (CIRIA Report C753, 2015)
- Coillte (2009): Forest Operations & Water Protection Guidelines.
- Department of Agriculture, Food and the Marine (2018) DRAFT Plan for Forests & Freshwater Pearl Mussel in Ireland – Consultation Document.
- Forestry Commission (2004) Forests and Water Guidelines, Fourth Edition. Publ. Forestry Commission, Edinburgh.
- Forest Services (2006) Draft Plan for Forestry and Freshwater Pearl Mussel Requirements – Site Assessment and Mitigation Measures.

- Forest Service (2000) Forestry and Water Quality Guidelines. Forest Service, DAF, Johnstown Castle Estate, Co. Wexford.
- IFI (2016) Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters.
- GPP1 (2020) Understanding your Environmental Responsibilities – Good environmental Practices, NetRegs.
- GPP 5 (2018) Works and Maintenance in or Near Water, NetRegs.
- GPP21 (2021) Pollution Incident Response Planning, NetRegs.
- GPP 22 (2018) Dealing with Spills, NetRegs.
- EU Construction and Demolition Waste Management Protocol - BIBM.
- EPA Best practice guidelines for the preparation of resource & waste management plans for construction & demolition projects.
- IEMA's latest Impact Assessment Guidance, 'A New Perspective on Land and Soil in Environmental Impact Assessment' (Feb 2022).

Prevention of the release of suspended solids/nutrients, dissolved substances, concrete and hydrocarbons into the drainage network and site run-off as a result of clearance of vegetation and other associated earthworks

Nature Based Solutions (NBS) will be implemented on site where possible. These measures aim to mimic natural hydrological processes and restore ecological functions. The use of Sustainable Drainage Systems (SuDS) will be central to water management at the Site and will eliminate the risk of sedimentation to watercourses during both construction and operational phases. SuDS follows a treatment train approach with design principles that include:
Minimise → Intercept → Treat → Disperse → Dilute.
This system improves water quality, slows down flow rates, and encourages sediment settlement.
Extending or maximising this approach has the potential to deliver net beneficial effects, such as a reduction in overall runoff rates at the Site, improved water quality in receiving watercourses, and a decrease in downstream flood risk.

Surface water management measures will be implemented early in the project timeline, including the installation of silt fencing and delineation of riparian buffer zones prior to any internal road construction. Additional key elements, described in detail in the Surface Water Management Plan (**Appendix 2.1**), include:

- Open constructed drains to collect and treat development-related runoff.

- Collection drains for upslope "clean" water to ensure it is dispersed away from disturbed construction areas.
- Filtration check dams along roads running perpendicular to contours to reduce flow velocity and trap sediment.
- Settlement ponds, lagoons, proprietary systems like Siltbusters, and buffered outfalls to encourage sedimentation before discharge at greenfield runoff rates.

A combination of source, in-line, and end-of-line controls will be used during all construction activities. These include interceptor drains, check dams, silt fences, sumps, settlement ponds, level spreaders, vegetation filters, and proprietary systems such as Siltbusters. These measures are designed to capture and treat sediment-laden runoff and control flow velocities, reducing the risk of downstream impacts. Clean water diversion drains will also be installed upslope of construction areas to separate uncontaminated water from the treatment system.

Pre-commencement drainage works will include blocking of dry drains downgradient of construction areas, installation of silt traps and check dams, and implementation of a double silt fence system where work occurs within the 50m buffer zone of watercourses.

Pumped water from excavations will pass through silt bags before discharge to ensure sediment removal. All drainage features will be regularly inspected and maintained throughout the construction period.

To prevent sediment transport from spoil storage, temporary stockpiles will be covered or stabilised, and weather forecasts will be used to schedule works, with large-scale soil disturbance avoided during heavy rainfall events. The site team will monitor real-time rainfall data using Met Éireann resources and adjust activities accordingly.

There will be no direct site runoff to watercourses during construction. All outflows will be directed through sediment control features like check dams and stilling ponds and finally dispersed via diffuse overland flow through buffered outfalls.

To minimise treatment load, clean water drains will divert uncontaminated runoff away from the construction area. This proactive measure reduces the volume of potentially silt-laden water and the risk of suspended solids or dissolved substances entering nearby watercourses.

Contaminated water from construction activities such as excavations, drilling, and temporary stockpiling will be isolated, contained, and appropriately treated prior to any discharge.

Earthworks will be suspended in the event of an orange warning for rainfall. Prior to earthworks being suspended the following further control measures will be completed:

- All open spoil excavations will be secured and sealed.
- Temporary or emergency drainage will be created to prevent back-up of surface runoff.
- Working during heavy rainfall and for up to 24 hours after heavy events will not be allowed to ensure drainage systems are not overloaded.

Prevention of pollution from debris caused by vehicles during the crossing of watercourses within the Site on the site access track.

To minimise pollution risks at watercourse crossings, strict movement protocols for machinery will be enforced. There will be no tracking of machinery directly across watercourses. Instead, all plant will remain on designated access routes within the defined working corridor.

This working corridor will be clearly delineated using posts and high-visibility tape to prevent unintentional encroachment into sensitive habitats. The delineation ensures that contractors' plant remains within permitted areas and does not disturb adjacent watercourses or ecological features.

Where working within the 50m buffer is unavoidable, such as at watercourse crossings or upgrades to existing roads, additional controls such as silt fences and sediment barriers will be installed. These will serve to capture sediment and reduce the risk of pollution entering nearby waterbodies.

These measures will ensure that sediment and vehicular debris are retained and treated on-site, thereby protecting downstream aquatic habitats from turbidity spikes and sedimentation.

Prevention of pollution to Natura 2000 sites that are hydrologically connected downstream from the site

The Site drains into watercourses that are hydrologically connected to designated Natura 2000 sites downstream. To prevent any adverse effects on these protected habitats and species, a suite of mitigation measures will be implemented, including

Nature Based Solutions and a SuDS approach, ensuring no sediment or pollutants reach these sensitive receptors.

All surface water runoff will be directed through multiple treatment stages, including check dams, settlement ponds, and buffered outfalls, ensuring only clean, treated water is discharged. No direct discharge to watercourses will occur at any phase of the development.

If required, a Siltbuster or similar proprietary system will be used to enhance water treatment, particularly during high-risk activities like excavation and dewatering. This system, when managed correctly, reduces suspended solids and has an overall positive effect on water quality.

Additionally, early consultation with the OPW will ensure that scheduled drainage maintenance works do not coincide with construction activities, avoiding the potential for cumulative impacts on downstream water quality and, by extension, aquatic ecology within Natura 2000 sites.

Potential for accidental spillage of hydrocarbons and other pollutants including concrete laitance.

Accidental spillage of hydrocarbons, concrete, or other pollutants presents a known risk during construction. To mitigate this, robust dewatering and containment protocols will be in place.

Dewatering flow rates will be tightly regulated using inline gate valves or similar infrastructure to prevent sudden surges that could overload drainage and attenuation systems. Pumped water will be directed through an on-site treatment train or discharged to vegetated surfaces via silt bags, always outside designated buffer zones. Continuous monitoring and adaptive management of dewatering operations will be carried out to ensure environmental performance under varying site conditions. Contaminated water resulting from activities like drilling, excavation, and temporary stockpiling will be isolated, treated, and only discharged when safe and compliant.

These preventative measures, along with routine inspections and emergency spill response plans, will ensure no unintentional release of pollutants into surface waters.

Prevention of loss of natural watercourses due to 2 no. new watercourse crossings and the placement of bridges and culverts.

Two new watercourse crossings are proposed within the Site. These crossings will utilise clear-span bridges and culverts, with mitigation measures to avoid release of pollutants to downstream waters as detailed in **Chapter 10, Section 10.6.2.1**.

There will be no tracking of machinery through any watercourse. Construction plant will operate exclusively within designated routes and the established working corridor.

Where buffer zone encroachments are unavoidable for crossing works, appropriate sediment control measures such as silt fencing and settlement features will be installed to prevent mobilisation of sediment and protect aquatic habitats.

The design avoids in-stream works, thereby preserving channel morphology, flow continuity, and ecological connectivity. As a result, permanent loss or fragmentation of natural watercourses is not likely.

Management of Runoff from Spoil Storage Areas to prevent contamination of watercourses.

Spoil will be temporarily stored in the temporary spoil storage area (berm) shown on **Figure 1.2**. Where any spoil cannot be used for reinstatement and landscaping works it will be permanently stored in the permanent spoil storage area (berm) located at the back of the substation**.** This is further detailed in the **Spoil Management Plan** in **Appendix 2.1: Construction Environmental Management Plan** and fully assessed in **Chapter 9: Soils and Geology.** These designated spoil storage areas are located outside of the fluvial flood zones and above the 1 in 1,000-year flood level (refer to **Figure 10.4**). These spoil storage areas are also located outside of the 50m hydrological buffer zones. During the initial placement of subsoil, silt fences and biodegradable matting will be used to control surface water runoff from the spoil storage areas.

Where applicable the vegetative topsoil layer of the spoil storage areas will be rolled back to facilitate placement of excavated spoil, following which the vegetative topsoil later will be reinstated. Where reinstatement is not possible, the spoil storage areas will be sealed with a digger bucket and seeded as soon as possible to reduce sediment entrainment in runoff.

Drainage from the spoil storage areas will ultimately be routed to oversized swales and a number of stilling ponds and a 'Siltbuster' with appropriate storage and settlement designed for a 1 in 10 year return period before being discharged to the onsite watercourses.

Prevention of risk of chemical carryover from use of Siltbuster

Measures employed to prevent overdosing and potential chemical carryover:

- The Siltbuster system comprises an electronic in-line dosing system which provides an accurate means of adding agents so overdosing does not occur.
- Continued monitoring and water analysis of pre and post treated water by means of an inhouse lab and dedicated staff, means the correct amount of chemical is added by the dosing system.
- Dosing rates of chemical to initiate settlement is small, being in the order of 2-10 mg/L and the vast majority of the chemical is removed in the deposited sediment.
- Final effluent not meeting the discharge criteria is recycled and retreated, which has a secondary positive effect of reducing carryover.
- Use of biodegradable chemical agents can be used at very sensitive sites (i.e. adjacent to SACs).
- Sludge from the Siltbuster will be removed off site for disposal at a licenced facility.

Ecological Enhancement Proposals

The proposed Ecological Enhancement proposals at the Site includes the planting of approximately 0.669ha of woodland, 1.646km of hedgerow to compensate for the loss of existing hedgerow and the enhancement and re-vitalisation of 5.433km of existing degraded hedgerow. Further details are provided in the **BEMP** in **Appendix 6.2**.

Riparian planting plays a vital role in enhancing the resilience of freshwater ecosystems to climate change, while also providing critical support for fish species. Vegetation along watercourse margins offers shade, which helps regulate stream temperatures, an increasingly important function as rising air temperatures threaten to exceed thermal tolerances for sensitive fish, such as salmonids. The root systems of riparian plants stabilise banks, reduce erosion, and improve water quality by filtering runoff, thereby maintaining the clean, oxygen-rich habitats required for spawning and juvenile development. Additionally, leaf litter and woody debris contribute essential nutrients and structural habitat diversity, supporting aquatic invertebrates that form the base of the aquatic food web. By increasing habitat complexity, flood attenuation, and ecological connectivity, riparian planting serves as a natural buffer against climatedriven hydrological extremes and supports the long-term sustainability of fish populations.

The measures have limited potential to impact the hydrological/hydrogeological environment due to the scale of the proposed works. During the planting works there may be a potential for not significant, temporary negative effects on surface water quality when best practice measures for planting are followed (*e.g.*, avoiding planting directly in drains or in highly sensitive wetland areas). However, the long-term effect of the ecological enhancement will be a positive effect. To mitigate this, all planting works will be undertaken during dry weather.

This will also include preparatory work in the vicinity of all watercourses and all riverbank works. Method statements for watercourse crossings will be prepared at the construction stage and submitted to the ECoW for prior approval. All banksides in the vicinity of the new crossings will be fully reinstated with vegetation cover as quickly as possible using only native species appropriate to the existing environment.

To address the identified issue of livestock-induced pollution and physical damage to on-site streams, the implementation of protective fencing along stream corridors will be implemented. This would prevent cattle from directly accessing sensitive watercourses, thereby reducing bank erosion, sedimentation, and nutrient enrichment. As required under the European Union (Good Agricultural Practice for Protection of Waters) Regulations 2022, such measures are consistent with best practice for watercourse protection. To ensure animal welfare, alternative drinking water sources, such as troughs supplied from piped or rainwater-fed systems, should be provided outside of fenced riparian zones. Incorporating these protections into the project would likely have a net positive effect on local water quality and habitat integrity, particularly for species of conservation concern.

7.5.2.3 Mitigation by Reduction

The specified measures detailed below are aimed at protection of instream aquatic biota within the vicinity of any proposed works at watercourses on the Site but equally with regards to the protection of the downstream population of salmonids and other fish species. These measures are a summary of the principal requirements with full detail being presented in **Chapter 10: Hydrogeology and Hydrology**, which are transposed into the Construction Environmental Management Plan. The accompanying NIS deals with the hydrologically linked Natura 2000 sites.

During the construction phase the appointed contractor(s) will ensure that the following mitigation is adhered to in line with IFI (2016) Guidelines on Protection of Fisheries during Construction Works in and Adjacent to Waters:

- A buffer zone of at least 50m will be in place for the EPA mapped watercourses , with the exception of the sections of proposed Access Tracks to be constructed across the Maigue River and the Charleville (Stream) see **Drawing No. 6839-JOD-GGE-XX-DR-C-0202** and **Drawing No. 6839-JOD-GGE-XX-DR-C-0205** attached as part of the EIAR application.
- The Temporary Construction Compound and temporary spoil storage areas are located at a minimum distance of 50m from any watercourse as shown on planning drawings (**6839-JOD-GGE-XX-DR-C-0200 - 6839-JOD-GGE-XX-DR-C-0208**). All drainage from these facilities will be directed through a settlement pond with appropriate capacity and measures to provide spill containment. Details on how such measures will be applied (objectives, design considerations, layout) will be contained in a Surface Water Management Plan (SWMP) (appended to the CEMP in **Appendix 2.1**).
- All site drainage, as described in the SWMP (**Appendix 2.1 - MP3**) and shown on associated drawings (**6839-JOD-GGE-XX-DR-C-0301 – 6839-JOD-GGE-XX-DR-C-0304**), will be directed through either sediment traps, settlement ponds and/or buffered drainage outfalls to ensure that total suspended solid levels in all waters discharging to any watercourse will not exceed 25mg/l (IFI, 2016). All construction site run-off will be channelled through a stilling process to allow suspended solids to settle out and through a spill-containment facility prior to discharge.
- Daily monitoring of all sediment traps and settlement ponds will be undertaken by the Environmental Manager or Ecological Clerk of Works to ensure satisfactory operation and/or maintenance requirements. A full specification for the water quality monitoring is presented in the Water Quality Management Plan (WQMP) **Appendix 2.1 - MP 2**.
- The storage of oils, hydraulic fluids, etc., will be undertaken in accordance with current best practice for oil storage (Enterprise Ireland, BPGCS005).
- All machinery operating at the Site will be fully maintained and routinely checked to ensure no leakage of oils or lubricants occurs Vehicles will be refuelled off-site where possible. For vehicles that require being refuelled on-site, fuels will be stored in the temporary construction compound and bunded to at least 110% of the storage capacity of fuels to be stored. Refuelling will take place via a mobile double skinned fuel bowser. The bowser will be a double axel refuelling trailer which will be towed to the refuelling locations by a 4x4 vehicle. The 4x4 will carry a drip tray,

spill kit and absorbent mats in case of any accidental spillages. Only designated competent personnel will refuel plant and machinery on the Site.

- Any extensions to existing drainage culverts on the Site Access Roads will be undertaken in dry conditions and in low flow.
- During the culvert installation and associated construction work, double silt fences shall be installed immediately downgradient and downstream of the construction area for the duration of the construction phase.
- The pouring of concrete, sealing of joints, application of water-proofing paint or protective systems, curing agents, etc., will be completed in the dry to avoid pollution of the freshwater environment (see **Chapter 10** for further details). There will be no batching or storage of cement in the vicinity of any watercourse crossing construction area.
- Procedures (as detailed in **Chapter 10: Hydrology and Hydrogeology**) will be put in place to ensure the full control of raw or uncured waste concrete to ensure that watercourses will not be affected.
- Should there be any incidents of pollution to watercourses, immediate steps as specified in the Emergency Response Plan in the CEMP will be undertaken to resolve the cause of the pollution and where feasible, mitigate against the effect of pollution.
- Re-seeding / re-vegetation of all areas of bare ground or the placement of geo-jute (or similar) matting will take place prior to the operational phase to prevent silt-laden run-off. Seed mixes will contain only suitable native species of plant that occur in the local area. Species selection is outlined in **Section 2.4** of the **BEMP**.
- Silt traps erected during the construction phase within roadside and artificial drainage will be replaced with stone check dams for the lifetime of the project. These stone check dams will only be placed within artificial drainage systems such as roadside drains and not in natural streams or drainage lines.
- A full review of construction stage temporary drainage will be undertaken by the Developer (in conjunction with the Project Hydrologist/ Site Engineer and the Project Ecologist) following the completion of construction, and drainage removed or appropriately blocked where this will not interfere with infrastructure.

7.5.3 Operational Phase Mitigation

The following measures will be implemented during the operational phase to ensure the ongoing protection of watercourses and water quality at the Site and in downstream reaches in regard to the potential operational phase effects (Downstream flood risk, runoff resulting in contamination of surface waters and wastewater contamination):

- The Site compound / office will house all potential pollutants within a secure bunded COSSH store for the operational phase of the project.
- All onsite wastewater treatment facilities will function in full compliance with current water quality requirements (Building Regulations 2010 as amended S.R. 66:2015) to prevent nutrient loading entering aquatic environments. It is proposed to install a sealed underground holding tank for effluent (wastewater) from the Substation compound. The tank shall be routinely emptied by a licensed contractor.
- As discussed further in **Chapter 2: Project Description - Section 2.5.4 and Section 2.5.6**, design measures have been implemented that minimise both environmental and infrastructure risks associated with the Project. In the event of forecasted extreme flooding, a construction phase and operational phase flood event emergency response procedure has been prepared, further details can be found in **Management Plan 4: Surface Water Management Plan**. This will be further updated by the appointed contractor to take into consideration any planning conditions prior to construction activities commencing.
- Further details in relation to the flood zones and mitigation measures proposed can be found in **Chapter 10: Hydrology and Hydrogeology** and **Appendix 2.1: CEMP**

7.5.4 Decommissioning Phase Mitigation

Decommissioning of the Wind Farm will be scheduled to take place after the proposed 35-year lifespan has expired. Decommissioning phase effects for the Project are likely to be broadly similar to construction phase effects, in terms of potential surface water quality effects from ground disturbance, refuelling and the storage of potentially hazardous materials onsite. A Site-specific **Decommissioning Management Plan (DMP)** (**Appendix 2.1 CEMP – MP6)** has been developed and will be amended prior to the commencement of any decommissioning activities. The implementation of all mitigation measures detailed for the construction phase will be adopted in full during the decommissioning phase to ensure all such significant effects are avoided.

When the final Decommissioning Plan is prepared prior to decommissioning and presented as a standalone document for consideration by the relevant authority at that time, all drainage management measures, which will include maintenance of the operational drainage measures, will be included in that document, as required. However, it should be noted that by the time decommissioning is undertaken after the planned 35-year lifespan of the Project , the areas within the Site will have revegetated resulting in a resumption of the natural drainage management that will have existed prior to any construction. It is not anticipated that the decommissioning phase will interrupt this restored drainage regime in any way with the works proposed. As a minimum measure, areas where freshly placed soil material as part of Turbine Foundation reinstatement work will be surrounded by silt fencing if deemed necessary until the area has naturally revegetated.

The Grid Connection and the Substation will become an asset of the national grid under the management of ESB and& EirGrid and will likely remain in place permanently upon decommissioning of the Project as required by ESB/EirGrid. Wastewater from the substation will continue to be treated as underlined in **Section 7.5.3**, therefore no significant long-term effects on aquatic habitats or species are anticipated as a result of its permanent retention. However, regular maintenance of the drainage infrastructure will be necessary to ensure ongoing protection of downstream water quality and aquatic ecological receptors.

Biodiversity enhancement measures as set out in the Biodiversity Enhancement Management Plan (**Appendix 6.2 BEMP**) will have become part of the fabric of the local ecology and will be retained for the benefit of the local wildlife.

Restoration of the Site following decommissioning of infrastructure will require the prior establishment of the new baseline conditions at the Site which will have developed over the intervening 35-year life of the Project.
These studies will inform any modification or additional sensitivities that may need to be factored in restoration and site-specific measures.

7.6 RESIDUAL EFFECTS OF THE PROJECT

The approach to the Project design, the use of SuDS drainage and the suite of comprehensive measures to avoid, reduce or remedy all potential significant effects on water quality will ensure that the receiving water bodies in the catchment of the Project do not suffer any deterioration in water quality, either during construction, operation, or decommissioning.

A comprehensive assessment of potential residual effects to water quality is carried out in **Chapter 10: Section 10.7**.

With the appropriate mitigation in place there is expected to be no adverse residual effect on any aquatic species, habitat or on water quality at a local or catchment level as a result of the Project.

7.7 MONITORING

In order to verify the efficacy of pollution prevention and mitigation works during construction, water quality monitoring will be undertaken prior to, during and post completion of construction works. Monitoring will be undertaken in watercourses within the catchment as outlined in the CEMP, and in compliance with any potential conditions of planning consent. Monitoring will be overseen by a qualified and experienced Environmental Manager or Ecological Clerk of Works.

The specific monitoring requirements including frequency and parameters, are detailed in the **Chapter 10: Hydrogeology and Hydrology**.

Baseline monitoring undertaken at the Site as part of this study will be repeated periodically *i.e.*, before, during and after construction phase, to measure any deviations from baseline hydrochemistry that occur at the Site, including discharge rates.

7.7.1 Construction Phase Monitoring

The Site Environmental Manager (EM) will have a stop works authority. Weekly site meeting will include for scheduling of works according to weather forecast. Suitable locations (further downstream) for biological Q-Value sampling will be identified by Site EM.

- During the construction phase daily inspection of silt traps, settlement ponds, buffered outfalls and drainage channels will be undertaken. Routine measurement of total suspended solids, electrical conductivity, pH, and water temperature at selected water monitoring locations at the Site will be carried out. Monitoring of locations where excavations are being dewatered (likely high in solids) will be done in real time.
- One baseline monitoring visit (in advance of construction), including upstream and downstream biological Q value sampling and reporting.
- Once daily general visual inspections by site EM at all sample sites identified.
- Weekly grab sample inspections by site EM (Sample parameters will include, suspended solids, and on-site measurement of: turbidity, pH, temperature, electrical conductivity). At two locations within the WF site in man-made drains, and at SW3 and SW4.

- Monthly grab sampling by site EM at surface water monitoring locations SW3, SE4 and SW5 (refer to **Figure 10.5** in **Chapter 10**). Analysis suite will include (same as **Chapter 10 – Section 10.6.5** including suspended solids, BOD, nitrite, nitrate, ammonia, orthophosphate and chloride).
- An Ecological Clerk of Works ("ECoW") / Environmental Officer with an appropriate level of experience relevant to aquatic ecology will be present to supervise all water crossings
- Monitoring after heavy rain /prolonged rain events will be undertaken particularly downstream of spoil storage areas and drainage swales around the site to assess the ongoing efficacy of the mitigation measures.
- Daily monitoring of excavations by the Geotechnical Engineer will occur during the construction phase. If high levels of seepage inflow occur, excavation work will immediately be stopped, and a geotechnical assessment undertaken.
- During the construction phase of the project, the development areas will be monitored daily for evidence of groundwater seepage, water ponding and wetting of previously dry spots, and visual monitoring of the effectiveness of the constructed drainage and attenuation system so that it does not become blocked, eroded or damaged during the construction process.

7.7.2 Post-construction phase monitoring

- During the operational phase of the Project the stilling ponds and buffered outfalls will be periodically inspected during maintenance visits to the Site.
- Water monitoring on nearby natural watercourses will be undertaken during and post construction to determine if any pollution has migrated off-site, and if so, measures will be implemented to rectify the impact, as agreed with relevant statutory agencies (e.g. Inland Fisheries Ireland (IFI)).
- Monthly inspections and grab sampling during post construction for 3 months.
- Annual upstream and downstream biological Q value sampling and reporting, including one post construction event.

7.8 CUMULATIVE OR IN-COMBINATION EFFECTS

The Habitats Directive requires competent authorities to make an Appropriate Assessment of any plan or project which is likely to have a significant effect alone or in-combination with other plans and projects. This is carried out in this chapter in respect to potential significant effects to aquatic ecology.

The greatest potential for cumulative impacts on aquatic ecology arises during the construction phase, when activities such as earthworks, excavation, and the use of cementitious materials pose a heightened risk of sediment runoff, hydrocarbon release, and discharges into nearby watercourses. These impacts could collectively degrade water quality and affect sensitive aquatic habitats, particularly those supporting protected species. In contrast, the operational phase presents a substantially lower risk to aquatic environments, as no open excavations or sediment-generating activities will occur, cement use will cease, and only minimal quantities of fuels or oils will be stored on-site. During the decommissioning phase, while some risk to aquatic ecology remains, it will be significantly reduced relative to the construction phase due to the limited scale of ground disturbance and the implementation of best-practice mitigation measures developed at that time.

7.8.1 Potential Cumulative Effects with Other Wind Farm Developments and Grid Connections

There are 10 wind farms within 20km of the Site of which 7 are operational, 1 is consented and 2 are proposed. **Figure 2.1** shows the location of proposed, permitted and operational wind farms within a 20km radius of the proposed turbines and **Table 2.1** provides further information on these wind farms. The closest wind farms in operation are Rathnacally Wind Farm (2 turbines) located approximately 5.9km to the south of the Site and Boolard Wind Farm (2 turbines) located approximately 9 km southwest of the Site. The closest proposed wind farms are Ballinlee Wind Farm (17 turbines) located approximately 7.7km to the Northeast of the Site and Annagh Wind Farm (6 turbines) located approximately 8.6km to the South of the Site The remaining 6 wind farms are located at distances ranging from 11.3 km to 20.7 km from the Site.

While ten wind farms have been identified within a 20 km radius of the proposed site, the potential for cumulative effects, particularly on aquatic ecology, hydrology, and other environmental receptors, is considered to be low. All of these projects are located at distances greater than 5 km from the Site. **Table 10.21** in **Chapter 10 (Hydrology and Hydrogeology**) identifies whether any of the nearby wind farms are located within the outlined catchment study area for the Project. Only one wind farm, the operational Slieveragh Wind Farm, falls within this area. This site drains to the Loobagh River and is located along the eastern boundary of the aquatic study area. The most recent Q-value assessment in 2023 at monitoring station RS24L010200 (Easting 166554, Northing 124729) located at Ballinanima Bridge (M45) on the IE_SH_24L010200 waterbody recorded a Q-value of 4, indicating Good ecological status under the WFD.

Historic biological monitoring data from this station shows a consistent Q-value of 4 across all assessment years since 1971, indicating sustained Good ecological status with no evidence of deterioration in water quality since wind farm operations commenced in the area (https://epawebapp.epa.ie/). As Slieveragh Wind Farm is already operational, it is unlikely that there will be cumulative effects on aquatic ecology. Given the robust mitigation measures in place, particularly those relating to surface water and sediment control, no significant cumulative effects are anticipated on water quality, aquatic habitats, or species. Furthermore, each development is subject to its own environmental assessment and regulatory control, ensuring that environmental thresholds are not exceeded when considered in combination. Therefore, the cumulative impact of the proposed Project alongside other wind farm projects in the area is not considered to be significant.

7.8.2 Potential Cumulative Effects with Agriculture

The proposed Site is located within a predominantly agricultural landscape, where existing pressures on local watercourses, particularly the River Maigue, are primarily attributed to agricultural practices across the catchment. Agriculture is recognised as the most significant pressure on water quality in Ireland, with activities such as soil disturbance, livestock access to watercourses, and the use of fertilisers and pesticides contributing to the elevation of nutrient levels, particularly nitrogen and phosphorus, and the entrainment of suspended solids into surface waters. These diffuse pollutants can lead to adverse effects on aquatic ecology, including eutrophication, loss of habitat quality, and impacts on sensitive species and aquatic community structure.

Within the Site itself, agricultural activity is expected to decrease during the construction phase, reducing direct local inputs from farming. However, in an unmitigated scenario, the Project could potentially interact with ongoing agricultural pressures in the wider catchment. This could occur via temporary emissions of suspended solids, sediment, or cementitious materials, and the possible release of trace levels of ammonia from ground disturbance or machinery operation. Such interactions could contribute to localised degradation of water quality and pose a risk to aquatic habitats and species, particularly in watercourses that are already considered 'At Risk' under the Water Framework Directive.

Nevertheless, with the implementation of robust mitigation measures, as outlined in **Section 7.5** during the construction, operation, and decommissioning phases will ensure that the Project does not result in any deterioration in the status of water bodies.

These measures include effective surface water management, sediment control, protection of riparian zones, and pollution prevention protocols, which collectively safeguard water quality and support the ecological integrity of downstream aquatic environments.

Given the reduced agricultural activity on-site during construction and the effectiveness of the proposed mitigation, it is concluded that the Project will not contribute to a significant cumulative effect on aquatic ecology in combination with ongoing agricultural pressures in the surrounding catchment.

7.8.3 Potential Cumulative Effects with Other Developments and Projects

A list of all other proposed or permitted developments larger than a once-off house within 10 km of the proposed Garrane Green Energy Project are listed in **Table 2.2** of **Chapter 2** in this EIAR. There are numerous developments within 10km which are of considerable size, such as the proposed M20 Motorway, a roundabout at O' Rourke's Cross, two solar farm developments located 3.8km north and 8.7km southwest respectively, and a 56 - unit residential development located 3.9km south. Other developments in the area are generally for change of use of existing buildings and the construction of a recreational 'Astro Turf' football pitch. On the TDR, the most significant proposed development is the proposed Foynes to Limerick Road (which includes the Adare bypass). Given that these projects are not within the catchment wide ZOI of this assessment, there is no potential for overlapping impacts. Furthermore, when considered alongside the robust mitigation measures detailed throughout this report for the protection of the water environment, it is concluded that the proposed Project, across its construction, operational, and decommissioning phases, will not contribute to any significant cumulative effects in combination with other ongoing or planned developments in the area.

An Industrial Emissions (IE) licence (P0386-04) is held by Kerry Ingredients (Ireland) Ltd for the Rathgoggan North WwTP, which discharges treated effluent to the River Maigue downstream of its confluence with the Loobagh River. The discharge is regulated under strict ELVs for parameters relevant to aquatic ecology, including BOD, COD, suspended solids, nitrogen, ammonia, and orthophosphate. The 2024 AER confirms the facility is compliant with these limits.

Mitigation measures outlined for the Project in **Section 7.5** will protect downstream water quality and aquatic habitats during all phases of the project. If a Siltbuster system is used, careful dosing and monitoring will ensure no elevation in COD or other pollutants. With these controls, the Siltbuster is expected to improve water quality. As a result, no significant cumulative effects on aquatic ecology are anticipated in combination with the existing licensed discharge.

The Water Framework Directive Status (2016-2021) was reviewed for all watercourses within the proposed Site to determine the potential for significant adverse effects on water quality as a result for the proposed Project in combination with other plans and/or projects. The River Maigue (EPA ID: MAIGUE_030) and Charleville stream (EPA ID: CHARLEVILLE STREAM_020) were both classified as of 'Moderate' status. The Loobagh River (EPA ID: LOOBAGH_030) was classified as of 'Good' status. All watercourses within the proposed Project Site are classified under the Water Framework Directive Risk 3rd Cycle were defined as 'At risk', while the Loobagh River was defined as 'Not at risk'. The proposed site is located across three Groundwater Bodies; Charleville (EPA ID: IE_SH_G_055), North Kilmallock (EPA ID: IE_SH_G_193) and the Hospital (EPA ID: IE_SH_107). All three groundwater bodies are defined as of 'Good' status according to the Water Framework Directive Groundwater Body Status (2016-2021). The Hospital Groundwater Body is deemed 'Not at risk' according to the Water Framework Directive Risk Status, while the North Kilmallock and the Charleville are both deemed 'At risk'.

A review of the Water Framework Directive (WFD) status (2016–2021) for waterbodies within and adjacent to the proposed development indicates that the River Maigue (MAIGUE_030) and the Charleville Stream (CHARLEVILLE STREAM_020) are currently classified as having 'Moderate' status and are deemed 'At risk' under the WFD 3rd Cycle Risk Assessment. Therefore, any deterioration in water quality arising from the proposed development could have significant implications for compliance with the European Commission Environmental Objectives (Surface Waters) (S.I. No. 272 of 2009, as amended).

Taking this into account, the potential for direct and indirect adverse effects on these watercourses has been carefully assessed. Any negative impacts arising during the construction phase, such as the release of suspended solids, hydrocarbons, or cementitious materials, are considered to be short-term and temporary in nature. These risks will be effectively managed through strict adherence to robust mitigation measures (as outlined in the CEMP), which are specifically designed to protect water quality and ecological integrity.

Furthermore, there is no reasonable likelihood of cumulative long-term adverse effects from the proposed Project, either alone or in combination with other plans or projects, due to the absence of significant nearby developments and the implementation of best-practice environmental controls. The proposed Project has been designed and will be executed in such a way that no deterioration in the status of any surface water or groundwater body will occur, in full compliance with the requirements of S.I. 272 of 2009 (as amended) or is it likely to affect the chemical status of any water bodies or hinder their ability to achieve the objectives set out under the Water Framework Directive and its transposing legislation.

7.9 SUMMARY OF SIGNIFICANT EFFECTS

The potential sources of environmental impact associated with the construction, operational, and decommissioning phases of the proposed Project have been identified (see **Section 7.4**). In the absence of appropriate mitigation, these sources could result in short-term adverse effects on aquatic ecology at the local scale, including possible disturbance to sensitive flora and fauna within watercourses surveyed. There is also a theoretical risk of modification to natural watercourses from proposed crossings and bridge installations; however, the complete loss or fragmentation of natural watercourses is considered highly unlikely due to the use of clear-span bridge designs and avoidance of in-stream works.

Importantly, the project has been designed and will be implemented in accordance with Article 5 of the EC Environmental Objectives (Surface Waters) Regulations 2009, which prohibits any development that would result in a deterioration in the status of a surface water body. The mitigation measures proposed have been specifically developed to ensure that there is no deterioration in the ecological or chemical status of any surface water or groundwater body. Therefore, with these measures fully in place and implemented, no significant effects on aquatic ecology are predicted to occur as a result of the Project.

Furthermore, any potential cumulative or in-combination effects on downstream Natura 2000 sites within the zone of influence (ZoI) have been assessed in the accompanying Natura Impact Statement (NIS). With the proposed mitigation in place, no adverse effects on the integrity of any European site are anticipated, either alone or in combination with other plans or projects.

7.10 STATEMENT OF SIGNIFICANCE

In the absence of mitigation measures, appropriately designed, implemented and managed, there is deemed to be a potential for adverse significant short-term environmental effects from the project, as listed above. However, it is considered that with the proposed mitigation (outlined in **Section 7.5** and the accompanying **Chapters 2 & 10** of the EIAR) successfully implemented, the proposed Project will result in an overall negligible to low residual effect and therefore no likely significant effects upon the aquatic ecological features that lie within the Zone of Influence for the duration of the construction, operational and decommissioning phases.

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