TOBIN

# Future Energy Ireland
# Lissinagroagh Wind Farm
# Aquatic Report 2025

Ireland FuturEnergy

BUILT ON KNOWLEDGE

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# 1. INTRODUCTION

## 1.1 BACKGROUND

FuturEnergy Ireland are proposing to develop Lissinagroagh Wind Farm in County Leitrim (herein referred to as the proposed development). The proposed development is located approximately 2km northeast of Manorhamilton. The proposed development will comprise the installation of 14 wind turbines, associated foundations, hard-standing areas, all associated onsite and ancillary works and the grid connection route (GCR).

This report presents the baseline information of the aquatic habitats and species of ecological importance within the study area of the proposed development and is based on an aquatic survey and associated desktop study.

Previous aquatic surveys were carried out in 2020 and 2021 and comprised biological water quality monitoring, aquatic habitat assessment (see Appendix D) and an electrofishing survey (see Appendix A). As the proposed site layout design was substantially changed and the aquatic survey results were out of date (>5 years), the survey site locations were redesigned, and a complete new biological water quality monitoring and aquatic habitat assessment was carried out. The previous aquatic ecology and electrofishing report are added as appendix and the findings will be referenced where useful.

## 1.2 LEGISLATION AND POLICIES

The following legislation was taken into account:

- European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. 477 of 2011), as amended, with particular reference to the First Schedule of the European Union (Invasive Alien Species) Regulations 2024 (S.I. No. 374/2024) which deals with invasive species;
- European Union (EU) (Environmental Impact Assessment and Habitats) (No. 2) Regulations 2015 (S.I. No. 320/2015);
- Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds, herein referred to as the Birds Directive;
- The EU Water Framework Directive (2000/60/EC);
- The Wildlife Acts 1976 to 2025 (as amended), herein referred to as the Wildlife Acts;
- The Flora (Protection) Order 2022 (S.I. No. 235/2022);
- The Inland Fisheries Acts 1959-2025, as amended.

# 2. METHODOLOGY

## 2.1 DESK STUDY

A desktop study encompassing a review of information and literature relating to the study area, legislation/designations and other notable ecological records, was carried out. The sources reviewed included;

- NBDC website, records of protected flora, fauna and invasive species within the 10km grid squares that corresponded with the Lisnagroagh Wind Farm and GCR (G72, G82, G83 and G93) were obtained from the NBDC (2025) database;
- Identification of all sites designated for nature conservation within the study area (NPWS, 2025a) and a review of the NPWS site synopsis, Natura 2000 data forms, and Conservation Objectives for European sites within the Zone of Influence (ZoI) of the proposed development;
- NPWS datasets on Annex I habitats and Annex II species (NPWS, 2025b);
- A sensitive data request for Lisnagroagh Wind Farm was issued to the NPWS on 02-04-2025 and to date no NPWS data package was received;
- WFD website 'Catchments.ie' (EPA, 2025a);
- Inland Fisheries Ireland Barrier Programme (IFI, 2025)
- Environmental Protection Agency mapping database (EPA, 2025b);
- Inland Fisheries Ireland (IFI) WFD fish monitoring data (IFI, 2023);

For a prior outdated site layout an electrofishing survey and report was carried out (Aztec, 2021) see Appendix A. Most of the survey sites do not overlap with the current survey sites but where relevant, the data was used as part of the desktop study and to determine fish habitat suitability in Section 3.2.

## 2.2 AQUATIC FIELD STUDY

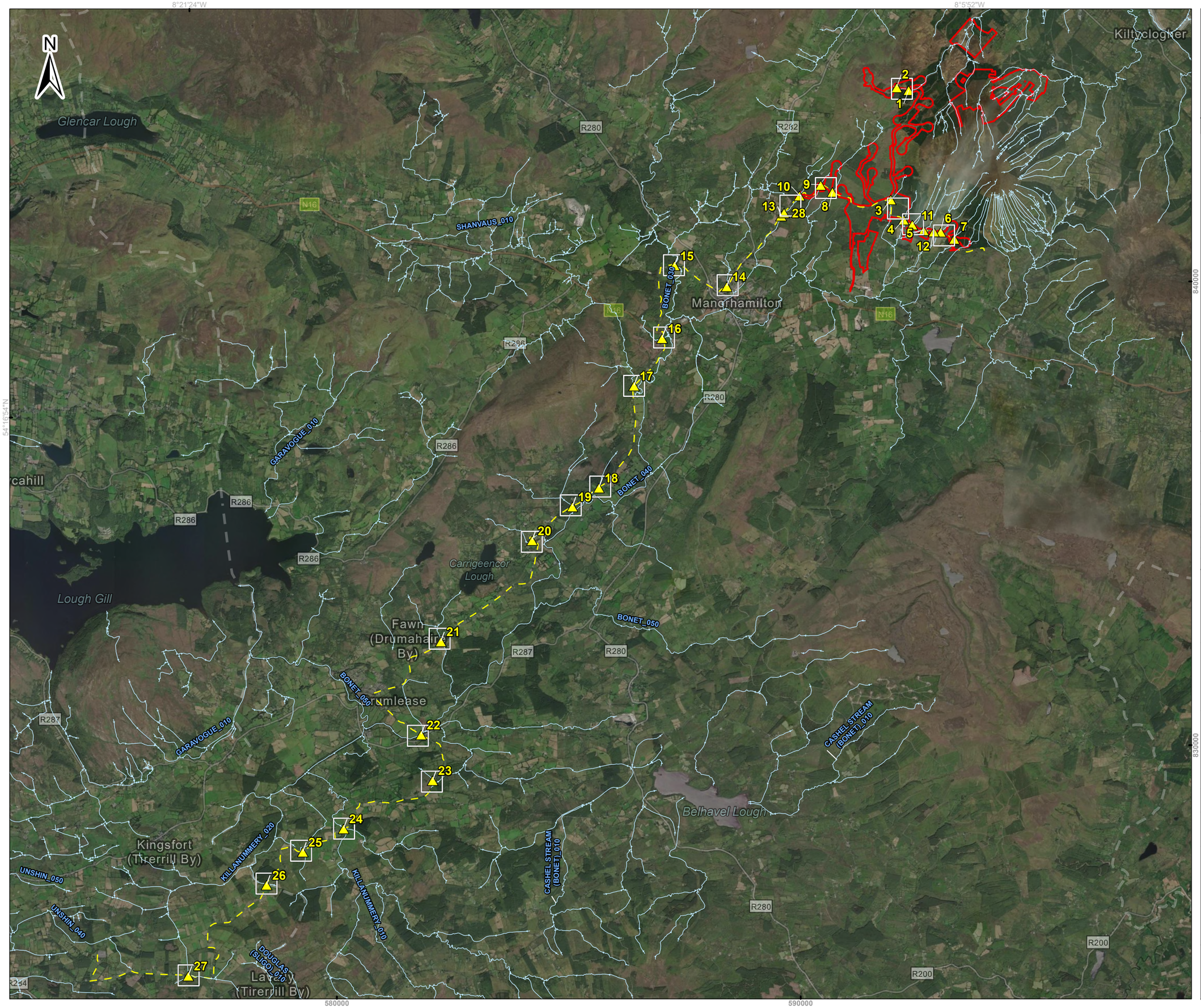
### 2.2.1 Aquatic Survey Site Selection

Representative survey locations on watercourses within the study area were selected for surveying using expert judgement of the proposed development site layout:

- Sites within the proposed development site boundary where proposed infrastructure (eg roads and turbine hardstands) are proposed to be constructed over or lie adjacent to a watercourse were selected (Site 1 to 12).
- Sites where the GCR crosses a waterbody (Site 13 to 28).

A total of 28 aquatic survey sites were selected within the study area, on known watercourses mapped by the EPA (2025). For survey sites where no access was granted by the landowner, a visual habitat assessment was conducted from a suitable vantage point (eg a road bridge).

Surveys were conducted over ten days from the 25th of August until the 5th of September. All aquatic field survey sites were accessed using public roadways, forest tracks, and across private lands where permitted. A list of the survey site locations is provided in Table 3-1. A map of the entire study area and the survey locations within the study area is shown on Figure 2 1.





**Legend**

- Application Boundary
- Map extents
- Grid Connection Route
- Aquatic Survey Locations
- WFD - River Water Bodies

0 2 4
Kilometers

**Spatial Reference**
Datum: IRENET95
EPSG: 2157



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| A | 25/03/2026 | First issue | S.P | S.R |

Client: FuturEnergy Ireland

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Title: Figure 2-1: Aquatic Survey Site Locations Overview

Scale @ A3: 1:75,000

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Map Ref: 10955-001.AqR-Aq..SURV.L-GCR-TOB_Overview

Draft: A

### 2.2.2 Riverine Habitat Survey

The aquatic ecological assessment included a habitat assessment of the receiving watercourses within the study area. The habitat assessment of the watercourses followed methodologies outlined in the Environment Agency's 'River Habitat Survey in Britain and Ireland Field Survey Guidance Manual' (EA, 2022) and the Irish Heritage Council's 'A Guide to Habitats in Ireland' (Fossitt, 2000).

An assessment was made on the suitability of the habitat to support aquatic species of conservation concern (e.g. White-clawed Crayfish (*Austropotamobius pallipes*), Lamprey species (*Lampetra* sp.), Atlantic Salmon (*Salmo salar*), Otter (*Lutra lutra*) and Kingfisher (*Alcedo atthis*). A broad appraisal/overview of the upstream and downstream habitat at each site was undertaken to evaluate the wider contribution to salmonid and lamprey spawning and to assess if suitable and accessible habitats were present to support the above mentioned species.

Aquatic surveys were conducted along the selected sites and consisted of kick sampling for macroinvertebrates to assess water quality. Macrophytes, bryophytes and Invasive Alien Species (IAS) were recorded at each site.

All watercourse survey locations were assessed in terms of:

- Waterbody width and depth;
- Bank width and banks heights;
- 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 and bryophytes occurrence and their percentage coverage of the stream bottom at the sampling sites; and
- Riparian vegetation composition on banksides and cover offering shading.

Each sampling site along the watercourse was described in terms of the important aquatic habitats and species recorded (i.e. based on their conservation value) to determine the ecological valuation of each aquatic survey site.

### 2.2.3 Aquatic Habitat and Species Survey

The habitat suitability for sensitive species and Annex I habitats was fully assessed and all watercourses were photographed at survey site locations throughout the study area.

#### *2.2.3.1 Salmonids*

River habitat surveys and fish assessments were carried out utilising elements of the approaches in the Fishery Assessment Methodology (O'Grady, 2006) and 'Ecology of the Atlantic Salmon' (Hendry and Cragg-Hine, 2003) to broadly characterise the river sites (i.e. channel profiles, substrata etc.). Any fish captured were identified with reference to the Freshwater Biological Association's publication 'Field Key to the Freshwater Fishes and Lampreys of the British Isles' (Wheeler, 1998).

#### 2.2.3.2 Lamprey spp.

An evaluation of potential lamprey habitats within the study area was made with reference to methodologies outlined in 'Ecology of the River, Brook, and Sea Lamprey' (Maitland, 2003). Any fish captured were identified with reference to the Freshwater Biological Association's publication 'Field Key to the Freshwater Fishes and Lampreys of the British Isles' (Wheeler, 1998).

#### 2.2.3.3 White-clawed Crayfish

An assessment of the habitat to support White-clawed Crayfish was also undertaken following methodologies outlined in 'Guidance on Habitat for White-clawed Crayfish' (Peay, 2002). This included a visual survey for suitable refugia such as boulders, macrophyte or riparian root structures and burrows in the bank. Crayfish are typically caught during kick net sampling if they are present but a hand search was also carried out if suitable refugia was present.

#### 2.2.3.4 Otter

Signs of otter (spraints, food remains, footprints, slides, couches and holts) were searched for within 150m of the site, where accessible, according to the document 'Otters & Development' (NIEA, 2011).

#### 2.2.3.5 Macrophytes and Riparian Habitats

Macrophytes were identified on site where possible according to the book 'Aquatic Plants in Ireland, a Photographic Guide' (Caffrey et al., 2023) and bryophytes were identified where possible according to the book 'Mosses and Liverworts of Britain and Ireland' (Atherton et al., 2010). This was carried out because many species are water quality indicators (good or bad) and to assess if the habitats correspond to the Annex I habitats, e.g., 'Water courses of plain to montane levels, with submerged or floating vegetation of the *Ranunculion fluitantis* and *Callitricho-Batrachion* [3260]' which usually comprises water crowfoot (*Ranunculus* pp.), water starwort (*Callitriche* spp.), Pondweed (*Potamogeton* spp.), water milfoil (*Myriophyllum* spp.) and aquatic mosses (eg *Fontinalis antipyretica*). This habitat is commonly referred to as 'floating river vegetation'. The riparian habitats were also assessed as its ecological connection is crucial to good water quality, especially habitat types such as Riparian Woodland (WN5) and Wet Willow Alder Ash Woodland (WN6) which may correspond to Annex I Alluvial Woodland (*Alluvial forests with Alnus glutinosa and Fraxinus excelsior (*Alno-padion*, *Alnion incanae*, *Salicion albae*) (91E0).

#### 2.2.3.6 Macroinvertebrates

Macroinvertebrates were identified to family level (the minimum level of identification necessary to determine Q value for most groups according to Toner *et al.* (2005) and to genus or species level where possible to do so in the field. The publications used to identify these macroinvertebrates included the Field Studies Council Aidgap series books on major groups of freshwater invertebrates, caddis larvae, mayfly nymphs and stonefly nymphs.

### 2.2.4 Biological (Kick-) Sampling

Semi-quantitative sampling of benthic (or bottom dwelling) aquatic macroinvertebrates was undertaken at selected sites using 'travelling kick method' and stone washing method which are

used as standard by the EPA (Toner, *et al.* 2005; EPA, 2015). Weed sweeping was also undertaken, where appropriate habitat existed, to ensure a representative sample of the site was collected. The Quality Rating (Q) System (Toner *et al.,* 2005) and the Small Streams Risk Score (SSRS) (EPA, 2015) was used to obtain a water quality rating for each site.

A semi-quantitative, two-minute macroinvertebrate kick-sample was collected from the riverbed, from the faster flowing riffle habitats where possible. A standard 500µm mesh D-shaped kick net was submerged on the riverbed with the mouth of the net directed upstream. The substrate just upstream of the net was disturbed (with the foot, in a kicking motion) for two minutes in order to dislodge invertebrates into the net. The surveyor moved in a diagonal direction upstream to ensure that different micro-habitats in the waterbody, such as fast-moving riffles, glides and pools were included in the sample.

A further one-minute hand search was carried out to locate macroinvertebrates that may have remained attached to the underside of the cobbles (Toner *et al.,* 2005). This sampling approach is sufficient to achieve a suitable representation of taxa for bioassessment. Occasionally, when the substratum (e.g. bedrock) or flow conditions made kick-sampling difficult, or the abundance of macroinvertebrates collected was extremely low, it was necessary to spend a longer amount of time sampling the river to accumulate a sufficient diversity and abundance of macroinvertebrates. This sampling approach requires avoidance of obvious localized disturbance (e.g. cattle access points) which may adversely influence the sample taken. Once a live sample was collected, the macroinvertebrate assemblages of each sample were identified and counted on the riverbank. Once all taxa and their relative abundance were recorded, the sample was returned to the river.

### 2.2.5 Water Quality- Biological River Classification System (Q-Scheme)

The national Irish methodology to measure biological water quality was established by the EPA (EPA, 2006). The quality rating system (Q-value) methodology was designed to meet the specific monitoring requirements of the EU Water Framework Directive (WFD) and to support the development and implementation of the river basin management plans. According to the WFD, all EU states are required to obtain 'good status' (i.e. Q4) by 2027 (EPA, 2025a).

The biological water quality kick sampling survey (see Section 3.4.2.2.2) provided baseline macroinvertebrate species compositions which are used to determine water quality by assigning a Q-value to the sampled waterbodies. This involved recording the macroinvertebrate taxa present at a suitable and attainable taxonomic resolution (family level) and their categorical relative abundance determined using exact counts and approximate counts where species abundance was excessive. The relative proportions of taxonomic groups were recorded based on the EPA categories (i.e. 8 categories ranging from present, 1 or 2 individuals, to excessive, >75% occurrence) and the presence of good or bad macrophyte and macroalgae indicator species is also taken into account (Appendix I of (Toner et. al., 2005).

Biological water quality data, as prescribed by the EPA (Toner et al., 2005), group invertebrates into classes whereby species highly intolerant to pollution and low dissolved oxygen levels are denoted Class A, and species with greater tolerance to pollution and dissolved oxygen levels fall into the successive classes B, C, D and E where high abundance D and E classes indicate severe water quality issues. As such the presence or absence of these groups and their relative

abundances facilitate an assessment of biological river health. The classes encountered are described in the site descriptions (see Section 3.2) and in the macroinvertebrate summary table (see Appendix B).

The Q-value system comprises a five point scale (Q1-Q5: with intermediate scores obtainable, e.g. Q3-4) based on the proportions of five groups of macroinvertebrates, with different pollution tolerances with Q1 being of poorest quality and Q5 being pristine/unpolluted (see Table 2-1).

Table 2-1: Biotic index scoring system for the Q-scheme

| Biotic Index | Quality Status | Quality Class | Water Quality |
|---|---|---|---|
| Q5, 4-5, 4 | Unpolluted | Class A | High |
| Q4 | Unpolluted | Class A | Good |
| Q3-4, | Slightly Polluted | Class B | Moderate |
| Q3, 2-3 | Moderately Polluted | Class C | Poor |
| Q2, 1-2, 1 | Seriously Polluted | Class D | Bad |

### 2.2.6 Small Stream Risk Score

The Small Streams Risk Score (SSRS) is a biological risk assessment system for identifying rivers that are 'at risk' of failing to achieve the 'good' water quality status goals of the WFD. It was developed by the Environmental Protection Agency (EPA) in association with the Western River Basin District (WRBD) in 2006.

The SSRS method is a rapid field methodology for risk assessment that is based solely on Macroinvertebrate indicators of water quality and their well-understood response to pollution. Importantly the SSRS score indicates whether or not the stream is at risk from pollution and not the ecological health of the stream. The SSRS score ranges from 0-11.2 (EPA, 2015).

In this method, the macroinvertebrates present in the water course are analysed and a grade of water quality is given to the water course based on the numbers and types of macroinvertebrate species present. The system looks at five main macroinvertebrate groups:

- Ephemeroptera (Mayfly)
- Plecoptera (Stonefly)
- Trichoptera (Caddis Fly)
- G.O.L.D. (Gastropods, Oligochaetes, Leeches, Diptera)
- Asellus

Each group is given a score based on the number of taxa present and their abundance. Species that are more sensitive to pollution (e.g. Mayfly) are given a higher score and those that are more tolerant of pollution (e.g. Asellus) are given a lower score. To obtain the final score, the score associated with each group is added together and divided by 5 to get an average result. This average is then multiplied by two to give the final Small Streams Risk Score (SSRS). Table 2-2 below shows the categories associated with the final score.



Table 2-2: Small Streams Risk Score Categories

| SSRS score | Quality Status |
|---|---|
| <6.5 | Stream at Risk |
| >6.5-7.25 | Indeterminate stream may be at risk |
| >7.25 | Probably not at risk |

## 2.3 BIOSECURITY

A biosecurity protocol, recommended by IFI, was also adhered to during the surveys. All equipment and Personal Protection Equipment (PPE) was disinfected with Virkon® prior to and post-survey completion, and best practice precautions were employed to prevent the potential spread of invasive species and water-borne pathogens between sites, according to standard IFI biosecurity protocols (IFI, 2010).

# 3. RESULTS

## 3.1 SUMMARY AQUATIC DESK STUDY RESULTS

A comprehensive desk study was carried out as part of this project which is formulated and further described in the biodiversity chapter (TOBIN, 2025). A summary of the desk study concludes that the following species are present at the wind farm site or GCR route (IFI, 2023; NBDC, 2025):

- Otter (*Lutra lutra*; EU Habitats Directive Annex II and IV)
- White-clawed crayfish (*Austropotamobius pallipes*; EU Habitats Directive Annex II and V)
- Atlantic Salmon (*Salmo salar*; EU Habitats Directive Annex II and V, Inland Fisheries Amendment Act 2017)
- Brown trout (*Salmo trutta*; Inland Fisheries Amendment Act 2017)
- River lamprey (*Lampetra fluviatilis*; EU Habitats Directive Annex II and V, Inland Fisheries Amendment Act 2017)
- Brook lamprey (*Lampetra planeri*; EU Habitats Directive Annex II, Inland Fisheries Amendment Act 2017)
- European Eel (*Anguila anguila*; Inland Fisheries Amendment Act 2017, Critically Endangered on Ireland's Red List (King et al., 2011)
- Kingfisher (*Alcedo atthis*; EU Birds Directive Annex I, Wildlife Act 2024)

### 3.1.1 Electrofishing Results 2021

Electrofishing was carried out in 2021 (see Appendix A) in waterbodies within the wind farm site and on connected waterbodies outside of the wind farm site. The following fish species were recorded:

- Brown Trout
- Atlantic Salmon

No lamprey species or European eel were recorded at any of the electrofishing sites.

A map showing the electrofishing sites is shown below in Figure 3-1. These sites and the findings are referenced in the site descriptions below where relevant.

8°11'10"W 8°9'20"W 8°7'30"W 8°5'40"W 8°3'50"W

54°22'0"N 54°21'0"N 54°20'0"N 54°19'0"N

846000 844000 842000 840000

590000 592500 595000 597500

N

e1 e2 e3 e4 e5 e6 e7 e9 e10 e11 e12 e14 e15 e16 e17

R282 R281 R283 R28

T1 T2 T3 T4 T5 T6 T7 T8 T9 T10 T11 T12 T13 T14

1 2 3 4 5 6 7 8 9 10 11 12 13 28 14

Kilcoo

Kilcoo River

Kiltyclog

BONET_030

Skreeny

Skreeny (Rosclogher Bay)

Manorhamilton

N16


## Legend

- Survey Area of the proposed Wind Farm Site
- Application Boundary
- Turbine Locations
- Electrofishing Survey Sites
- Aquatic Survey Locations
- WFD - River Water Bodies

0 0.5 1
Kilometers

**Spatial Reference**
Datum: IRENET95
EPSG: 2157



| Rev | Date | Description | By | Chkd. |
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Client: FuturEnergy Ireland

Project: Lissinagroagh Wind Farm

Title: Figure 3-1: Overview of 2021 electrofishing sites relative to the 2025 aquatic survey sites

Scale @ A3: 1:29,000

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Map Ref: 10955-002..AqR-E.FISH-GCR-TOB-A

Draft: A

### 3.1.2 Hydrology

The study area was defined as surface waters potentially affected by the proposed development, including watercourses within the proposed development site and those downstream. There was no fixed distance applied for the study area downstream, as site specific conditions determine the potential downstream transport of pollution and sediment runoff. Table 3-1 shows the EPA stream name and code, the order (1 is the outermost tributary and order 5 is where the river flows into an estuary) and the Water Framework Directive water body code.

Table 3-1: Hydrology overview of sites

| Site nr | Site name | Order | EPA code | WFD River Waterbody Code |
|---|---|---|---|---|
| 1 | Lisdarush Stream | 1 | 35L68 | Lattone 35_010 |
| 2 | Lisdarush Stream | 1 | 35L68 | Lattone 35_010 |
| 3 | Unnamed Stream | 1 | NA | Owenmore (Manorhamilton)_020 |
| 4 | Unnamed Stream | 1 | NA | Owenmore (Manorhamilton)_020 |
| 5 | Mt Dough River | 3 | 35M62 | Owenmore (Manorhamilton)_020 |
| 6 | Moneenshinnagh 35 Stream | 2 | 35M60 | Owenmore (Manorhamilton)_020 |
| 7 | Unnamed Stream | 1 | NA | Owenmore (Manorhamilton)_020 |
| 8 | Skreeny River | 3 | 35S46 | Owenmore (Manorhamilton)_020 |
| 9 | Unnamed Stream | 1 | NA | Owenmore (Manorhamilton)_020 |
| 10 | Curraghfore Stream | 2 | 35C68 | Brackary_010 |
| 11 | Unnamed Stream | 1 | NA | Owenmore (Manorhamilton)_020 |
| 12 | Unnamed Stream | 1 | NA | Owenmore (Manorhamilton)_020 |
| 13 | Curraghfore Stream | 2 | 35C68 | Brackary_010 |
| 14 | Brackary River | 3 | 35B10 | Brackary_010 |
| 15 | Bonet River | 4 | 35B06 | Bonet_030 |
| 16 | Cornstauk Drain Stream | 1 | 35C09 | Bonet_040 |
| 17 | Shanvaus 35 River | 4 | 35S01 | Bonet_040 |
| 18 | Gortgarrigan Stream | 1 | 35G61 | Bonet_040 |
| 19 | Boihy Stream | 2 | 35B76 | Bonet_040 |

| | | | | |
|---|---|---|---|---|
| 20 | Lough_Carrigeencor Stream | 1 | 35L88 | Bonet_040 |
| 21 | Rubbal Stream | 2 | 35R44 | Bonet_050 |
| 22 | Bonet River | 5 | 35B06 | Bonet_050 |
| 23 | Killananima Stream | 1 | 35K09 | Cashel Stream (Bonet)_010 |
| 24 | Killanummery River | 3 | 36K03 | Killanummery_020 |
| 25 | Bawn 35 Stream | 1 | 35B11 | Killanummery_020 |
| 26 | Barroe 35 Stream | 1 | 35B97 | Killanummery_020 |
| 27 | Rathgeean Stream | 2 | 35R37 | Killanummery_020 |
| 28 | Curraghfore Stream | 2 | 35C68 | Brackary_010 |

### 3.1.3 Barriers

No barriers were previously recorded within any of the WFD River Water Bodies that overlap with the survey sites (IFI, 2025).

## 3.2 Aquatic Survey Results

### 3.2.1 Site 1 Lisdarush Stream

Located at a proposed road crossing in the most northern part of the proposed windfarm site, site 1 was located on the Lisdarush Stream (order 1, EPA code: 35L68). The stream comprised a straightened drainage ditch along a forestry track, culverted in places (see Plate 3-1).

The channel was v-shaped and had an average bank width of 2.0m, a wet width of 0.7m, an estimated average depth of 8cm and a steep bank height of 0.5m on both sides. The flow of water comprised dominant glide sections with small areas of riffles and pools (<10%) over a gradual gradient. The riparian habitat comprised sedges (*Carex* spp.), ferns (*Dryopteris* spp.) and willow (*Salix* spp.) and light shading was observed.

The site featured 10% boulder, 80% cobble and 10% gravel substrata. Glide habitat dominated (90%) with localised pools (5%) and riffle areas (5%) throughout. No instream vegetation or macrophytes were observed and no filamentous algae or invasive species were recorded.

A 2 minute instream kick sample was carried out in glide (5s), pool (10s) and riffle (105s) habitat. Mainly class C macroinvertebrates were collected but the representation of two stonefly families and cased caddis nymphs resulted in a moderate water quality value Q3-4.

The stream is unlikely to support juvenile salmonids and shows low potential as salmonid spawning habitat due to the upland and ephemeral nature of the stream. However, salmon was recorded on the hydrologically connected Lattone 35 River (EPA code: 35L66) approximately 4km downstream therefore the stream could act as a vector to transport sediment and effect salmonid populations downstream.

No typical soft sediment habitat was observed and lamprey is unlikely to be present in this small modified upland stream. The river had some suitable eel habitat in terms of boulder, cobble and coarse gravel refugia but was of very high energy and gradient reducing its value.

No signs of crayfish were observed and the habitat was considered unsuitable due to the upland nature and lack of refugia present. No evidence of otter was observed and due to the absence of suitable prey item habitat this stream is unlikely to be important for otter. No signs of Kingfisher or suitable perch or nesting habitat were observed.

Plate 3-1: Representative photo of site 1 Lisdarush Stream

### 3.2.2 Site 2 Lisdarush Stream

Located at a proposed road crossing and turning bay in the most northern part of the proposed windfarm site, site 2 was located on the Lisdarush Stream (order 1, EPA code: 35L68). The stream comprised a straightened overgrown drainage ditch along a forestry track (see Plate 3-2).

The channel was v-shaped and had an average bank width of 1.0m, a wet width of 0.25m, an average depth of 5cm and a right bank height of 0.2m and 1.5m left bank height. The flow of water was stagnant. The riparian habitat comprised upland heath / conifer plantation habitat. Moderate shading was present due to overhanging vegetation. The site featured 100% mud substrata with 100% stagnant glide habitat.

The instream vegetation present comprised 100% *Shagnum* spp., no filamentous algae or invasive species were recorded.

Due to absence of suitable habitat an instream kick sample was not carried out.

This upper reach of the stream is not considered to be suitable habitat for salmonids and lamprey due to the absence of flow and open water. However, salmon was recorded on the

hydrologically connected Lattone 35 River (EPA code: 35L66) approximately 4km downstream therefore the stream could act as a vector to transport sediment and effect salmonid populations downstream.

No signs of crayfish were observed and the habitat was considered unsuitable due to the upland nature and lack of refugia present. No evidence of otter was observed and due to the absence of suitable prey item habitat this stream is unlikely to be important for otter. No signs of Kingfisher or suitable perch or nesting habitat were observed.

This habitat showed low suitability for lamprey and eel.

Plate 3-2: Representative photo of site 2 Lisdarush Stream

### 3.2.3 Site 3 Unnamed Stream

Located at a proposed road crossing and turning bay in the south part of the proposed windfarm site, site 3 was located on an unnamed EPA Stream (located in the upstream (order 1) reaches of the WFD River Waterbody Owenmore (Manorhamilton)_020). The stream comprised a straightened overgrown channel flowing through scrub and conifer plantations (see Plate 3-3).

The channel was u-shaped and had an average bank width of 0.7m, a wet width of 0.35m, an average depth of 14cm and a height of 1.5m on either side. The moderate flow of water comprised dominant glide sections with small areas of riffles and pools over a gradual gradient. The riparian habitat comprised native willow and bramble (*Rubus* spp.) scrub, rushes (*Juncus* spp.) and ferns. The stream was moderately shaded.

The site featured 15% boulder, 60% cobble and 15% gravel substrata. Glide habitat dominated (70%) with localised pools (10%) and riffle areas (20%) throughout. Instream vegetation comprised (semi-) aquatic bryophytes (not identified liverworts and mosses), no macrophytes were observed and no filamentous algae or invasive species were recorded.

A 2 minute instream kick sample was carried out in glide (90s), pool (20s) and riffle (10s) habitat. The sample comprised few macroinvertebrates and was dominated by class C species but the representation of a class A mayfly nymph (*Heptageniidae*) and class B cased caddis nymphs (*Trichoptera*) resulted in a moderate water quality value Q3-4.

This upper reach of the stream is considered to be suitable habitat for salmonids and crayfish due to the depth of water, moderate flow, relative natural riparian vegetation, the moderate water quality (Q3-4) and the presents of salmonid spawning gravels and crayfish refugia boulders. Although due to the upland nature and size of the stream the suitability for these species would likely be Low.

Electrofishing was carried out at two locations in 2021 approximately 1.5km and 2km downstream of site 3 on the Mt Dough River (EPA code: 35M62) and no fish were caught at either of these sites. However, salmon was recorded further upstream on the Owenmore (Manorhamilton) River (order 2, EPA code: 35O08).

No typical soft sediment habitat was observed and lamprey is unlikely to be present in this small modified upland stream. The river had some suitable eel habitat in terms of boulder, cobble and coarse gravel refugia but was of very high energy and gradient. This site is of low value to lamprey spp. and eel.

No signs of crayfish were observed and the habitat suitability was considered to be low due to the upland nature of the stream. No evidence of otter was observed and due to the absence of suitable prey items and low habitat suitability this stream is unlikely to be important for otter. No signs of Kingfisher or suitable perch or nesting habitat were observed.

Plate 3-3: Representative photo of site 3 Unnamed Stream

### 3.2.4 Site 4 Unnamed Stream

Located at a proposed road crossing in the south part of the proposed windfarm site, site 4 was located on an unnamed EPA stream (located in the upstream (order 1) reaches of the WFD River Waterbody Owenmore (Manorhamilton)_020). The stream comprised a naturally meandering fast flowing stream flowing through (semi-) natural scrub and woodland.

The channel was trapezoidal shaped and had an average bank width of 3.0m, a wet width of 1.2m, an average depth of 8cm and a left bank height of 0.8m and a right bank height of 2.0m.

The fast flow of water comprised dominant riffle sections with smaller glide and pool areas over a steep gradient. The riparian habitat comprised native woodland and scrub with alder (*Alnus glutinosa*), hazel (*Corylus avellana*), ferns and mosses. The stream was moderately shaded.

The site featured 40% boulder, 40% cobble and 15% gravel and 5% sand substrata. Riffle habitat dominated (70%) with localised pools (10%) and glide areas (20%) throughout. Instream vegetation comprised (semi-) aquatic bryophytes (*Chiloscyphus* spp. a high water quality indicator species and *Platyhypnidium riparioides* a good water quality indicator species) covering 50% of the substrata, no macrophytes were observed and no filamentous algae or invasive species were recorded.

A 2 minute instream kick sample was carried out in glide (90s), pool (10s) and riffle (20s) habitat. The sample showed good representation of class B macroinvertebrates but was dominated by class C. The representation of a class A mayfly nymph (*Heptageniidae*) and class B cased caddis nymphs (*Trichoptera*) resulted in a moderate water quality value Q3-4.

This upper reach of the stream is considered to be suitable habitat for salmonids due to the depth of water, fast flow, relative natural riparian vegetation, the moderate water quality (Q3-4) and the presents of salmonid spawning gravels. Although due to the upland nature, small size and high gradient (fast spate flow) of the stream the suitability for salmonids is considered to be low.

No typical soft sediment habitat was observed and lamprey is unlikely to be present in this upland stream. The river had some suitable eel habitat in terms of boulder, cobble and coarse gravel refugia but was of very high energy and gradient. This site is of low value to lamprey spp. and eel.

Electrofishing was carried out at two locations in 2021 approximately 0.9km and 1.5km downstream of site 4 on the Mt Dough River (EPA code: 35M62) and no fish were caught at either of these sites. However, salmon was recorded further upstream on the Owenmore (Manorhamilton) River (order 2, EPA code: 35O08).

No signs of crayfish were observed and the habitat suitability was considered to be low due to the upland nature and high gradient of the stream. No evidence of otter was observed and due to the absence of suitable prey items and low habitat suitability this stream is unlikely to be important for otter. No signs of Kingfisher or suitable foraging, perch or nesting habitat were observed.

Plate 3-4: Representative photo of site 4 Unnamed Stream

### 3.2.5 Site 5 Mt Dough River

Located at a proposed road crossing in the south part of the proposed windfarm site, site 5 was located on the Mt Dough River (order 3, EPA code: 35M62). The stream comprised a naturally meandering fast flowing stream flowing through conifer plantation.

The channel was rectangular shaped and had an average bank width of 4.0m, a wet width of 1.8m, an average depth of 14cm and a left bank height of 1.3m and a right bank height of 0.9m.

The fast flow of water comprised dominant riffle sections with smaller glide and pool areas over a steep gradient. The riparian habitat comprised a conifer plantation with a thick needle bed on the forest floor with very low density understory growth of some low grasses. The river was fully shaded.

The site featured 30% boulder, 50% cobble and 5% gravel and 5% sand substrata. Riffle habitat dominated (90%) with localised pools (5%) and glide areas (5%). Instream vegetation comprised 1% cover of water starwort (*Callitriche* spp.). No filamentous algae or invasive species were recorded.

A 2 minute instream kick sample was carried out in glide (5s), pool (5s) and riffle (110s) habitat. The sample showed good representation of class A and B macroinvertebrates but was dominated by class C (*Gammarus* spp.) and also showed moderate numbers of class D (*Asellus* spp.). The representation of a class A mayfly nymphs (*Heptageniidae*), stonefly nymphs (*Plecoptera*) and class B cased caddis nymphs (Trichoptera) in combination with the relative abundance of the class C and D species mentioned above, resulted in a moderate water quality value Q3-4.

This upper reach of the stream is considered to be suitable habitat for salmonids due to the depth of water, fast flow, the moderate water quality (Q3-4) and the presents of salmonid spawning gravels. Although due to the upland nature, small size, high gradient (fast spate flow) and full shading cover by non-native conifers, the river suitability for salmonids is considered to be low.

No typical soft sediment habitat was observed and lamprey is unlikely to be present in this upland stream. The river had some suitable eel habitat in terms of boulder, cobble and coarse gravel refugia but was of very high energy and gradient. This site is of low value to lamprey spp. and eel.

Electrofishing was carried out at two locations in 2021 approximately 1.1km and 1.6km downstream of site 5 on the Mt Dough River (EPA code: 35M62) and no fish were caught at either of these sites. However, salmon was recorded further upstream on the Owenmore (Manorhamilton) River (order 2, EPA code: 35O08).

No signs of crayfish were observed and the habitat suitability was considered to be low due to the upland nature and high gradient of the stream. No evidence of otter was observed and due to the absence of suitable prey items and low habitat suitability this stream is unlikely to be important for otter. No signs of Kingfisher or suitable foraging, perch or nesting habitat were observed.

Plate 3-5: Representative photo of site 5 Mt Dough River

### 3.2.6 Site 6 Moneenshinnagh 35 Stream

Located at a proposed road crossing in the south part of the proposed windfarm site, site 6 was located on the Moneenshinnagh 35 Stream (order 2, EPA code: 35M60). The stream comprised a semi naturally meandering fast flowing stream flowing through upland, sheep grazed, agricultural fields surrounded by conifer plantations.

The channel was u-shaped and had an average bank width of 3.0m, a wet width of 1.5m, an average depth of 22cm and a left bank height of 0.9m and a right bank height of 0.8m.

The fast flow of water comprised dominant riffle sections with smaller glide and pool areas over a steep gradient. The riparian habitat comprised sheep grazed agricultural land with abundant rushes. The river was lightly shaded.

The site featured 50% boulder, 40% cobble and 10% gravel substrata. Riffle habitat dominated (90%) with localised pools (5%) and glide areas (5%). Instream vegetation comprised not identified (semi-) aquatic mosses and earwort (*Chiloscyphus* spp.). No filamentous algae or invasive species were recorded.

A 2 minute instream kick sample was carried out in glide (10s), pool (0s) and riffle (110s) habitat. The sample showed good representation of class A macroinvertebrates but were outnumbered by class C (*Gammarus* spp.). The representation of a class A mayfly nymphs (*Heptageniidae*), and two stonefly nymph (*Plecoptera*) families in combination with the relative abundance of the class C species mentioned above, resulted in a good water quality value Q4.

This mid reach of the stream is considered to be suitable habitat for salmonids due to the depth of water, fast flow, the good water quality (Q4) and the presence of salmonid spawning gravels. Although due to the upland nature, small size, high gradient (fast spate flow) and the poor state of the riparian habitat, the river suitability for salmonids is considered to be low.

No typical soft sediment habitat was observed and lamprey is unlikely to be present in this upland stream. The river had some suitable eel habitat in terms of boulder, cobble and coarse gravel refugia but was of very high energy and gradient. This site is of low value to lamprey spp. and eel.

Electrofishing was carried out at one location in 2021 approximately 1.0km downstream of site 6 on the Moneenshinnagh 35 Stream (EPA code: 35M60) and no fish were caught. However, salmon was recorded further upstream on the Owenmore (Manorhamilton) River (order 2, EPA code: 35O08).

No signs of crayfish were observed and the habitat suitability was considered to be low due to the upland nature and high gradient of the stream. No evidence of otter was observed and due to the absence of suitable prey items and low habitat suitability this stream is unlikely to be important for otter. No signs of Kingfisher or suitable foraging, perch or nesting habitat were observed.

Plate 3-6: Representative photo of site 6 Moneenshinnagh 35 Stream

### 3.2.7 Site 7 Unnamed Stream

Located at a proposed road crossing in the south part of the proposed windfarm site, site 7 was located on an unnamed EPA stream (located in the upstream (order 1) reaches of the WFD River Waterbody Owenmore (Manorhamilton)_020). The stream comprised a semi natural meandering moderately fast flowing stream flowing through conifer plantations. The channel was u-shaped and had an average bank width of 3.0m, a wet width of 3m, an average depth of 9cm and a bank height of 1.0m on both banks.

The moderate flow of water comprised dominant riffle sections with smaller glide areas and no pools over a moderate gradient. The riparian habitat comprised sitka spruce (*Picea sitchensis*), rushes and low grasses. The river was heavily shaded.

The site featured 40% boulder, 50% cobble, 5% gravel and 5% mud substrata. Riffle habitat dominated (80%) with some glide areas (20%). Instream vegetation comprised not identified (semi-) aquatic mosses and liverworts. No filamentous algae or invasive species were recorded.

A 2 minute instream kick sample was carried out in glide (20s), pool (0s) and riffle (100s) habitat. The sample comprised high macroinvertebrate numbers and was dominated by class C species but the representation of a class A mayfly nymph (*Heptageniidae*) and class B cased caddis nymphs (*Trichoptera*) resulted in a moderate water quality value Q3-4.

This reach of the stream is considered to be suitable habitat for salmonids due to the depth of water, moderate flow, the moderate water quality (Q3-4) and the presence of salmonid spawning gravels. Although due to the upland nature, small size, absence of pools and the poor state of the riparian habitat (sitka spruce overhanging the stream where the spruce needles will directly fall into the stream and thus directly impacting water quality), the river suitability for salmonids is considered to be low.

No typical soft sediment habitat was observed and lamprey is unlikely to be present in this upland stream. The river had some suitable eel habitat in terms of boulder, cobble and coarse gravel refugia but was of very high energy and gradient. This site is of low value to lamprey spp. and eel.

Electrofishing was carried out at in 2021 on other tributaries of the WFD River Waterbody Owenmore (Manorhamilton)_020) approximately 1.5km downstream and no fish were caught. However, salmon was recorded further upstream on the Owenmore (Manorhamilton) River (order 2, EPA code: 35O08).

No signs of crayfish were observed and the habitat suitability was considered to be low due to the upland nature and high gradient of the stream. No evidence of otter was observed and due to the absence of suitable prey items and low habitat suitability this stream is unlikely to be important for otter. No signs of Kingfisher or suitable foraging, perch or nesting habitat were observed.

Plate 3-7: Representative photo of site 7, note sitka spruce is overhanging the stream.

### 3.2.8 Site 8 Skreeny River

Located at a proposed road crossing in the west part of the proposed windfarm site, site 8 was located on the Skreeny River (order 3, EPA code: 35S46). The stream comprised a semi natural meandering river with slow to moderate flow, flowing through semi natural scrub/immature woodland. The channel was rectangular shaped with undercut banks and had an average bank width of 4.5m, a wet width of 2.5m, an average depth of 8cm and a bank height of 1.5m on both banks.

The moderate flow of water comprised riffle, glide, pool sequences over a shallow gradient. The riparian habitat comprised willow and alder with a diverse herbaceous understory. The river was heavily shaded.

The site featured 15% boulder, 50% cobble, 25% gravel, 5% sand and 5% mud substrata. Glide habitat dominated (70%) with some riffle (20%) and glide areas (10%). Instream vegetation comprised (semi-) aquatic mosses of which *Platyhypnidium riparioides* (a good water quality indicator species) covered 5% of the instream cobbles and boulders. No filamentous algae or invasive species were recorded.

A 2 minute instream kick sample was carried out in glide (90s), pool (10s) and riffle (20s) habitat. The sample showed good representation of class A, B and C macroinvertebrates. The representation of twelve class A mayfly nymphs (*Heptageniidae*), and four stonefly nymph (*Plecoptera*) in combination with the relative abundance of four class B cased caddis nymphs (*Trichoptera*), resulted in a good water quality value Q4.

This reach of the stream is considered to be suitable habitat for salmonids due to the depth of water, moderate flow, the water quality (Q4) and the presence of salmonid spawning gravels and holding habitat (glide and pool sections). Salmonids were observed instream, likely Brown Trout (*Salmo trutta*), and due to the moderate size, presence of good holding habitat and the good quality riparian vegetation and habitat, the river suitability for salmonids is considered to be high.

Small areas of soft sediment habitat were observed and suitable spawning gravels are present, however, due to the upland nature of the river lamprey suitability is moderate. The river had some suitable eel habitat in terms of boulder, cobble and coarse gravel refugia but due to its high energy and high altitude this site was considered to be of low value to eel.

No electrofishing was carried out in 2021 on the WFD River Waterbody Owenmore (Manorhamilton)_020) on or downstream of the Skreeny River (only on upstream tributaries).

No signs of crayfish were observed and the habitat suitability was considered to be moderate due to the lower altitude (approx. 160 mOD) location of the river and low gradient of the stream. No evidence of otter was observed but due to the presence of suitable prey items (salmonids) and good riparian habitat suitability, this stream is considered to be of moderate suitability for otter. Although suitable foraging, perching and nesting bank habitat was observed, the altitude was considered too high for Kingfisher.

Plate 3-8: Representative photo of site 8 Skreeny River

### 3.2.9 Site 9 Unnamed Stream

Located at a proposed road crossing in the west part of the proposed windfarm site, site 9 was located on an unnamed EPA stream (located in the upstream (order 1) reaches of the WFD River Waterbody Owenmore (Manorhamilton)_020). The stream comprised a straightened moderately fast flowing stream flowing through conifer plantations. The channel was trapezoidal v-shaped and had an average bank width of 2.2m, a wet width of 0.8m, an average depth of 5cm and a left bank height of 0.8m and a right bank height of 1.5m.

The moderate flow of water comprised riffle and glide sections with localised pools over a moderate gradient. The riparian habitat comprised a rank grassland and scrub buffer surrounded by conifer plantations. The stream was lightly shaded but heavily shaded in some wooded sections.

The site featured 5% boulder, 30% cobble, 30% gravel and 15% sand substrata. Riffle habitat (40%) and glide habitat (50%) with occasional pools (10%) comprised the stream structure. Instream vegetation comprised 5% brooklime (*Veronica beccabunga*). No filamentous algae or invasive species were recorded.

A 2 minute instream kick sample was carried out in glide (60s), pool (10s) and riffle (50s) habitat. The sample comprised moderate macroinvertebrate numbers and was dominated by class C and D species but the representation of nine class A stonefly nymphs (*Plecoptera*) and class B cased caddis nymphs (*Trichoptera*) resulted in a moderate water quality value Q3-4.

This reach of the stream is considered to be suitable habitat for salmonids due to the depth of water, moderate flow, the moderate water quality (Q3-4) and the presence of salmonid spawning gravels. Although due to the upland nature, small size, scarcity of holding habitat

(pools) and the degraded state of the riparian habitat and upstream conifer plantations, the suitability for salmonids is considered to be low.

Suitable spawning gravels are present and flows are moderate, however, due to the upland nature of the river lamprey suitability is moderate. The river had some suitable eel habitat in terms of boulder, cobble and coarse gravel refugia but due to its high energy and high altitude this site was considered to be of low value to eel.

No electrofishing was carried out in 2021 on the WFD River Waterbody Owenmore (Manorhamilton)_020) on or downstream of this unnamed stream (only on upstream tributaries).

No signs of crayfish were observed and the habitat suitability was considered to be low due to the upland nature and small size of the stream. No evidence of otter was observed and due to the absence of suitable prey items and low habitat suitability this stream is unlikely to be important for otter. No signs of Kingfisher or suitable foraging, perch or nesting habitat were observed.

Plate 3-9: Representative photo of site 9 Unnamed Stream

### 3.2.10 Site 10 Curraghfore Stream

Located at a proposed road crossing in the west part of the proposed windfarm site, site 10 was located on the Curraghfore Stream (order 2, EPA code: 35C68). The stream comprised a semi natural straightened river with moderate flow, flowing through semi natural scrub/immature woodland. The channel was rectangular shaped with undercut banks and had an average bank width of 2.0m, a wet width of 1.5m, an average depth of 28cm and a bank height of 0.7m on both banks.

The moderate flow of water comprised riffle, glide, pool sequences over a moderately steep gradient. The riparian habitat comprised willow, alder and ash immature woodland with a diverse herbaceous understory. The river was heavily shaded, the gravels were silted and the water was peat stained.

The site featured 20% boulder, 70% cobble and 10% gravel substrata. Riffle habitat was most prevalent (60%) with glide (40%) and no pools. No instream vegetation was observed and no filamentous algae or invasive species were recorded.

A 2 minute instream kick sample was carried out in glide (60s) and riffle (60s) habitat. The sample showed one record of class A, seventeen records of class B and excessive C (*Gammarus* spp. 200+) macroinvertebrates. The representation of one class A mayfly nymphs (*Heptageniidae*) in combination with the relative abundance of seventeen class B cased caddis nymphs (*Trichoptera*), resulted in a moderate water quality value Q3-4.

This reach of the stream is considered to be suitable habitat for salmonids due to the depth of water, fast flow, the moderate water quality (Q3-4) and the presence of salmonid spawning gravels and holding habitat (deep glide sections). Due to the moderate size, presence of good holding habitat and the good quality riparian vegetation and habitat, the river suitability for salmonids is considered to be high.

No typical soft sediment habitat was observed and lamprey is unlikely to be present in this upland stream. The river had some suitable eel habitat in terms of boulder, cobble and coarse gravel refugia but was of very high energy and gradient. This site is of low value to lamprey spp. and eel.

Electrofishing was carried out on the Curraghfore Stream in 2021 approximately 0.5km downstream and no fish were caught. However, brown trout was recorded on the Brackary River (order 3, EPA code: 35B10), a tributary located to the west of site 10 on the WFD river water body Brackary_010.

No signs of crayfish were observed and the habitat suitability was considered to be moderate due to the lower altitude (approx. 140 mOD) location of the river and low gradient of the stream. No evidence of otter was observed but due to the presence of suitable habitat for prey items (salmonids) and good riparian habitat suitability, this stream is considered to be of moderate suitability for otter. Although suitable foraging, perching and nesting bank habitat was observed, the altitude was considered too high for Kingfisher.

Plate 3-10: Representative photo of site 10 Curraghfore Stream

### 3.2.11 Site 11 Unnamed Stream

Located at a proposed road crossing in the south part of the proposed windfarm site, site 11 was located on an unnamed EPA stream (located in the upstream (order 1) reaches of the WFD River Waterbody Owenmore (Manorhamilton)_020). The stream comprised a semi natural meandering fast flowing stream flowing through conifer plantations. The channel was trapezoidal shaped and had an average bank width of 5.0m, a wet width of 1.5m, an average depth of 5cm and a left bank height of 4.0m and right bank height of 3.0m.

The fast flow of water comprised cascades, dominant riffle sections with smaller glide and pool areas over a very steep gradient. The riparian habitat comprised semi natural immature woodland with willow and ash with a diverse herbaceous understory. The river was heavily shaded.

The site featured 30% boulder, 40% cobble, 20% gravel and 10% sand substrata. Riffle habitat dominated (80%) with some small glide (10%) and pool areas (10%). No instream vegetation was identified. No filamentous algae or aquatic invasive species were recorded.

Due to the high, instable banks and the very steep gradient of the stream comprising many cascading features the stream was not accessible to carry out a kick sample.

This upper reach of the stream is not considered to be suitable habitat for salmonids due to the very steep gradient and high energy flow.

No typical soft sediment habitat was observed and lamprey is unlikely to be present in this upland stream. The river had some suitable eel habitat in terms of boulder, cobble and coarse gravel refugia but was of very high energy and gradient. This site is of low value to lamprey spp. and eel.

Electrofishing was carried out at two locations in 2021 approximately 0.9km and 1.5km downstream of site 11 on the Mt Dough River (EPA code: 35M62) and no fish were caught at either of these sites. However, salmon was recorded further upstream on the Owenmore (Manorhamilton) River (order 2, EPA code: 35O08).

No signs of crayfish were observed and the habitat suitability was considered to be low due to the upland nature and high gradient and high energy nature of the stream. No evidence of otter was observed and due to the absence of suitable prey items and low habitat suitability this stream is unlikely to be important for otter. No signs of Kingfisher or suitable foraging, perch or nesting habitat were observed.

Plate 3-11: Representative photo of site 11 Unnamed Stream showing cascade feature

### 3.2.12 Site 12 Unnamed Stream

Located at a proposed road crossing in the south part of the proposed windfarm site, site 12 located on an unnamed EPA stream (located in the upstream (order 1) reaches of the WFD River Waterbody Owenmore (Manorhamilton)_020).

The stream comprised a wet drainage ditch draining an agricultural field for sheep grazing. This site has no value for aquatic species.

Plate 3-12: Representative photo of site 12

### 3.2.13 Site 13 Curraghfore Stream

Located at a GCR crossing along the L61801 directly south of the proposed windfarm site boundary, site 13 was located on the Curraghfore Stream (order 2, EPA code: 35C68). The stream comprised a semi natural meandering river with moderate flow, flowing through semi natural scrub/immature woodland and agricultural land grazed by cattle.

The channel was rectangular shaped with banks undercut in places and had an average bank width of 3.5m, a wet width of 1.9m, an average depth of 3cm and a left bank height of 0.6m and right bank height of 1.5m.

The moderate flow of water comprised riffle, glide, pool sequences over a shallow gradient. The riparian habitat comprised wet woodland with an understory grazed by cattle. The river was heavily shaded, the gravels were silted/bedded and the banks were poached by cattle.

The site featured 10% boulder, 70% cobble, 15% gravel and 5% sand substrata. Riffle habitat was most prevalent (60%) with glide (30%) and occasional pools (10%). Aquatic mosses (*Platyhypnidium riparioides*) were present on 5% of the instream substrate and liverworts (*Marchantia* spp.) were present on the bank sides. No filamentous algae or invasive species were recorded.

A 2 minute instream kick sample was carried out in riffle (90s), glide (20s) and pool (10s) habitat. The sample showed ten class A, three class B and excessive class C (*Gammarus* spp. 100+) macroinvertebrates. The representation of ten class A mayfly nymphs (*Heptageniidae*) in combination with one class B stonefly nymph (*Leuctridae*) and two class B cased caddis nymphs (*Trichoptera*), resulted in a moderate water quality value Q3-4.

This reach of the stream is considered to be suitable habitat for salmonids due to the substrate present and hydrology of the stream. However, at the time of survey the water depth was low, the flow was slow and the potential spawning gravels were bedded and compacted by sediment and cattle accessing the stream. Apart from deeper pools near the bridge very little holding habitat was present. The water quality was moderate (Q3-4) and the riparian habitat was in reasonable condition, therefore the stream suitability for salmonids is considered to be moderate.

No typical soft sediment habitat was observed and lamprey is unlikely to be present in this upland stream. The river had some suitable eel habitat in terms of boulder, cobble and coarse gravel refugia but was of very high energy and gradient. This site is of low value to lamprey spp. but of moderate value to eel due to the river width.

Electrofishing was carried out on the Curraghfore Stream in 2021 approximately 0.1km upstream (at Site 28) and no fish were caught. However, brown trout was recorded on the Brackary River (order 3, EPA code: 35B10), a tributary located to the west of site 13 on the WFD river water body Brackary_010.

No signs of crayfish were observed and the habitat suitability was considered to be moderate due to the lower altitude (approx. 130 mOD) location of the river and low gradient of the stream. No evidence of otter was observed but due to the presence of suitable habitat for prey items (salmonids) and good riparian habitat suitability, this stream is considered to be of moderate suitability for otter. Although suitable foraging, perching and nesting bank habitat was observed, the altitude was considered too high for Kingfisher.

Plate 3-13: Representative photo of site 13 Curraghfore Stream

### 3.2.14 Site 14 Brackary River

Located at a GCR crossing along the R282 in Manorhamilton town, site 14 was located on the Brackary River (order 3, EPA code: 35B10). The stream comprised a semi natural meandering river with moderate flow, flowing through a small valley in an urban environment with semi natural scrub/immature woodland present on the banks. The channel flowed over very steep cascading gradient after flowing through a large concrete box culvert and into a riffle, glide and pool sequence.

The channel was trapezoidal shaped with average bank width of 12m, a wet width of 3.0m, an average depth of 7cm and a left bank height of 3.5m and right bank height of 2.2m.

The moderate flow of water comprised riffle, glide, pool sequences over a shallow gradient. The riparian habitat comprised semi natural immature woodland. The river was moderately shaded and the gravels were heavily silted/bedded.

The site featured 10% boulder, 60% cobble, 20% gravel, 5% sand and 5% mud substrata. Glide habitat was most prevalent (60%) with riffle (30%) and occasional pools (10%). Aquatic mosses (*Platyhypnidium riparioides*) were present on 5% of the instream substrate and liverworts (*Marchantia* spp.) were present on the bank sides. No filamentous algae or invasive species were recorded.

A 2 minute instream kick sample was carried out in riffle (80s), glide (20s) and pool (20s) habitat. The sample showed class A, nine class B, abundant class C (eg *Gammarus* spp. n= 25) and dominant class D (New Zealand mud snail (*Potamopyrgus antipodarum* n= 50+) macroinvertebrates. The representation of nineteen class A mayfly nymphs (*Heptageniidae*) in combination with nine class B stonefly nymphs (*Leuctridae*) would normally result in a good water quality value of Q4, but due to the presence of the New Zealand mud snail a moderate water quality Q3-4 was obtained.

This reach of the stream is considered to be suitable habitat for salmonids due to the present spawning gravels and the riffle, pool, glide hydrology of the river. However, the stretch of river that was surveyed was located between a long (>20m) box culvert upstream and a bridge downstream, the flow was slow and the potential spawning gravels were bedded and compacted by sediment. Deeper pools near the bridge and box culvert offered good holding habitat. The water quality was good (Q4) and the semi natural riparian habitat was in reasonable condition, therefore the river suitability for salmonids is considered to be moderate to good at this location.

Some semi suitable sandy mud lamprey habitat was recorded but no lamprey were observed. Lamprey habitat suitability as this site was considered to be moderate. The river had good suitable eel habitat in terms of eroded concrete structures, boulder, cobble and coarse gravel refugia and was of moderate energy and low gradient at this section of the river. This site has good suitability for eel.

Electrofishing was carried out on the Brackary River in 2021 approximately 0.6km and 1.6km upstream of site 14 and at both sites brown trout was caught.

White-clawed crayfish were observed in abundance and the habitat suitability was considered to be high due to the lower altitude (approx. 64 mOD), abundant refugia and bankside burrowing

habitat. Four crayfish were captured during kick sampling and a subsequent presence/absence handsearch; two males with total carapace length (TCL) of 3cm each and two females with a TCL of 1.2cm and 2.8cm.

Otter spraints were observed (old and fresh) mainly containing crayfish remains, therefore the otter suitability of the river is good as there are plentiful prey items available and good riparian habitat cover. Although suitable foraging, perching and nesting bank habitat was recorded, Kingfisher was not observed but habitat suitability was considered moderate as the water level was less than 10cm (Kingfisher prefers a depth approx. of 25cm with slow or no flows).

Plate 3-14: Representative photo of site 14 Brackary River

Plate 3-15: Juvenile (TCL 1.2cm) white-clawed crayfish

Plate 3-16: Otter spraints, the left spraint is older and crayfish remains are clearly visible, the right brown spraint was fresh and indicates current activity.

### 3.2.15 Site 15 Bonet River

Located at a GCR crossing along the L2136 to the north west of Manorhamilton town, site 15 was located on the Bonet River (order 4, EPA code: 35B06). The river comprised a natural

meandering river with moderate flow, flowing through an area of semi natural woodland. The channel flowed over a shallows gradient of riffle, glide and pool sequences.

The channel was rectangular shaped with average bank width of 12m, a wet width of 9.0m, an average depth of 15cm and a left bank height of 1.8m and right bank height of 2.0m. The river was moderately shaded and the gravels were clean, only light sedimentation was observed.

The site featured 10% boulder, 50% cobble, 30% gravel and 10% sand substrata. Glide habitat was most prevalent (55%) with riffle (25%) and occasional pools (20%). Aquatic mosses (eg *Platyhypnidium riparioides and Fontinalis antipyretica both good water quality indicators*) were present on 10% of the instream substrate. No filamentous algae or invasive plant species were recorded.

A 2 minute instream kick sample was carried out in riffle (80s) and glide (40s) habitat. The sample showed rare class A, abundant class C (eg *Gammarus* spp. n= 25 and *Baetis sp.* n=45) and a single class D (the invasive New Zealand mud snail (*Potamopyrgus antipodarum* n= 1) macroinvertebrates. The representation of two class A mayfly nymphs (*Heptageniidae*) in combination with dominant *Baetis* spp. resulted in a moderate water quality value Q3-4.

The river has high suitability for salmon, brown trout and other fish species. Suitable spawning and holding habitat is present combined with semi natural woodland habitat offering ideal dappled shading. IFI were encountered on site who had carried out an electrofishing survey the previous day during which they encountered healthy stocks of salmon and trout. No electrofishing was carried out below site 14. During Kick sampling two juvenile salmon were caught one parr 9cm fork length (FL) and one fry 5cm FL

No suitable soft sediment lamprey habitat was recorded but may be present downstream, therefore lamprey habitat suitability as this site was considered to be moderate (spawning). The river had good suitable eel habitat in terms of eroded concrete structures, boulder, cobble and coarse gravel refugia and was of moderate energy and low gradient at this section of the river. This site has good suitability for eel.

White-clawed crayfish were observed in abundance and the habitat suitability was considered to be high due to the lower altitude (approx. 50 mOD), abundant refugia and bankside burrowing habitat. Three crayfish were captured during kick sampling and a subsequent presence/absence hand search; two males with total carapace length (TCL) of 2.2cm and 2.0cm and one female with a TCL of 1.8cm.

Otter spraints were observed (old and fresh) mainly containing crayfish remains, therefore the otter suitability of the river is high as there are plentiful prey items available and good riparian habitat cover.

Although suitable foraging, perching and nesting bank habitat was recorded, Kingfisher was not observed but habitat suitability was considered good as water levels >25cm were recorded (Kingfisher prefers a depth approx. of 25cm with slow or no flows).

Plate 3-17: Representative photo of site 15 Bonet River.

Plate 3-18: Salmon fry, note forked tail, long pectoral fin and streamlined head.

Plate 3-19: Otter spraint with crayfish remains.

### 3.2.16 Site 16 Cornstauk Drain Stream

Located at a GCR crossing along the L2169 140m south of the N16 Sligo Road, site 16 was located on the Cornstauk Drain Stream (order 1, EPA code: 35C09). The stream comprised a

straightened overgrown channel flowing through a pocket of wet woodland and agricultural grassland (see Plate 3-20 ).

The channel was u-shaped and had an average bank width of 5.0m, a wet width of 1.0m, an average depth of 5cm upstream and 40cm downstream of the L2169 road and a bank height of 1.0m on either side. The very slow flow of water comprised dominant glide over a flat gradient. The riparian habitat comprised native willow, alder and ash with a herbaceous understory. The channel was moderately shaded. The site featured 100% mud substrata. No instream macrophytes or bryophytes were identified and no filamentous algae or invasive species were recorded.

Due to absence of suitable habitat an instream kick sample was not carried out.

This site is not considered to be suitable habitat for salmonids, crayfish or lamprey due to the stagnant nature of the stream and mud substrate. However, as this site is located approx. 160m upstream of the Bonet River (see site 15), suitable habitat may be present at the outflow, the site is therefore considered to be of moderate suitability for lamprey ammocoetes. Soft sediment overgrown drainage ditches can be good suitable habitat especially for juvenile eel.

No evidence of otter was observed and due to the absence of suitable prey items and low habitat suitability this stream is unlikely to be important for otter, although it may be used for commuting as there is potentially suitable otter holt habitat within the densely wooded areas upstream. No signs of Kingfisher or suitable perch or nesting habitat were observed.

Plate 3-20: Representative photo of the Cornstauk Drain Stream downstream of the L2169 crossing; a heavily overgrown drainage ditch.

### 3.2.17 Site 17 Shanvaus 35 River

Located at a GCR crossing along the L2169 approx. 1.3km south of site 16, site 17 was located on the Shanvaus 35 River (order 4, EPA code: 35S01). The river comprised a natural meandering river with very slow flow, flowing through an area of agricultural grassland and semi natural riparian scrub with signs of historical modification and deepening. The channel flowed over a shallow gradient of glide and pool sequences. The banks were poached by sheep.

The channel was trapezoidal shaped with average bank width of 14.0m, a wet width of 6.0m, an average depth of 27cm and a left bank height of 3.0m and right bank height of 3.0m. The river was moderately shaded and river bed mainly comprised sandy mud.

The site featured 5% boulder, 5% cobble, 10% gravel and 20% sand and 60% mud substrata. Glide habitat was most prevalent (60%) with large pool areas (40%). Aquatic mosses (eg *Fontinalis antipyretica* a good water quality indicator and *Leptodictium riparium* a moderate/poor water quality indicator) were present on 15% of the instream substrate, mostly the downstream concrete wingwall of the bridge. Reed canary-grass (1%) (*Phalaris arundinaceae*) was recorded on pool margins. No filamentous algae or aquatic invasive plant species were recorded.

Due to absence of suitable riffle (flow) and hard substrate habitat, an instream kick sample was not carried out.

The river has high suitability for brown trout and other fish species as very good holding pools (>1m deep) were present downstream of the bridge. Suitable spawning habitat was not present.

Suitable soft sediment lamprey habitat was present in abundance which is preferred habitat for juvenile lamprey (ammocoetes), therefore lamprey habitat suitability as this site was considered to be high. The river had good suitable eel habitat in terms of eroded concrete structures, boulder, cobble and coarse gravel refugia and was of moderate energy and low gradient at this section of the river. This site has good suitability for eel.

A large number of otter spraints (25+) were recorded under the bridge. The presence of crayfish (observed in spraints) and the presence of the large deep pool adjacent to a bridge offer good cover and foraging habitat for otter. Further signs included well used otter trails and slides along the riverbank.

No live white-clawed crayfish were observed but the habitat suitability was considered to be high due to the abundant presence in the otter spraints, suitable refugia and bankside burrowing habitat.

Suitable foraging, perching and nesting bank habitat was recorded downstream, kingfisher was not observed but habitat suitability was considered high as water levels >25cm were recorded (Kingfisher prefers a depth approx. of 25cm with slow or no flows (Vilches et al., 2013)).

Plate 3-21: Representative photo of the Shanvaus 35 River looking upstream.

Plate 3-22: Shanvaus River looking downstream, the majority of the otter spraints were recorded under the bridge on the right hand bank.

Plate 3-23: Heavily used and compacted otter path (otter prints are visible) along the right hand bank upstream of the bridge.

Plate 3-24: Wide and deep pool directly downstream of the bridge; ideal otter and kingfisher hunting grounds.

### 3.2.18 Site 18 Gortgarrigan Stream (magic sticks)

Located at a GCR crossing along the L2169 2.5km south of site 17, site 18 was located on the Gortgarrigan Stream (order 1, EPA code: 35G61). The stream comprised a straightened overgrown channel flowing through a pocket of wet woodland and agricultural grassland (see ).

The channel was v-shaped and had an average bank width of 2.5m, a wet width of 1.0m, an average depth of 9cm and a bank height of 0.8m on either side. The very slow flow of water comprised dominant glide over a flat gradient. The riparian habitat comprised native willow, alder and ash with a herbaceous understory upstream of the road and cut agricultural grassland downstream. The channel was heavily shaded upstream of the road and no shading was present downstream.

The site featured 100% mud substrata and an unpleasant anoxic smell was encountered, possibly due to rotting leaf and wood material. No instream macrophytes or bryophytes were identified and no filamentous algae or invasive species were recorded.

Due to absence of suitable habitat an instream kick sample was not carried out.

This site is not considered to be suitable habitat for crayfish (low), lamprey (low) and eel (moderate) due to the stagnant nature of the stream and anoxic mud substrate. However, a juvenile brown trout was observed and as this site is located approx. 450m upstream of the Bonet River (see Site 15), the habitat is considered moderately suitable as juvenile holding habitat for salmonids.

No evidence of otter was observed and due to the absence of suitable prey items and low habitat suitability this stream is unlikely to be important for otter, although it may be used for commuting as there is potentially suitable otter holt habitat within the densely wooded areas upstream. No signs of Kingfisher or suitable perch or nesting habitat were observed.

Plate 3-25: Representative phot of site 18 upstream of the road with abundant leaf and wood (magic sticks) litter.

Plate 3-26: Representative phot of site 18 downstream of the road.

### 3.2.19 Site 19 Boihy Stream

Located at a GCR crossing along the L2169 approx. 0.7km south west of site 18, site 19 was located on the Boihy Stream (order 2, EPA code: 35B76). The river comprised a historically modified and deepened stream with a slow flow, flowing through an area of conifer plantations and semi natural woodland. The channel flowed over a moderate gradient of riffle, glide and pool sequences. The banks were eroded, undercut in places and derelict rock armour was visible downstream of the bridge. Approximately 30m downstream of the bridge the stream flowed into a wet woodland marsh area where *Potamogeton berchtoldii* spp. were recorded.

The channel was u-shaped with average bank width of 9.0m, a wet width of 3.0m, an average depth of 10cm and a left bank height of 4.5m and right bank height of 4.5m. The river was moderately shaded and river bed mainly comprised hard substrate with areas of sandy mud.

The site featured 20% boulder, 30% cobble, 15% gravel and 10% sand and 25% mud substrata. Riffle habitat was most prevalent (40%) with equal pool (30%) and glide (30%) sections. Aquatic mosses (eg *Fissidens* spp.) were present on 15% of the instream substrate, water starwort (*Callitriche* spp.) and earwort (unidentified 1%) were also present. No filamentous algae or invasive plant species were recorded.

A 2 minute instream kick sample was carried out in riffle (50s), pool (35s) and glide (35s) habitat. The sample showed, abundant class C (eg *Gammarus* spp. n= 30) and rare class D (the invasive New Zealand mud snail *Potamopyrgus antipodarum* n= 2 and Chironomus spp.) macroinvertebrates. This resulted in a poor water quality value Q3.

The river has moderate suitability for brown trout and other fish species as good holding pools (>1m deep) were present downstream of the bridge and some areas of suitable spawning habitat were observed. A single brown trout fry (FL= 5cm) was caught during kick sampling. The stream is unlikely to be suitable for salmon due to the high sediment nature of the stream.

Suitable soft sediment lamprey habitat was present in abundance which is preferred habitat for juvenile lamprey (ammocoetes), therefore lamprey habitat suitability as this site was considered to be high. The river had good suitable eel habitat in terms of eroded concrete structures, boulder, cobble and coarse gravel refugia and was of moderate energy and low gradient at this section of the river. This site has good suitability for eel.

A number of otter signs were recorded including foot prints, otter spraints and meal remnants. The site downstream of the bridge is ideal resting and foraging habitat for otter as it is inaccessible by land, holts may be present although these are unlikely to be maternity holts as it likely floods in winter.

No live white-clawed crayfish were observed but the habitat suitability was considered to be high due to the abundant presence in the otter spraints, suitable refugia and bankside burrowing habitat. Crayfish burrows were recorded.

Suitable foraging and perching habitat was recorded downstream, kingfisher was not observed but habitat suitability was considered good as water levels >25cm were recorded (Kingfisher prefers a depth approx. of 25cm with slow or no flows (Vilches et al., 2013)), although the size of the stream likely does not hold abundant prey items.

Plate 3-27: Representative photo of site 19.

Plate 3-28: Crayfish burrows in clay bank.

Plate 3-29: Crayfish mouth parts, tail and legs neatly dismembered and not consumed.

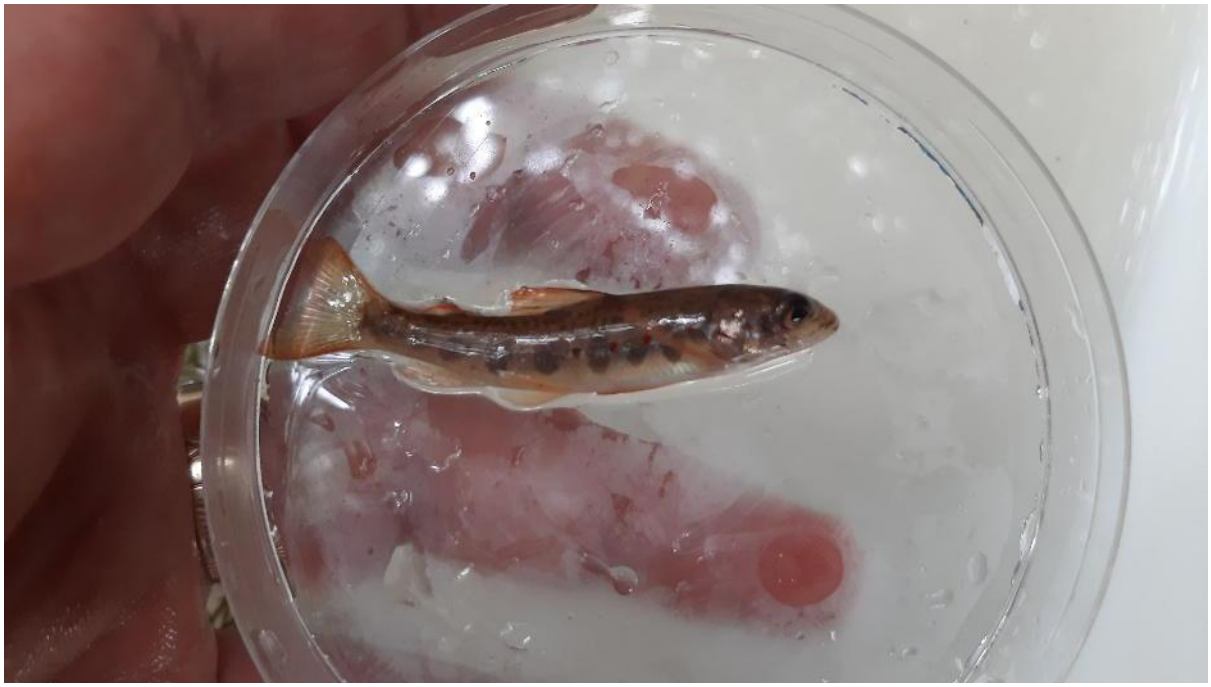

Plate 3-30: Brown trout fry.

### 3.2.20 Site 20 Lough_Carrigeencor Stream

**No permission was granted to access this stream over third party lands.**

Located at a GCR crossing along the L2169 approx. 1.2km south west of site 19, site 20 was located on the Lough_Carrigeencor Stream (order 1, EPA code: 35L88). The river comprised a semi natural meandering stream with a slow flow, flowing through an area of agricultural grassland and semi natural woodland. The channel flowed over a moderate gradient of riffle, glide and pool sequences.

The channel was trapezoidal shaped with banks undercut in places and had an average estimated bank width of 5m, a wet width of 1.5m, an average depth of 5cm and a left bank height of 0.5m and right bank height of 0.7m.

The moderate flow of water comprised riffle, glide, pool sequences over a shallow gradient. The riparian habitat comprised scrub and agricultural land, river was accessible to cattle (ford). The river was moderately shaded and the gravels were heavily silted.

The site featured 25% boulder, 50% cobble, 15% gravel, 5% sand and 5% mud substrata. Glide habitat was most prevalent (80%) with riffle (10%) and pools (10%). Brooklime (1%) and water starwort (1%) were present in the stream margins. The filamentous algae *Cladophera* spp. was observed to cover approx. 10% o the stream. No invasive species were recorded.

Due to absence of suitable habitat an instream kick sample was not carried out.

This reach of the stream is considered to be suitable habitat for salmonids due to the substrate present and hydrology of the stream. However, at the time of survey the water depth was low, the flow was slow and the potential spawning gravels were bedded and compacted by sediment and cattle accessing the stream. Apart from some small pools near the bridge very little holding habitat was present. Riparian habitat was present offering shading, therefore the stream suitability for salmonids is considered to be moderate.

Small areas of soft sediment habitat were observed but lamprey is unlikely to be present in this shallow stream, habitat suitability is low. The river had some suitable eel habitat in terms of boulder, cobble and coarse gravel refugia. This site is of moderate value to eel.

No signs of crayfish were observed and the habitat suitability was considered to be moderate due to the location of the river and low gradient of the stream. No evidence of otter was observed but due to the presence of suitable habitat for prey items (salmonids) and moderate riparian habitat suitability (cover), this stream is considered to be of moderate suitability for otter. Although suitable foraging and perching bank habitat was observed, the stream was very shallow and therefore of low suitability for Kingfisher.

Plate 3-31: Representative photo of site 20 showing cattle ford and heavily sedimented and coloured water.

### 3.2.21 Site 21 Rubbal Stream

Located at a GCR crossing along the L2169 approx. 3.3km south west of site 20, site 21 was located on the Rubbal Stream (order 2, EPA code: 35R44).

The river comprised a historically modified, deepened and straightened stream with a slow flow, flowing through an area of agricultural land, semi natural woodland and conifer plantations downstream. The channel flowed over a shallow gradient of riffle, glide and pool sequences. The banks were in relatively good condition, only slightly eroded and undercut in places.

The channel was u-shaped with average bank width of 5.0m, a wet width of 1.5m, an average depth of 13cm and a left bank height of 1.5m and right bank height of 2.0m. The river was lightly shaded and river bed mainly comprised gravelly/ sandy mud.The site featured 5% cobble, 40% gravel and 15% sand and 40% mud substrata. Glide habitat was most prevalent (85%) with some pools (10%) and small riffles (5%). Macrophytes recorded included water starwort (1%), water crowfoot (*Ranunculus* pp.) 15%, fools' watercress (*Apium nodiflorum*) 30%, reed canary grass 50%, yellow iris (*Iris pseudacorus*) 1%, unidentified earwort 1% and *Platyhypnidium riparioides* 1%. No filamentous algae or invasive plant species were recorded.

A 2 minute instream kick sample was carried out in riffle (60s) and glide (60s) habitat. The sample showed common class A, a single class B, abundant class C (eg Gammarus spp. n= 30) and abundant class D (the invasive New Zealand mud snail (*Potamopyrgus antipodarum* n= 30) macroinvertebrates. The representation of two class A mayfly nymphs (*Heptageniidae* n=12 and *Ephemera danica* n=1) and a single stonefly nymph (*Plecoptera* n=1) in combination with dominant class C and D species resulted in a moderate water quality value Q3-4.

The river has moderate suitability for brown trout and other fish species as good holding pools (>0.3m deep) were present and some areas of suitable spawning habitat were observed, although the gravels were sedimented. The stream is unlikely to be suitable for salmon due to the high sediment nature of the stream.

Suitable soft sediment lamprey habitat was present in abundance which is preferred habitat for juvenile lamprey (ammocoetes), therefore lamprey habitat suitability as this site was considered to be high. A single lamprey ammocoete (*Lampetra* spp.) was caught during kick sampling and measured 12cm. The stream had good suitable eel habitat in terms of instream macrophyte root beds and other dense macrophyte bed (*Ranunculus* spp.) and concrete structure refugia. The stream was of low energy and low gradient at this section of the river. This site has good suitability for eel.

One white-clawed crayfish was caught during kick sampling, a female (TCL 3cm). The habitat suitability was considered to be high due to the abundant suitable refugia (macrophyte beds) and bankside burrowing habitat.

A single crayfish claw was observed which could potentially be an otter food remnant. No otter spraints were observed, but due to the presence of crayfish, preferred otter prey, otter suitability is considered to be good for foraging and commuting.

Suitable foraging and perching habitat was available, kingfisher was not observed but habitat suitability was considered moderate to good as water levels >25cm were recorded (Kingfisher prefers a depth approx. of 25cm with slow or no flows (Vilches et al., 2013)), although the size of the stream likely does not hold abundant prey items (small fish).

Plate 3-32: Representative photo of site 21.

Plate 3-33: Lamprey ammocoete.

Plate 3-34: White-clawed crayfish.

### 3.2.22 Site 22 Bonet River

Located at a GCR crossing along the L4165 1.7km south east of Dromohair, site 22 was located on the Bonet River (order 5, EPA code: 35B06). The river comprised a natural meandering river with moderate flow, flowing through an area of semi natural riparian woodland bordered by

agricultural grasslands. The channel flowed over a moderate gradient of riffle, glide and pool sequences.

The channel was rectangular shaped with average bank width of 26m, a wet width of 20.0m, an average depth of 21cm and a left bank height of 3.0m and right bank height of 4.0m. The river was lightly shaded and the gravels were clean, only light sedimentation was observed. The river showed signs of historic deepening.

The site featured 15% boulder, 40% cobble, 25% gravel, 15% sand and 5% mud substrata. Glide habitat was most prevalent (60%) with riffle (30%) and occasional pools (10%).

Aquatic mosses (eg *Fissidens* spp.) and earwort (*Chiloscyphus polyanthos*) covered 5% of the substrate. Water crowfoot was present and covered approximately 20% of the river bed. Filamentous algae was recorded on 10% of the substrata and no invasive plant species were recorded.

A 2 minute instream kick sample was carried out in riffle (100s) and glide (20s) habitat. The sample showed low abundance but good diversity of class A and class B macroinvertebrates but the sample was dominated by class C (eg Gammarus spp. n= 30 and Baetis sp. n=65) and class D (the invasive New Zealand mud snail (*Potamopyrgus antipodarum* n= 100+) macroinvertebrates. The representation of class A mayfly nymphs (*Heptageniidae* n=3 and *Ephemera danica* n=6), stonefly nymphs (*Plecoptera* n=2) and two cased caddis families (*Limnephilidae* n=7 and *Lepidostoma hirtum* n=1) in combination with dominant C and D classes resulted in a moderate water quality value Q3-4.

The river has high suitability for salmon and brown trout and good suitability for eel and lamprey species. Suitable spawning and holding habitat is present combined with semi natural woodland habitat offering some degree dappled shading in places. During Kick sampling one minnow (*Phoxinus Phoxinus*) was caught 4cm fork length (FL).

Little suitable soft sediment lamprey habitat was recorded but may be present elsewhere on the river, therefore lamprey habitat suitability as this site was considered to be good (spawning).

White-clawed crayfish were observed in abundance and the habitat suitability was considered to be high due to the abundant refugia and bankside burrowing habitat. Three crayfish were captured during kick sampling and a subsequent presence/absence hand search; two males with total carapace length (TCL) of 1.5cm and 1.0cm and one female with a TCL of 3.4cm.

One otter spraint and one area with otter food remnants of crayfish was recorded. The otter suitability of the river is high as there are plentiful prey items available and good riparian habitat cover.

Although suitable foraging, perching and nesting bank habitat was recorded, Kingfisher was not observed but habitat suitability was considered good as water levels >25cm were recorded (Kingfisher prefers a depth approx. of 25cm with slow or no flows).

Plate 3-35: Representative photo of site 22.

Plate 3-36: White-clawed crayfish.

Plate 3-37: Juvenile crayfish and minnow together with some of the water crowfoot and *Chiloscyphus polyanthos*.

### 3.2.23 Site 23 Killananima Stream

**No permission was granted to access this stream over third party lands.**

Located at a GCR crossing along the L8269 approx. 1.3km south of site 22, site 23 was located on the Killananima Stream (order 1, EPA code: 35K09). This stream was located in a steep small valley with high banks and was entirely overgrown. The stream may have been historically deepened and modified.

The channel seemed to have a trapezoidal shape and had an average estimated bank height of more than 3m, no other channel measurements could be taken.

The land surrounding the channel showed a moderate to steep gradient which likely translates to a steep gradient channel. The adjacent habitat comprised scrub and agricultural land, although native riparian trees, willow, birch, alder ash and hazel were present in the channel valley.

No data on substrate, macrophytes, macroinvertebrates or invasive species could be recorded.

The stream at this location, the most upper reaches with steep gradient, likely has low potential for salmonids but potential likely increases to moderate and good as this stream flows towards the Bonet River situated 2.3km downstream.

The stream at this location is unlikely to comprise suitable habitat for crayfish, lamprey and eel and suitability is considered low. The stream at this location is not suitable for kingfisher as no open water is present.

Suitability for otter may be moderate as the stream offers very good cover for commuting and dense woodland and scrub habitat is present that might be suitable for an otter (maternity) holt.

Plate 3-38: Location of stream not visible due to dense vegetation from road as no access was granted here.

### 3.2.24 Site 24 Killanummery River

Located at a GCR crossing along the L4264 2.5km south west of site 23, site 24 was located on the Killanummery River (order 3, EPA code: 36K03).

The river comprised a natural meandering river with moderate flow, flowing through an area of semi natural riparian woodland bordered by agricultural grasslands and conifer plantations. The channel flowed over a moderate gradient of riffle, glide and pool sequences.

The channel was rectangular shaped with average bank width of 9.0m, a wet width of 7.0m, an average depth of 9cm and a left bank height of 3.5m and right bank height of 1.5m. The river was moderately shaded and the gravels were moderately sedimented and showed heavy discoloration (suspended solids). The river showed possible signs of historic deepening and modification.

The site featured 20% boulder, 50% cobble, 25% gravel and 5% sand. Riffle habitat was most prevalent (60%) with glide (30%) and occasional pools (10%).

Aquatic mosses (eg *Platyhypnidium riparioides* a good water quality indicator and *Fissidens* spp.) and earwort (*Chiloscyphus polyanthos* a high water quality indicator) covered 10% of the substrate. No macrophytes or filamentous algae and no invasive plant species were recorded.

A 2 minute instream kick sample was carried out in riffle (60s), glide (30s) and pool (10s) habitat. The sample showed high abundance of class A and class C macroinvertebrates and the sample was dominated by class A macroinvertebrates. The representation of class A mayfly nymphs (Heptageniidae n=75), class B stonefly nymphs (*Leuctridae* n=3) and class C mayfly nymphs *Baetis* spp. n=14 resulted in a good water quality value Q4. Depending on the number of genera

present within the *Heptageniidae* it may qualify for high water quality Q5 but due to the common class C (*Gammarus* spp. n=10) and present class D (the invasive New Zealand mud snail *Potamopyrgus antipodarum* n= 6) the biological water quality will remain at Q4.

The river has high suitability for salmon, brown trout and other fish species. Suitable spawning and holding habitat is present combined with semi natural woodland habitat offering good dappled shading.

No suitable soft sediment lamprey habitat was recorded in this high energy river but may be present elsewhere on the river downstream, therefore lamprey habitat suitability as this site was considered to be moderate (spawning). The river had good suitable eel habitat in terms of eroded concrete structures, boulder, cobble and coarse gravel refugia and was of moderate energy and low gradient at this section of the river. This site has good suitability for eel.

White-clawed crayfish were not recorded but habitat suitability was considered to be good due to the abundant refugia and bankside burrowing habitat. The river was high energy at the survey location but further downstream slower flows were observed.

No otter signs were recorded but the otter suitability of the river is high as there is good prey item habitat available and good riparian habitat cover.

Although suitable foraging, perching and nesting bank habitat was recorded, Kingfisher was not observed but habitat suitability was considered good as water levels >25cm were recorded (Kingfisher prefers a depth approx. of 25cm with slow or no flows).

Plate 3-39: Representative photo of site 24.

### 3.2.25 Site 25 Bawn 35 Stream

**No permission was granted to access this stream over third party lands.**

Located at a GCR crossing along the L4264 1.2km south west of site 24, site 25 was located on the Bawn 35 Stream (order 1, EPA code: 35B11).

The channel was u-shaped with average bank width of 3.0m, a wet width of 0.3m, an average estimated depth of 3cm and a left bank height of 1.0m and right bank height of 1.5m. The river was heavily shaded. The river showed possible signs of historic deepening and modification.

The site featured 40% boulder, 50% cobble and 10% gravel. Riffle habitat was most prevalent (60%) with glide (30%) and occasional pools (10%). No macrophytes or filamentous algae and no invasive plant species were recorded.

The river has low suitability for salmonids. Little suitable spawning and holding habitat is present on this high gradient stream with an ephemeral nature.

No suitable soft sediment lamprey habitat was recorded in this high energy stream but may be present elsewhere downstream, therefore lamprey and eel habitat suitability as this site was considered to be low.

White-clawed crayfish were not recorded and habitat suitability was considered to be low due to the high gradient and ephemeral nature of the stream.

No otter signs were recorded and the otter suitability of the stream is likely low due to the absence of prey item habitat in this stream which is located high up in the catchment.

This stream was not suitable for kingfisher due to the overgrown nature of the stream and low waterlevels.

Plate 3-40: Representative photo of site 25; a heavily overgrown high energy stream.

### 3.2.26 Site 26 Barroe 35 Stream

**No permission was granted to access this stream over third party lands.**

Located at a GCR crossing along the L4264 1.4km south west of site 25, site 26 was located on the Barroe 35 Stream (order 1, EPA code: 35B97).

The channel was v-shaped with average bank width of 3.0m, a wet width of 0.2m, an average estimated depth of 2cm and a left bank height of 1.5m and right bank height of 1.5m. The stream was lightly shaded. The stream showed signs of historic deepening and modification.

The site featured 5% boulder, 10% cobble, 80% gravel and 5% sand. Riffle habitat (50%) and glide (50%) comprised the flow of the stream. Watercress (*Nasturtium officinale*) 5% and 10% unidentified mosses and liverworts were recorded. No filamentous algae and no invasive plant species were recorded.

The river has low suitability for salmonids. Suitable spawning gravels but low water levels and no holding habitat indicate this stream has an ephemeral nature and is prone to drying out.

No suitable soft sediment lamprey habitat was recorded in this stream, lamprey and eel habitat suitability as this site was considered to be low.

White-clawed crayfish were not recorded and habitat suitability was considered to be poor due to the low water levels, lack of suitable refugia and ephemeral nature of the stream.

No otter signs were recorded and the otter suitability of the stream is likely low due to the absence of prey item habitat in this stream which is located high up in the catchment.

This stream was not suitable for kingfisher due to the overgrown nature of the stream and low waterlevels.

Plate 3-41: Representative photo of site 26.

### 3.2.27 Site 27 Rathgeean Stream

**No permission was granted to access this stream over third party lands.**

Located at a GCR crossing along a boreen road 3.5km south west of site 26, site 27 was located on the Rathgeean Stream (order 2, EPA code: 35R37). The stream comprised a straight stream with a very slow flow, flowing through an area of agricultural grasslands. The channel flowed over a shallow gradient of riffle, glide and pool sequences.

The channel was v-shaped and straightened with average bank width of 5.0m, a wet width of 1.5m, an average estimated depth of 20cm and a left bank height of 1.5m and right bank height of 1.5m. The river was lightly shaded. The river showed signs of historic deepening, straightening and modification.

The site featured 25% boulder, 30% cobble, 10% gravel and 15% sand. Pool habitat was most prevalent (60%) with glide (35%) and occasional riffle (5%). Reed canary grass (15%), but no filamentous algae and no invasive plant species were recorded.

The river has good suitability for salmonids. Suitable spawning and good holding habitat was present on this moderate gradient stream. Juvenile salmonids were observed from the bank.

No suitable soft sediment lamprey habitat was recorded in this high energy stream but may be present elsewhere downstream, therefore lamprey habitat suitability as this site was considered to be low. Due to the available pools and boulder cobble refugia habitat suitability for eel is considered to be moderate.

White-clawed crayfish were not recorded and habitat suitability was considered to be moderate as pools and refugia were present.

No otter signs were recorded and the otter suitability of the stream is likely moderate due to the presence of prey item habitat in this stream.

This stream was moderately suitable for kingfisher due to the overgrown nature of the stream and low water levels.

Plate 3-42: Representative photo of site 27.

### 3.2.28 Site 28 Curraghfore Stream

**No permission was granted to access this stream over third party lands.**

Located at a GCR crossing along the L61801 directly south of the proposed windfarm site boundary and 100m north of site 13, site 28 was located on the Curraghfore Stream (order 2, EPA code: 35C68). The stream comprised a semi natural meandering river with moderate flow, flowing through semi natural scrub/immature woodland and agricultural land grazed by cattle.

The channel was rectangular shaped with banks undercut in places and had an average bank width of 3.0m, a wet width of 1.2m, an average depth of 10cm and a left bank height of 0.3m and right bank height of 0.3m.

The slow flow of water comprised riffle, glide, pool sequences over a shallow gradient. The riparian habitat comprised wet woodland with an understory grazed by cattle. The river was moderately shaded, the gravels were silted/bedded and the banks and stream bed were poached by cattle.

The site featured 5% boulder, 60% cobble, 5% gravel and 20% sand substrata. Riffle habitat was most prevalent (60%) with glide (10%) and pools (30%). Unidentified aquatic mosses were present on 15% of the instream substrate, 20% was covered in watercress and 1% brooklime was observed on the banks.

This reach of the stream is considered to be suitable habitat for salmonids due to the substrate present and hydrology of the stream. However, at the time of survey the water depth was low, the flow was slow and the potential spawning gravels were bedded and compacted by sediment and cattle accessing the stream. Apart from deeper pools near the bridge very little holding habitat was present. The water quality downstream at site 13 was moderate (Q3-4) and the

riparian habitat was in reasonable condition, therefore the stream suitability for salmonids is considered to be moderate.

No typical soft sediment habitat was observed and lamprey is unlikely to be present in this upland stream. The river had some suitable eel habitat in terms of boulder, cobble and coarse gravel refugia but was of very high energy and gradient. This site is of low value to lamprey spp. but of moderate value to eel due to the river width.

Electrofishing was carried out on the Curraghfore Stream in 2021 at this site and no fish were caught. However, brown trout was recorded on the Brackary River (order 3, EPA code: 35B10), a tributary located to the west of site 13 on the WFD river water body Brackary_010.

No signs of crayfish were observed and the habitat suitability was considered to be moderate due to the lower altitude (approx. 130 mOD) location of the river and low gradient of the stream. No evidence of otter was observed but due to the presence of suitable habitat for prey items (salmonids) and good riparian habitat suitability, this stream is considered to be of moderate suitability for otter. Although suitable foraging, perching and nesting bank habitat was observed, the altitude was considered too high for Kingfisher.

Plate 3-43: Representative photo of site 28.

## 3.3 SUMMARY AQUATIC SURVEY RESULTS

### 3.3.1 Protected Species

The aquatic surveys positively identified the presence of the following (protected) species:

- Atlantic salmon;
- Brown trout;
- Lamprey species;
- White-clawed crayfish; and
- Otter.

These species were not identified at all survey sites, but may be present where suitable habitat was identified. Similarly, Kingfisher and European eel were not recorded during the survey but these species are inevitably present where suitable habitat and prey items were recorded. Table 3-2 below shows an overview of all sites, the available suitable habitat and the ecological valuation of the relevant protected species at each site.

Table 3-2: Overview of protected species and habitats and initial valuation of the site.

| Site_Nr | Within SAC boundary | Species caught during 2021 electrofishing survey and location | Salmon recorded | Brown trout recorded | Salmonid habitat suitability (H/G/M/L) | Crayfish (signs) recorded | Crayfish habitat suitability (H/G/M/L) | Lamprey recorded | Lamprey habitat suitability (H/G/M/L) | European eel habitat suitability (H/G/M/L) | European eel reasoning | Otter signs recorded | Otter potential (H/G/M/L) | Kingfisher recorded | Kingfisher potential (H/G/M/L) | Riparian vegetation | Riparian habitat has links with Annex I habitat Y/N and type | Valuation of the site in regards aquatic species and habitats |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | No | Salmon [site e3]<br>Lattone 35 River (EPA code: 35L66) approximately 4km downstream of site 1 | No | No | Low | No | Low | No | Low | Low | not caught during electrofishing | No | Low | No | Low | Sedges, ferns, willows, | No | Local Importance (lower value) |
| 2 | No | Salmon [site e3]<br>Lattone 35 River (EPA code: 35L66) approximately 4km downstream of site 2 | No | No | Low | No | Low | No | Low | Low | not caught during electrofishing | No | Low | No | Low | Bilberry, ling, sphagnum, lodgepole pine, Sitka spruce, | No | Local Importance (lower value) |
| 3 | No | No fish caught at electrofishing sites located directly downstream [310, e11, e12]<br>Salmon and trout [site e13] were recorded on the main Owenmore [Manorhamilton] River 2.8km upstream of the confluence with the Moneenshinnagh 35 River (EPA code: 35M60) | No | No | Low | No | Low | No | Low | Low | not caught during electrofishing | No | Low | No | Low | Scrub including grey willow bramble and bilberry and grassland including soft rush and grasses | No | Local Importance (lower value) |
| 4 | No | No fish caught at electrofishing sites located directly downstream [310, e11, e12]<br>Salmon and trout [site e13] were recorded on the main Owenmore [Manorhamilton] River 2.8km upstream of the confluence with the Moneenshinnagh 35 River (EPA code: 35M60) | No | No | Low | No | Low | No | Low | Low | not caught during electrofishing | No | Low | No | Low | Alder, hazel, ferns, mosses | Alluvial woodland | Local Importance (Higher Value) |
| 5 | No | No fish caught at electrofishing sites located directly downstream [310, e11, e12]<br>Salmon and trout [site e13] were recorded on the main Owenmore [Manorhamilton] River 2.8km upstream of the confluence with the Moneenshinnagh 35 River (EPA code: 35M60) | No | No | Low | No | Low | No | Low | Low | not caught during electrofishing | No | Low | No | Low | Conifer plantation | No | Local Importance (lower value) |
| 6 | No | No fish caught at electrofishing sites located directly downstream [310, e11, e12]<br>Salmon and trout [site e13] were recorded on the main Owenmore [Manorhamilton] River 2.8km upstream of the confluence with the Moneenshinnagh 35 River (EPA code: 35M60) | No | No | Low | No | Low | No | Low | Low | not caught during electrofishing | No | Low | No | Low | Grassland | No | Local Importance (lower value) |

| Site_Nr | Within SAC boundary | Species caught during 2021 electrofishing survey and location | Salmon recorded | Brown trout recorded | Salmonid habitat suitability (H/G/M/L) | Crayfish (signs) recorded | Crayfish habitat suitability (H/G/M/L) | Lamprey recorded | Lamprey habitat suitability (H/G/M/L) | European eel habitat suitability (H/G/M/L) | European eel reasoning | Otter signs recorded | Otter potential (H/G/M/L) | Kingfisher recorded | Kingfisher potential (H/G/M/L) | Riparian vegetation | Riparian habitat has links with Annex I habitat Y/N and type | Valuation of the site in regards aquatic species and habitats |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7 | No | No fish caught at electrofishing sites located directly downstream [310, e11, e12]<br>Salmon and trout [site e13] were recorded on the main Owenmore [Manorhamilton] River 2.8km upstream of the confluence with the Moneenshinnagh 35 River (EPA code: 35M60) | No | No | Low | No | Low | No | Low | Low | not caught during electrofishing | No | Low | No | Low | Conifer plantation, grasses and sedges, | No | Local Importance (lower value) |
| 8 | No | No electrofishing carried out at site or downstream.<br>Salmon and trout [site e13] were recorded on the Owenmore [Manorhamilton] River 4.7km upstream of the confluence with the Skreeny River (EPA code: 35S46) | No | Yes, visually observed | High | No | Moderate | No | Moderate | Low | not caught during electrofishing | No | Moderate | No | Low | Alder, willow, ferns, hazel, sedges, bramble | Alluvial woodland | Local Importance (Higher Value) |
| 9 | No | No electrofishing carried out at site or downstream.<br>Salmon and trout [site e13] were recorded on the Owenmore [Manorhamilton] River 4.7km upstream of the confluence with the Skreeny River (EPA code: 35S46) | No | No | Low | No | Low | No | Moderate | Low | not caught during electrofishing | No | Low | No | Low | Overgrown grassy verges with meadowsweet and horsetail downstream of point, scrubland upstream | No | Local Importance (lower value) |
| 10 | No | No fish caught at electrofishing site downstream.<br>Salmon and trout [site e13] were recorded on the Owenmore [Manorhamilton] River. | No | No | High | No | Low | No | Low | Low | not caught during electrofishing | No | Moderate | No | Low | Ferns, ivy, hazel, wild strawberry, | No | Local Importance (higher value) |
| 11 | No | No fish caught at electrofishing sites located directly downstream [310, e11, e12]<br>Salmon and trout [site e13] were recorded on the main Owenmore [Manorhamilton] River 2.8km upstream of the confluence with the Moneenshinnagh 35 River (EPA code: 35M60) | No | No | Low | No | Low | No | Low | Low | not caught during electrofishing | No | Low | No | Low | Woodland | Alluvial woodland | Local Importance (higher value) |
| 12 | No | No fish caught at electrofishing sites located directly downstream [310, e11, e12]<br>Salmon and trout [site e13] were recorded on the main Owenmore [Manorhamilton] River 2.8km upstream of the confluence with | No | No | No | No | No | No | No | Low | not caught during electrofishing | No | No | No | No | Grasses, rushes | No | Local Importance (lower value) |

| Site_Nr | Within SAC boundary | Species caught during 2021 electrofishing survey and location | Salmon recorded | Brown trout recorded | Salmonid habitat suitability (H/G/M/L) | Crayfish (signs) recorded | Crayfish habitat suitability (H/G/M/L) | Lamprey recorded | Lamprey habitat suitability (H/G/M/L) | European eel habitat suitability (H/G/M/L) | European eel reasoning | Otter signs recorded | Otter potential (H/G/M/L) | Kingfisher recorded | Kingfisher potential (H/G/M/L) | Riparian vegetation | Riparian habitat has links with Annex I habitat Y/N and type | Valuation of the site in regards aquatic species and habitats |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | the Moneenshinnagh 35 River (EPA code: 35M60) | | | | | | | | | | | | | | | | |
| 13 | No | No fish caught at electrofishing site [e8] upstream.<br>Salmon and trout were recorded on the Owenmore [Manorhamilton] River where site 13 flows into. | No | No | Moderate | No | Moderate | No | Low | Moderate | suitable habitat present but relatively high altitude | No | Moderate | No | Low | Wet woodland and wet grassland | Alluvial woodland | Local Importance (higher value) |
| 14 | No | Brown Trout<br>Caught at three electrofishing sites upstream.<br>Salmon and trout were recorded on the Owenmore [Manorhamilton] River where site 14 flows into. | No | No | Moderate | Yes | High | No | Moderate | Good | Suitable habitat present(bridges, boulders, pools) | Spraint | | No | High | Woodland | No | County Importance |
| 15 | Lough Gill SAC [001976] | No electrofishing carried out upstream or downstream.<br>Salmon and trout were recorded on the Owenmore [Manorhamilton] River, a tributary of the River Bonet which confluences west of Manorhamilton town. | Yes | Yes, anecdotal | High | Yes | High | No | Moderate | Good | Great fo commuting although possible too high energy for high numbers | Spraint | High | No | Good | Woodland | Alluvial woodland | International Importance |
| 16 | Lough Gill SAC [001976] | No electrofishing carried out upstream or downstream.<br>Salmon and trout were recorded on the Owenmore [Manorhamilton] River, a tributary of the River Bonet which confluences west of Manorhamilton town. | No | No | Low | No | Low | No | Moderate | Good | Suitable juvenile habitat | No | Moderate | No | Low | Woodland, hedgerow | No | Local Importance (higher value) |
| 17 | Lough Gill SAC [001976] | No electrofishing carried out upstream or downstream.<br>Salmon and trout were recorded on the Owenmore [Manorhamilton] River, a tributary of the River Bonet which confluences west of Manorhamilton town. | No | No | High | Yes | High | No | High | Good | Suitable habitat present(bridges, boulders, pools) | Spraint | High | No | High | Grasses, willow, | No | International Importance |
| 18 | No | No electrofishing carried out upstream or downstream.<br>Salmon and trout were recorded on the Owenmore [Manorhamilton] River, a tributary of the River Bonet which | No | Yes, observed | Moderate | No | Low | No | Low | Moderate | Moderatel y uitable juvenile habitat | | Low | No | Low | Immature wet woodland upstream, pasture downstream | Alluvial woodland | Local Importance (higher value) |

| Site_Nr | Within SAC boundary | Species caught during 2021 electrofishing survey and location | Salmon recorded | Brown trout recorded | Salmonid habitat suitability (H/G/M/L) | Crayfish (signs) recorded | Crayfish habitat suitability (H/G/M/L) | Lamprey recorded | Lamprey habitat suitability (H/G/M/L) | European eel habitat suitability (H/G/M/L) | European eel reasoning | Otter signs recorded | Otter potential (H/G/M/L) | Kingfisher recorded | Kingfisher potential (H/G/M/L) | Riparian vegetation | Riparian habitat has links with Annex I habitat Y/N and type | Valuation of the site in regards aquatic species and habitats |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | confluences west of Manorhamilton town. | | | | | | | | | | | | | | | | |
| 19 | Lough Gill SAC [001976] | No electrofishing carried out upstream or downstream.<br>Salmon and trout were recorded on the Owenmore [Manorhamilton] River, a tributary of the River Bonet which confluences west of Manorhamilton town. | No | Yes, caught | Good | Yes | Good | No | High | Good | Suitable habitat present(bridges, boulders, pools) | Spraint | High | No | Moderate | Site ID 19 // historically modified | No | International Importance |
| 20 | No | No electrofishing carried out upstream or downstream.<br>Salmon and trout were recorded on the Owenmore [Manorhamilton] River, a tributary of the River Bonet which confluences west of Manorhamilton town. | No | No | Moderate | No | Moderate | No | Low | Moderate | Moderately suitable juvenile habitat | No | Moderate | No | Low | Willow, willowherb, gorse | No | Local Importance (higher value) |
| 21 | No | No electrofishing carried out upstream or downstream.<br>Salmon and trout were recorded on the Owenmore [Manorhamilton] River, a tributary of the River Bonet which confluences west of Manorhamilton town. | No | No | Moderate | Yes | High | Yes | High | Good | Suitable habitat present(bridges, boulders, pools, macrophytes slow flowing water | Food remnant | Good | No | Good | Grassy verge scattered willow | No | County Importance |
| 22 | Lough Gill SAC [001976] | No electrofishing carried out upstream or downstream.<br>Salmon and trout were recorded on the Owenmore [Manorhamilton] River, a tributary of the River Bonet which confluences west of Manorhamilton town. | No | Yes, observed | High | No | High | No | good | Good | Great for commuting although possible too high energy for high numbers | Spraint and Food remnant | High | No | High | Woodland and pasture | No | International Importance |
| 23 | No | No electrofishing carried out upstream or downstream.<br>Salmon and trout were recorded on the Owenmore [Manorhamilton] River, a tributary of the River Bonet which confluences west of Manorhamilton town. | No | No | Low | No | Low | No | Low | Low | small ditch | No | Moderate | No | Low | Willow, alder, ash, hazel | Alluvial woodland | Local Importance (higher value) |
| 24 | Lough Gill SAC [001976] | No electrofishing carried out upstream or downstream. | No | No | High | No | Good | No | Moderate | Good | Suitable habitat present(bridges, | No | High | No | Good | Scrub and woodland | Alluvial woodland | International Importance |

| Site_Nr | Within SAC boundary | Species caught during 2021 electrofishing survey and location | Salmon recorded | Brown trout recorded | Salmonid habitat suitability (H/G/M/L) | Crayfish (signs) recorded | Crayfish habitat suitability (H/G/M/L) | Lamprey recorded | Lamprey habitat suitability (H/G/M/L) | European eel habitat suitability (H/G/M/L) | European eel reasoning | Otter signs recorded | Otter potential (H/G/M/L) | Kingfisher recorded | Kingfisher potential (H/G/M/L) | Riparian vegetation | Riparian habitat has links with Annex I habitat Y/N and type | Valuation of the site in regards aquatic species and habitats |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Salmon and trout were recorded on the Owenmore [Manorhamilton] River, a tributary of the River Bonet which confluences west of Manorhamilton town. | | | | | | | | | boulders, pools, macrophytes slow flowing water | | | | | | | |
| 25 | No | No electrofishing carried out upstream or downstream.<br>Salmon and trout were recorded on the Owenmore [Manorhamilton] River, a tributary of the River Bonet which confluences west of Manorhamilton town. | No | No | Low | No | Low | No | Low | Low | small stream | No | Low | No | Low | Ash hazel blackthorn | | Local Importance (lower value) |
| 26 | No | No electrofishing carried out upstream or downstream.<br>Salmon and trout were recorded on the Owenmore [Manorhamilton] River, a tributary of the River Bonet which confluences west of Manorhamilton town. | No | No | Low | No | Low | No | Low | Low | small stream | No | Low | No | Low | Vetch, herb Robert, horsetail, ash hawthorn | | Local Importance (lower value) |
| 27 | No | No electrofishing carried out upstream or downstream.<br>Salmon and trout were recorded on the Owenmore [Manorhamilton] River, a tributary of the River Bonet which confluences west of Manorhamilton town. | No | Yes, observed | Good | No | Moderate | No | Low | Moderate | Moderately suitable juvenile habitat | No | Moderate | No | Low | Yellow iris, Angelica, figwort, reed canary grass, willow | | Local Importance (higher value) |
| 28 | No | No electrofishing carried out upstream or downstream.<br>Salmon and trout were recorded on the Owenmore [Manorhamilton] River, a tributary of the River Bonet which confluences west of Manorhamilton town. | No | No | Moderate | No | Moderate | No | Low | Moderate | suitable habitat present but relatively high altitude | No | Moderate | No | Low | Wet woodland and wet grassland | Alluvial woodland | Local Importance (higher value) |

### 3.3.2 Biological Water Quality (Macroinvertebrates)

A macroinvertebrate sample was collected where suitable habitat existed, the site was reasonably accessible and where permission was granted by the landowner to access the waterbody. Of the 28 sites, 16 sites were sampled and included site: 1, 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 19, 21, 22 and 24.

The macroinvertebrate communities recorded at the survey sites (see site descriptions in Section 3.2) comprised a wide range of macroinvertebrate taxa. A detailed list of the macroinvertebrate taxa recorded at each survey location with the classification of macroinvertebrate species recorded in terms of their pollution sensitivity is provided in Appendix B. The species listed are in alphabetical taxonomic order and separated by the EPA taxonomic classes as described in Section 2.2.5 and colour coded for clarity.

A total of 35 taxa were recorded during the survey, with individual sites recording between 7 and 14 taxa in each kick sample (see Appendix B). Overall, the list of species was well represented by more pollution tolerant groups, including *Baetidae* which was recorded at 15 out of 16 sampling sites and *Gammarus* spp. that was recorded at all sampling sites. Class A species were well represented by *Heptageniidae* which was recorded at 13 out of 16 sites and *Plecoptera* was recorded at 7 sites. Class B Trichoptera was less abundant and was recorded in 11 out of 16 sites.

Table 3-3: Table showing Q-value (left) and SSRS (right)

| Site | Q-value | WFD Ecological Status | SSRS | SSRS Category |
|---|---|---|---|---|
| 1 | 3-4 | Moderate | 7.2 | Probably not at risk |
| 2 | NA | NA | NA | NA |
| 3 | 3-4 | Moderate | 8 | Probably not at risk |
| 4 | 3-4 | Moderate | 7.2 | Probably not at risk |
| 5 | 3-4 | Moderate | 8.8 | Probably not at risk |
| 6 | 4 | Good | 8.8 | Probably not at risk |
| 7 | 3-4 | Moderate | 5.6 | At risk |
| 8 | 4 | Good | 9.6 | Probably not at risk |
| 9 | 3-4 | Moderate | 4 | At risk |
| 10 | 3-4 | Moderate | 8 | Probably not at risk |
| 11 | NA | NA | NA | NA |
| 12 | NA | NA | NA | NA |
| 13 | 3-4 | Moderate | 8 | Probably not at risk |

| Site | Q-value | WFD Ecological Status | SSRS | SSRS Category |
|---|---|---|---|---|
| 14 | 3-4 | Moderate | 8.8 | Probably not at risk |
| 15 | 3-4 | Moderate | 8 | Probably not at risk |
| 16 | NA | NA | NA | NA |
| 17 | NA | NA | NA | NA |
| 18 | NA | NA | NA | NA |
| 19 | 3 | Poor | 5.6 | At risk |
| 20 | NA | NA | NA | NA |
| 21 | 3-4 | Moderate | 8 | Probably not at risk |
| 22 | 3-4 | Moderate | 8 | Probably not at risk |
| 23 | NA | NA | NA | NA |
| 24 | 4 | Good | 8.8 | Probably not at risk |
| 25 | NA | NA | NA | NA |
| 26 | NA | NA | NA | NA |
| 27 | NA | NA | NA | NA |
| 28 | NA | NA | NA | NA |

# 4. CONCLUSION

The proposed wind farm site is located at high (approx. 250m mOD) altitude on the north-west, west and south-west flanks of Dough Mountain where eight out of twelve streams were small and shallow first order streams which typically have low to negligible value as fish habitat. The remaining streams comprised two order 2 streams (site 6 and 10) and two order 3 rivers (site 5 and 8). Of all sites locate within the proposed wind farm site, site 8 and 10 showed high suitability for salmonids and site 8 and 9 showed moderate suitability for lamprey spp. However, all of these streams have the potential to act as a vector for suspended solids downstream where suitable salmonid habitat may be impacted. Within the proposed windfarm site no signs of otter, crayfish, lamprey, eel or kingfisher were observed and the available habitat was considered to be low.

Along the GCR protected species were recorded at a number of sites, this data is summarised below:

### European otter

Species (signs) recorded at site: 14, 15, 17, 19, 21 and 22.

Good to high habitat suitability recorded: 14, 15, 17, 19, 21, 22 and 24.

### Atlantic salmon

Species recorded at site: 15.

Good to high habitat suitability recorded: 8, 10, 15, 17 and 24.

### Brown trout

Species recorded at site: 8, 15, 18, 19, 22 and 27.

Good to high habitat suitability recorded: 8, 10, 15, 17, 18, 19, 22, 24 and 27.

### Sea Lamprey , River Lamprey and Brook Lamprey

Species recorded at site: 21.

Good to high habitat suitability recorded: 17, 21 and 22.

### European eel

Species recorded at site: N/A.

Good to high habitat suitability recorded: 13 to 22, 24, 27 and 28.

### White-clawed Crayfish

Species or remains recorded at site: 14, 15, 17, 19 and 21.

Good to high habitat suitability recorded: 14, 15, 17, 19, 21, 22 and 24.

Given the results of the aquatic baseline survey carried out within the windfarm site and along the GCR and the presence of six protected species, any instream works or works to be carried out near these rivers will require appropriate mitigation measures to be implemented to prevent adverse effects on the protected aquatic species and their supporting habitats.

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# Appendix A ELECTROFISHING REPORT (AZTEC, 2021)

# ELECTROFISHING SURVEY OF TRIBUTARIES OF THE DROWES, GARVOGE AND ERNE, AT SELECTED LOCATIONS IN THE VICINITY OF LISSINAGROAGH WIND FARM, MANORHAMILTON, CO. LEITRIM

A REPORT COMMISSIONED BY TOBIN CONSULTING ENGINEERS

AZTEC MANAGEMENT CONSULTANTS

OCTOBER 2021

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# INTRODUCTION

Aztec Management Consultants were commissioned by TOBIN Engineering Consultants to carry out an electrofishing and macroinvertebrate survey on the upland tributaries of the Drowes, Garvoge and Erne in the vicinity of Lissinagroagh Wind Farm to inform the proposed development /expansion of the wind farm. The survey, at a total of seventeen electrofishing sites, was carried out by Dr Martin O'Farrell, Mr Ross Macklin (Triturus Environmental) on 27-29 September 2021. On the same dates and at the same locations, Mr Kevin McCaffrey (Aquafact International) carried out a macroinvertebrate survey and this work is reported on separately.

# STUDY SITES

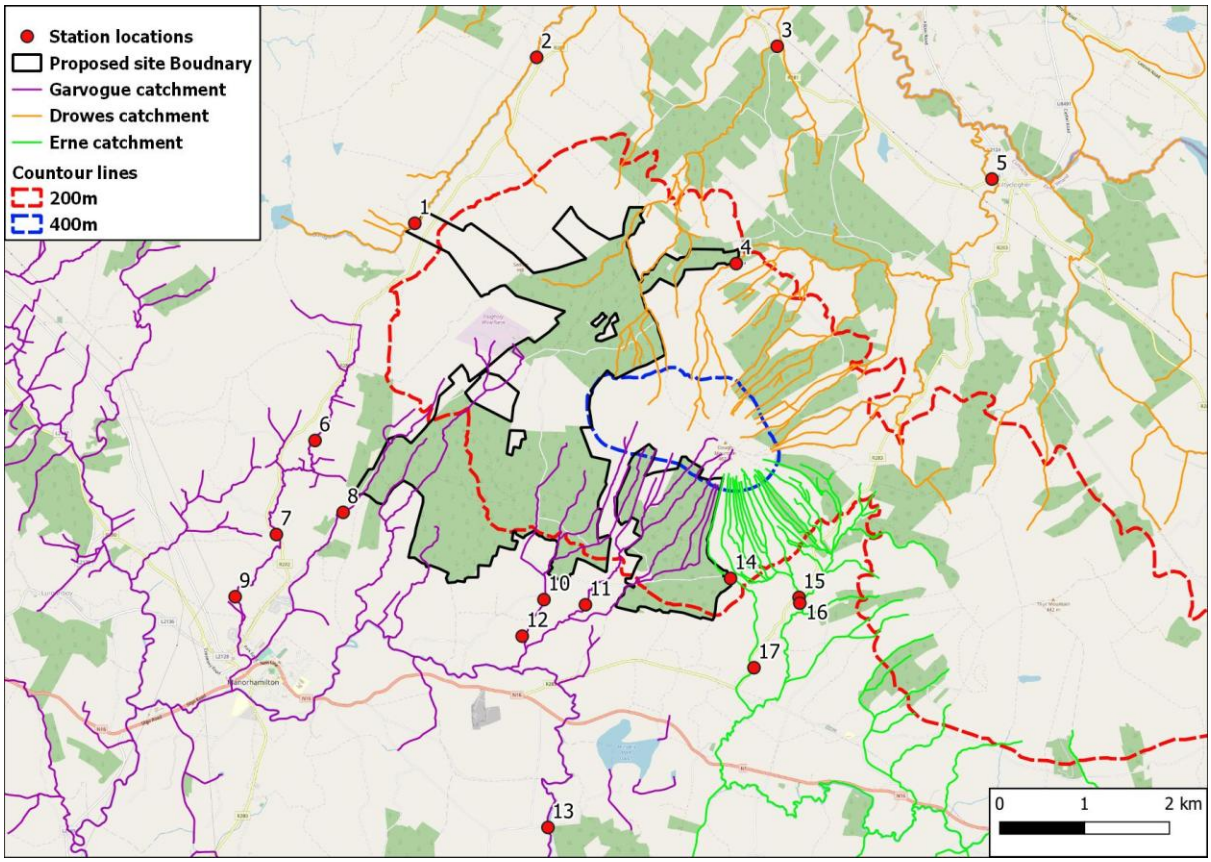


*Figure 1 Locations of electrofishing sites on the upland tributaries of the Drowes, Garvoge and Erne together with an outline of the proposed Lissinagroagh Wind Farm (shown in black)*

Appendix 1 provides a description in physical and fisheries terms and a photograph of each study site.

Table 1 details the location, altitude and dimensions of each study site. Electrofishing survey sites ranged in altitude from 62m to 226m with a mean of 120m (95% CI 23).

*Table 1 Location, altitude and dimensions for each study site*

| | | Downstream | | Upstream | | Altitude(m) | Site dimensions | | |
|---|---|---|---|---|---|---|---|---|---|
| River | SITE No. | ITM X | ITM Y | ITM X | ITM Y | | Length(m) | Width(m) | Area (m^2) |
| Ballagh | 1 | 590512 | 844872 | 590464 | 844837 | 160 | 80 | 2 | 160 |
| Ballagh | 2 | 591935 | 846819 | 591913 | 846800 | 88 | 30 | 4 | 120 |
| Lattone | 3 | 594791 | 846949 | 594765 | 8469843 | **62** | 25 | 4 | 100 |
| Sraduffy | 4 | 594286 | 844405 | 594274 | 844405 | 210 | 40 | 1.5 | 60 |
| Sraduffy | 5 | 597285 | 845385 | 597310 | 845384 | 72 | 25 | 6 | 150 |
| Owenbeg | 6 | 589311 | 842332 | 589328 | 842343 | 111 | 25 | 2.5 | 62.5 |
| Owenbeg | 7 | 588865 | 841209 | 588849 | 841239 | 107 | 40 | 2.5 | 100 |
| Owenbeg tributary | 8 | 589642 | 841486 | 589675 | 841505 | 133 | 10 | 1 | 10 |
| Owenbeg | 9 | 588371 | 840496 | 588383 | 840536 | 68 | 40 | 5 | 200 |
| Owenmore / Scardan tributary | 10 | 592010 | 840446 | 592014 | 840465 | 119 | 20 | 2 | 40 |
| Owenmore / Scardan tributary | 11 | 592497 | 840389 | 592510 | 840398 | 143 | 30 | 1.5 | 45 |
| Owenmore / Scardan tributary | 12 | 591755 | 840027 | 591758 | 840058 | 101 | 30 | 2 | 60 |
| Owenmore / Scardan | 13 | 592052 | 837782 | 592049 | 837767 | 100 | 35 | 5 | 175 |
| Cornavannoge tributary | 14 | 594226 | 840699 | 594225 | 840688 | 226 | 30 | 0.5 | 15 |
| Cornavannoge tributary | 15 | 595029 | 840470 | 595021 | 840502 | 123 | 40 | 2 | 80 |
| Cornavannoge | 16 | 595051 | 840403 | 595028 | 840422 | 118 | 70 | 4 | 280 |
| Cornavannoge tributary | 17 | 594481 | 839656 | 594478 | 839668 | 106 | 30 | 1.5 | 45 |

Table 2 details the ambient water conductivity (µS/cm), specific water conductivity ((µS/cm) and water temperature (°C). The ambient water conductivity ranged from 30.3 to 259.7 with a mean of 130.8 (95% CI 34). Ambient water conductivity at two sites on the Ballagh River averaged 181 µS/cm, at two sites on the Sraduffy River / County River the average was 55 µS/cm while at a total of four sites on the Owenbeg and a tributary of the Owenbeg the average was 216 µS/cm. At a total of four sites on the Owenmore River / Scardan River and its tributaries the average ambient water conductivity was 95 µS/cm and finally, on the Cornavannoge River and its tributaries the average water conductivity was 116 µS/cm.

*Table 2 Characteristics of water at each study site*

| | | Water characteristics | | |
|---|---|---|---|---|
| River | SITE No. | Ambient Conductivity (µS/cm) | Specific Conductivity (µS/cm) | Temp (oC) |
| Ballagh | 1 | 175.2 | 236.4 | 11.4 |
| Ballagh | 2 | 187.5 | 262 | 10.1 |
| Lattone | 3 | 47.2 | 63.4 | 11.7 |
| Sraduffy | 4 | 30.3 | 41 | 11.5 |
| Sraduffy | 5 | 79.6 | 105.9 | 12 |
| Owenbeg | 6 | 250 | 330 | 12.3 |
| Owenbeg | 7 | 202.8 | 284.2 | 10 |
| Owenbeg tributary | 8 | 259.7 | 362 | 10.2 |
| Owenbeg | 9 | 149.7 | 208.9 | 10.2 |
| Owenmore / Scardan tributary | 10 | 76.2 | 107.4 | 9.7 |
| Owenmore / Scardan tributary | 11 | 108.2 | 149 | 10.6 |
| Owenmore / Scardan tributary | 12 | 75.8 | 107.4 | 9.6 |
| Owenmore / Scardan | 13 | 118.9 | 161.5 | 11.2 |
| Cornavannoge tributary | 14 | 100.2 | 135.2 | 11.2 |
| Cornavannoge tributary | 15 | 135 | 184.2 | 11 |
| Cornavannoge | 16 | 109.6 | 151.2 | 10.7 |
| Cornavannoge tributary | 17 | 118.9 | 161.5 | 11.2 |

# MATERIALS AND METHODS

The electrofishing survey was carried out after receipt of a Section 14 Authorisation from the Department of Environment, Climate and Communications (DECC) which stipulated several conditions which related to the timing of the survey (which was to be carried out during the period 1 July-30 September), the water conditions (survey work had to be carried out during water temperatures of less than 20$^{o}$C) and the generally accepted methodologies for the deployment of electric fishing equipment. A biosecurity protocol recommended by Inland Fisheries Ireland was also adopted during the survey and all equipment used was disinfected before and after the completion of the survey.

An LR-24 LiFePO4 battery powered backpack electrofisher (Smith-Root Inc., Vancouver, WA, USA) was used during the survey. A 35-40 Hz pulsed DC (PDC) waveform with a pulse width of <4ms (13-14 percent duty cycle) at applied voltages of approximately 300-500 was deployed, depending on measured ambient conductivities at each site (Beaumont 2016). Electrofishing during one fishing run at each site was carried out over an elapsed time of 10 minutes (600 seconds) which was determined by an iPhone alarm. The number of seconds of actual fishing time was then recorded from the LR-24 menu which was set to zero seconds at the beginning of each electrofishing run. At some study sites, it was not possible to complete electrofishing over a 10-minute elapsed time period because of channel access issues. At other study sites, the absence of fish was determined after a few minutes of electrofishing and it was deemed unnecessary to continue for the full 10-minute elapsed time period.

Electrofishing was carried out in an upstream direction at each site starting with the most upstream site on each river. No stop nets were deployed and typically, electrofishing sections started and finished at the upstream limits of riffle sections which acted as a form of natural stream delineator. During electrofishing operations, fish were removed from the water using an insulated handheld dip-net with 4mm perforated knotless mesh and transferred to a holding bucket. Captured fish were anaesthetised using clove oil. All salmonids were measured for fork-length to the nearest mm. All processed fish were returned to the waterbody from whence they came after recovery from anaesthesia. No mortalities were recorded. Table 3 details the pulsed direct current (PDC) electrofishing settings and fishing times at each study site.

*Table 3 Electrofishing settings and electrofishing run characteristics*

| | | PDC Electrofishing settings | | | Electrofishing times | | |
|---|---|---|---|---|---|---|---|
| River | SITE No. | Pulse frequency | Duty cycle | Voltage | Fishing time | Elapsed Time | % Fishing time |
| Ballagh | 1 | 40 | 14 | 300 | 400 | 600 | 67 |
| Ballagh | 2 | 40 | 13 | 500 | 180 | 600 | 30 |
| Lattone | 3 | 40 | 14 | 375 | 234 | 600 | 39 |
| Sraduffy | 4 | 40 | 14 | 450 | 130 | 300 | 43 |
| Sraduffy | 5 | 40 | 13 | 400 | 271 | 600 | 45 |
| Owenbeg | 6 | 40 | 13 | 400 | 229 | 510 | 45 |
| Owenbeg | 7 | 40 | 14 | 300 | 295 | 600 | 49 |
| Owenbeg tributary | 8 | 40 | 14 | 300 | 94 | 150 | 63 |
| Owenbeg | 9 | 40 | 13 | 500 | 280 | 600 | 47 |
| Owenmore / Scardan tributary | 10 | 40 | 13 | 300 | 66 | 120 | 55 |
| Owenmore / Scardan tributary | 11 | 40 | 13 | 300 | 92 | 220 | 42 |
| Owenmore / Scardan tributary | 12 | 40 | 13 | 300 | 68 | 180 | 38 |
| Owenmore / Scardan | 13 | 35 | 13 | 400 | 253 | 480 | 53 |
| Cornavannoge tributary | 14 | 40 | 13 | 300 | 68 | 180 | 38 |
| Cornavannoge tributary | 15 | 40 | 13 | 400 | 213 | 510 | 42 |
| Cornavannoge | 16 | 40 | 13 | 300 | 292 | 600 | 49 |
| Cornavannoge tributary | 17 | 35 | 13 | 400 | 126 | 240 | 53 |

# RESULTS

## Overview of results

A total of two species of fish were recorded during the survey (table 4), namely, Atlantic salmon (*Salmo salar*) and Brown trout (*Salmo trutta*). Table 4 also presents the results of the electrofishing survey at each site in terms of site altitude, area fished and fishing time (as opposed to elapsed time), numbers of 0+ and >0+ (based on length frequency distributions) salmon and trout recorded, and their respective minimum density estimates at each study site.

*Table 4 Details of electrofishing site characteristics and numbers and minimum densities of 0+ / >0+ brown trout and Atlantic salmon recorded*

| | | | | | | | | | Minimum density estimates (no./m^2) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Brown trout | | Atlantic salmon | | Brown trout | | Atlantic salmon | |
| River | Site No. | Altitude(m) | Area (m^2) | Fishing time | 0+ | >0+ | 0+ | >0+ | 0+ | >0+ | 0+ | >0+ |
| Ballagh | 1 | 160 | 160 | 400 | 6 | 4 | | | 0.04 | 0.03 | | |
| Ballagh | 2 | 88 | 120 | 180 | 7 | 1 | | | 0.06 | 0.01 | | |
| Lattone | 3 | 62 | 100 | 234 | | | 27 | 10 | | | 0.27 | 0.10 |
| Sraduffy / County | 4 | 210 | 60 | 130 | | | | | | | | |
| Sraduffy / County | 5 | 72 | 150 | 271 | 3 | | 56 | 9 | 0.02 | | 0.37 | 0.06 |
| Owenbeg | 6 | 111 | 63 | 229 | 28 | | | | 0.45 | | | |
| Owenbeg | 7 | 107 | 100 | 295 | 17 | 9 | | | 0.17 | 0.09 | | |
| Owenbeg tributary | 8 | 133 | 10 | 94 | | | | | | | | |
| Owenbeg | 9 | 68 | 200 | 280 | 14 | 8 | | | 0.07 | 0.04 | | |
| Owenmore / Scardan tributary | 10 | 119 | 40 | 66 | | | | | | | | |
| Owenmore / Scardan tributary | 11 | 143 | 45 | 92 | | | | | | | | |
| Owenmore / Scardan tributary | 12 | 101 | 60 | 68 | | | | | | | | |
| Owenmore / Scardan | 13 | 100 | 175 | 253 | 3 | 12 | 5 | 7 | 0.02 | 0.07 | 0.03 | 0.04 |
| Cornavannoge tributary | 14 | 226 | 15 | 68 | | | | | | | | |
| Cornavannoge tributary | 15 | 123 | 80 | 213 | 15 | | | | 0.19 | | | |
| Cornavannoge | 16 | 118 | 280 | 292 | 15 | 7 | | | 0.05 | 0.03 | | |
| Cornavannoge tributary | 17 | 106 | 45 | 126 | 1 | | | | 0.02 | | | |
| | | | | | | | | | | | | |
| Totals | | | 1702.5 | 3291 | 109 | 41 | 88 | 26 | | | | |

## Atlantic Salmon

Atlantic salmon were recorded at a total of three sites (Site 3 on the Lattone River, Site 5 on the Sraduffy / County River (both Drowes tributaries) and Site 13 on the Owenmore / Scardan River), a tributary of the Garvoge.

The minimum density estimates for 0+ salmon at all three sites averaged 0.22/$m^2$ while the minimum density estimates for >0+ salmon at all three averaged 0.07/$m^2$, giving an overall minimum density estimate for salmon at all three sites of 0.29/$m^2$.

The length frequency distributions of salmon at each site are detailed in Appendix 2. Based on the length frequency distributions at each site, salmon of 8cm and longer are considered to be >0+ fish and it is probable that the vast majority of these fish are 1+ fish.

## Brown trout

Brown trout were recorded at a total of ten sites, two of which (site 5 on the Sraduffy River / County River and site 13 on the Owenmore River / Scardan River) also supported Atlantic salmon.

On the Owenbeg River, a tributary of the Garvoge, brown trout were recorded at three sites (6,7 and 9) with average minimum densities for 0+ fish of 0.23/$m^2$ and for >0+ fish 0.07/$m^2$ at sites where these age groups were recorded.

On the Ballagh River, a tributary of the Drowes, brown trout were recorded at two sites (1 and 2) with an average minimum density for 0+ fish of 0.05/$m^2$ and 0.02/$m^2$ for >0+ fish at sites where these age groups were recorded.

On the Cornavannoge River, a tributary of the Erne, brown trout were recorded at three sites (15,16 and 17) with an average minimum density for 0+ fish of 0.05/$m^2$ and 0.03/$m^2$ for >0+ fish at sites where these age groups were recorded.

Based on the length frequency distributions at each site, brown trout of 10cm and longer on the Ballagh River, 12cm and longer on the Owenbeg River and on the Owenmore River / Scardan River and 11cm and longer on the Cornavannoge River are considered to be >0+ fish and it is probable that the vast majority of these fish are 1+ fish.

## Altitude

Atlantic salmon were recorded at site 3 on the Lattone River (Drowes catchment) at an altitude of 62m, at site 5 on the Sraduffy River / County River (Drowes catchment) at an altitude of 72m and at site 13 on the Owenmore River / Scardan River (Garvoge catchment) at an altitude of 100m.

Brown trout were recorded at sites 1 and 2 on the Ballagh River (Drowes catchment) at altitudes of 160m and 88m, respectively. Brown trout were recorded on the Owenbeg River (Garvoge catchment) at sites 6,7 and 9 at altitudes of 111,107 and 68m, respectively. Brown trout were also recorded on the Cornavannoge River (Erne catchment) at sites 15,16 and 17 at altitudes of 123,118 and 106m, respectively.

No fish were recorded at site 4 (Sraduffy River / County River,Drowes catchment) at an altitude of 210m; at site 8 (a tributary of the Owenbeg River (Garvoge catchment) at an altitude of 133m; at sites 10,11 and 12 (tributaries of the Owenmore River / Scardan River (Garvoge catchment) at altitudes of 119m,143 and 101m,respectively, or at site 14 (a tributary of the Cornavannoge River (Erne catchment) at an altitude of 226m.

# DISCUSSION

The high altitude first order streams which originate on the slopes of Dough Mountain, in the vicinity of the proposed Lissinagroagh Wind Farm contribute to three catchments, namely the Drowes, Garvoge and the Erne. Outside of the boundary of the proposed Lissinagroagh Wind Farm, these streams combine to the north-west and north to form the Ballagh, Lattone and Sraduffy / County rivers (all tributaries of the Drowes). They combine to the west and south to form the Owenbeg and Owenmore / Scardan rivers (all tributaries of the Garvoge) and they combine to the south-east to form the Cornavannoge River (a tributary of the Erne).

There are several factors which collectively define lotic habitat in terms of its suitability for fish, and in this instance for salmonids (Atlantic salmon and brown trout). Mature fish must be able to reach the habitat, or close to it, for spawning purposes. The habitat must contain suitable spawning habitat and at least some suitable habitat for 0-group salmonids during some or all of their first year of life. Lotic habit might be suitable for adult spawners, ova and newly emerged alevins, but if suitable habitat in terms of physical attributes or stream flows is not available, then recently emerged parr will vacate spawning areas and drop downstream. If lotic habitat does not contain suitable habitat for 0-group fish during the first summer of life, they will not be recorded during electrofishing surveys carried out during the month of September.

In the case of the Cornavannoge River (Erne catchment) it is well known that the River Erne is an industrialised catchment which was harnessed for the generation of hydroelectricity during the 1940s and that this development impacted on salmon and that currently the Erne does not meet its estimated conservation limits for salmon. Accordingly, in the absence of information on the occurrence of barriers to the upstream migration of mature salmon, it is not surprising that the Cornavannoge River does not support salmon.

With regard to the tributaries of the Drowes, the Lattone and Sraduffy / County rivers support salmon and we can conclude that there is no barrier to the upstream migration of mature salmon downstream of the locations where salmon were recorded (sites 3 and 5 of the present survey).

Only brown trout were recorded on the Ballagh River (Drowes catchment) and, perhaps, there is a barrier to the upstream migration of mature salmon downstream of site 2 on this river.

Salmon were recorded at site 13 on the Owenmore River / Scardan River (Garvoge catchment) and it can be concluded that there is no barrier to the upstream passage of mature fish downstream of this location. The AMBER website (www.amber.international/european-barriers-atlas/) details a ford (red circle) on the Bonet River and a weir (blue circle) on the Owenmore River / Scardan River) near Manorhamilton. During the 27-29 Sept 2021 survey a cascade on the Owenmore River / Scardan River was also evident well downstream of site 13. However, as salmon were recorded at site 13, these impediments to the upstream migration of mature salmon do not appear to impede salmon in their upstream migration unduly.

With regards to the occurrence of brown trout only (Ballagh, Owenbeg and Cornavannoge rivers) it can be concluded that habitat and water quality are suitable for this species. Suitable water quality for salmonids at these locations is supported by the results of the macroinvertebrate survey (all Q3 and Q3-4 designations) carried out at the same 17 electrofishing sites during the 27-29 September 2021 survey.

The electrofishing sites where no fish were recorded during the 27-29 September 2021 survey can be categorised as high-gradient, low order, high altitude streams which do not provide suitable habitat for stream salmonids but do support healthy macroinvertebrate communities (Q3and Q3-4 designations). It is possible that these low order streams experience extremely low flow conditions from time to time e.g. the 2021 summer drought, and that these extremes contribute to the exclusion of all salmonid age groups.

Figure 2 below is a reproduction of Figure 1 which describes the electrofishing sites in terms of the presence of Atlantic salmon, brown trout and the absence of fish.

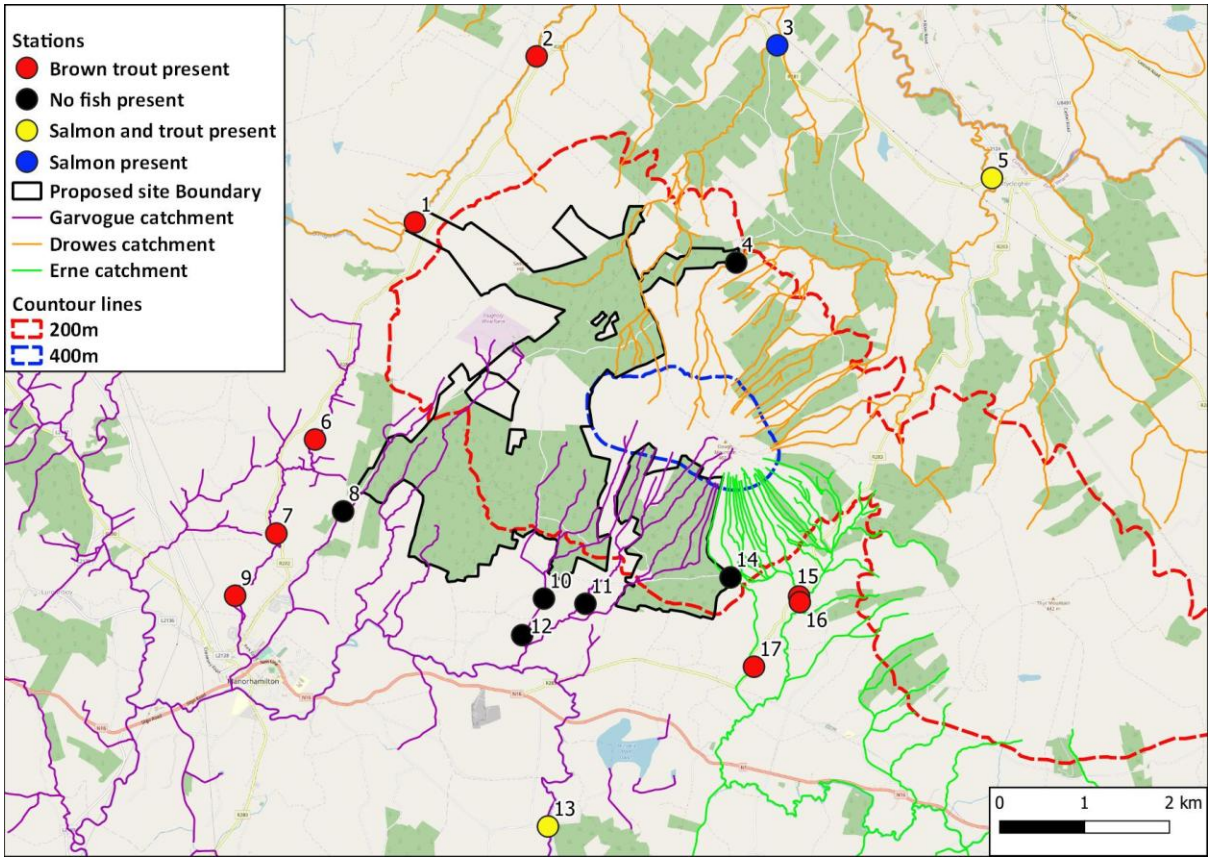


*Figure 2 Fish species recorded at each electrofishing site (categories include salmon, brown trout, salmon and brown trout, no fish present*

It is clear from Figure 2 that salmon were recorded at lower altitudes and at significant distances from the proposed development site boundary. Brown trout were recorded at intermediary altitudes and somewhat closer to the proposed development site and those sites where no fish were recorded were at higher altitudes and closer still to the proposed development site. Stream channels upstream of sites 8,10,11,12,14 and 4 do not support any species of fish and it is reasonable to assume that other stream channels flowing from Dough Mountain, which are inside or downstream from the proposed development site do not support any fish. This is certainly the case for stream

channels draining the bulk of the proposed development site to the west and south of the proposed development site i.e. stream channels which form part of the Garvoge catchment.

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# APPENDIX 1 TRIBUTARIES OF THE DROWES, GARVOGE AND ERNE ELECTROFISHING SITES

## Drowes catchment

Site 1 Ballagh River (upstream view)

Physical Description: Site 1 on the Ballagh River was a 2m wide semi-natural lowland depositing river. The small river had depths between 0.1m and 0.4m with 1m high banks. The river had some localised historical re-sectioning but retained good semi-natural chracterisctics. These included riffle, glide and shallow pool areas and a hard bed. The bed substrata were dominated by small boulder and cobble with patches of mixed gravels. The riparian areas were primarily open with a few scattered mature alder and hawthorn. The adjoining land use was of improved grassland.

Fisheries Description: Site 1 on the Ballagh River was considered a good quality nursery for brown trout given ample riffle and glide sequences with boulder and cobble substrata (offering good refugia). The river had moderate quality spawning locally in the survey reach due to more localised mixed gravels. The river was of too high energy for lamprey species and none were recorded. The river had suitable eel habitat in terms of boulder, cobble and coarse gravel refugia. However, no eel were recorded.

Site 2 Ballagh River (upstream view)

Physical Description: Site 2 on the Ballagh River was a 4m-6m wide upland eroding river with peat stained water. The spate channel had depths between 0.1m and 0.3m deep with 1m-1.5m high banks. The river had a semi-natural profile with riffle, glide and pool sequences and shallow cascading areas. It had a bed with boulder and cobble with patches of gravels at the tailings of deeper glide and pool. The riparian areas were lined with mature sycamore, hazel, ash and grey willow. The adjoining land uses were of improved pasture bordering wet grassland.

Fisheries Description: Site 2 on the Ballagh River was considered a moderate quality nursery for brown trout given ample riffle and glide sequences with a mixed substrata bed that provided oxygenated water and refugia. The river had moderate spawning in the tailings of deeper glide and in pools where unbedded mixed gravels and small cobbles were present. Holding habitat was good locally for brown trout in pools. The river was of too high energy for lamprey. The river had suitable eel habitat in terms of boulder, cobble and coarse gravel refugia. However, none were recorded.

Site 3 Lattone River (upstream view)

Physical Description: Site 3 on the Lattone River was a 5m wide upland eroding river with peat stained water. The spate channel had depths between 0.1m and 0.3m deep with 1m-2m high banks. The river had a natural meandering profile but did have evidence of some historical embankment works. It had a bed dominated by large boulder and cobble with very limited gravels given the high energy of the river. The channel profile was of boulder glide, cascading in regular sequences. The riparian areas were predominantly open with scattered semi-mature ash and occasional grey willow. The adjoining land uses were of semi-improved pasture (wetter in nature) being Juncus dominated.

Fisheries Description: Site 3 on the Lattone River was considered a good quality nursery for Atlantic salmon given ample riffle and glide sequences with a mixed substrata bed. The river had good spawning in the tailings of deeper glide and in pools where unbedded mixed gravels and small cobbles were present. The river had no lamprey ammocoete burial areas in the survey reach but spawning habitat was present. No lamprey species were recorded during the survey. The river had suitable eel habitat in terms of boulder, cobble and coarse gravel refugia. However, none were recorded.

Site 4 Sraduffy River (upstream view)

Physical Description: Site 4 on the Sraduffy River was a 1.5m-2m wide upland eroding river with peat stained water. The spate channel had depths between 0.1m and 0.2m with 1m-2m high banks. It locally deepened to 0.5m in isolated pools. The river had a natural meandering profile through mixed broadleaved woodland in a V-shaped valley. It had a bed dominated by large boulder and cobble with very limited gravels given the high energy of the river. The channel profile was of boulder cascade and glide. The riparian areas adjoined mixed broadleaved woodland.

Fisheries Description: Site 4 on the Sraduffy River was considered a poor quality nursery with very steep gradient and high energy. The river was an upland spate channel and had no spawning value due to predominance of coarse substrata. Holding habitat was restricted to isolated plunge pools. The river was of too high energy for lamprey species. The river had some suitable eel habitat in terms of boulder, cobble and coarse gravel refugia but was of very high energy and gradient reducing its value for eel. No fish were recorded.

Site 5 Sraduffy River / County River (upstream view)

Physical Description: Site 5 on the Sraduffy River / County River was an 8m-10m wide upland eroding river with peat stained water. The spate channel had depths between 0.1m and 0.3m with 1m-3m high banks. The river had a semi-natural profile with riffle, glide and pool sequences. It had a bed with boulder and cobble and large areas of mixed gravels at the tailings of deeper glide and pool. The riparian areas were lined with mature alder, birch and sycamore with bramble and bracken. The adjoining land uses were of built ground.

Fisheries Description: Site 5 on the Sraduffy River / County River was considered a very good quality nursery for Atlantic salmon given ample riffle and glide sequences (well oxygenated water) with a mixed substrata bed with abundant refugia for juvenile salmonids. The river had good spawning in the tailings of deeper glide and in pools where unbedded mixed gravels and small cobbles were present. The river had no lamprey ammocoete burial areas in the survey reach but spawning habitat was present. No lamprey species were recorded during the survey. The river had suitable eel habitat in terms of boulder, cobble and coarse gravel refugia. However, none were recorded.

## Garvoge catchment

Site 6 Owenbeg River (upstream view)

Physical Description: Site 6 on the Owenbeg River was a 2.5m-3m wide upland eroding river with a well-defined profile (good thalweg), comprising riffle, glide and pool sequences. The small spate river channel had depths between 0.1m and 0.4m with 1m high banks. The river had a bed dominated by boulder and cobble with areas of mixed gravels at the tailings of deeper glide and pool. The riparian areas were more open apart from scattered alder and hawthorn with bramble and gorse. The adjoining landuses were of semi-improved pastures that were wetter in nature (Juncus dominated).

Fisheries Description: Site 6 on the Owenbeg River was considered a very good quality nursery for brown trout given ample riffle and glide sequences with a mixed substrata bed that provided oxygenated water and refugia. The river had good spawning in the tailings of deeper glide and in pools where unbedded mixed gravels and small cobbles were present. The river had no lamprey ammocoete burial areas in the survey reach but spawning habitat was present. No lamprey species were recorded during the survey. The river had suitable eel habitat in terms of boulder, cobble and coarse gravel refugia. However, none were recorded.

Site 7 Owenbeg River (upstream view)

Physical Description: Site 7 on the Owenbeg was a 2.5m-3m wide upland eroding river with peat stained water. The spate channel had depths between 0.1m and 0.5m with 1m high banks grading into a shallow sloping V-shaped valley. The river had a natural profile with boulder cascades and glide sequences meandering through the river valley. It had substrata comprising exposed bedrock, boulder, cobble and patches of mixed gravels at the tailings of deeper glide and pool. The riparian areas were lined with scattered mature alder, ash, blackthorn and holly. The adjoining land uses were of semi-improved grassland and built land.

Fisheries Description: Site 7 on the Owenbeg River was considered a good quality nursery for brown trout (the only fish species recorded) given ample riffle and glide sequences with a mixed substrata bed that provided oxygenated water and refugia. The river had good salmonid spawning habitat locally in the tailings of deeper glide and in pools where unbedded mixed gravels and small cobbles were present. The river was of too high energy for lamprey and none were recorded during the survey. The river had suitable eel habitat in terms of boulder, cobble and coarse gravel refugia. However, none were recorded and given the higher gradient of the river the channel would be less accessible to eel. Low densities of white-clawed crayfish were recorded while electro-fishing.

Site 8 Owenbeg River tributary (upstream view)

Physical Description: Site 8 was situated on an un-named stream (a tributary of the Owenbeg River) that was a 1m wide upland eroding channel with 0.05m to 0.15m deep water. The upland channel was situated in a shallow sloping V-shaped valley. The river had a natural profile with bedrock and boulder cascades with short glide sequences giving higher energy. It had substrata comprising exposed lateral bedrock bars, boulder and cobble with very limited gravels. The substrata were bedded and suffered from heavy siltation. No macrophytes were present apart from some localised fool's watercress on the channel margins. The riparian areas were lined with scattered grey willow and alder with frequent gorse and Juncus sp. The adjoining land uses were of semi-improved grassland (very wet in nature) and patches of species poor wet grassland.

Fisheries Description: Site 8 on an un-named tributary of the Owenbeg River was considered a poor quality nursery for brown trout given very shallow water and the small size of the stream. The river had poor quality spawning due to the absence of mixed unbedded gravels and heavy siltation. The holding habitat was poor due to an absence of deeper glide and pool. The stream was of no value for lamprey and eel due to its steep gradient. No fish were recorded during the survey.

Site 9 Owenbeg River (upstream view)

Physical Description: Site 9 was situated on the Owenbeg River in a semi-natural channel with some historical embankment works. The channel was a 4m-6m wide upland eroding river channel with peat stained water. The spate channel had depths between 0.2m and 0.5m with 2m-4m high banks being historically deepened. The river had a semi-natural profile with glide and riffle sequences with occasional pool. The spate river substrata were dominated by boulder, cobble with patches of mixed gravels in the voids between coarser boulder and cobble. The riparian habitat comprised of mature ash, hawthorn, sycamore and hazel with gorse and bramble in the understories. The bordering land uses were semi-improved pasture (wetter in nature).

Fisheries Description: Site 9 on the Owenbeg River was considered a moderate to good quality nursery for brown trout given the presence of ample shallow riffle and glide with coarse substrata (refugia). The river had locally moderate quality salmonid spawning habitat in the tailings of deeper glide and in pools where unbedded mixed gravels and small cobbles were present. Holding habitat was moderate overall but improved downstream in deeper pool and glide. The river was of too high energy for lamprey. The river had suitable eel habitat in terms of boulder and cobble refugia with deep water. However, none were recorded. Moderate densities of white-clawed crayfish were present.

Site 10 Owenmore River Scardan River tributary (upstream view)

Physical Description: Site 10 was situated on a tributary of the Owenmore River / Scardan River was a 2m wide upland eroding river with boulder cascade sequences given steep gradient changes. The spate channel had depths between 0.1m and 0.3m with 1.5m high banks. The river had a semi-natural profile with boulder, glide and pool sequences but had recent embankment works that including removal of boulders from the bed. The channel had substrata of bedrock, cobble and angular very coarse gravel. The riparian areas had scattered mature ash, hawthorn and hazel. The adjoining land use was improved grassland (sheep and beef cattle grazing).

Fisheries Description: The Owenmore River / Scardan River tributary at site 10 was considered a low quality nursery for brown trout given small size and shallow water depth. The river had no spawning value due to the absence of suitable spawning gravels because of the high gradient. Holding habitat was moderate but no fish were recorded. No lamprey species or European eel were recorded during the survey due to gradients being unsuitable for the species. The low fisheries value of the channel was exemplified by the absence of fish captured during targeted electro-fishing.

Site 11 Owenmore River / Scardan River tributary (upstream view)

Physical Description: Site 11 was situated on a tributary of the Owenmore River / Scardan River. It was a 2m wide upland eroding river with boulder cascade sequences. The spate channel had depths between 0.1m and 0.3m with steep banks grading into a v-shaped valley. The channel bed was dominated by bedrock, large boulder and cobble with patches of angular gravels. The river had a natural profile with boulder, glide and pool sequences in equal proportions as the channel cut through the steep wooded valley. It was situated in a mature hazel woodland that covered the river valley. Outside of the wooded river valley the channel was bordered by improved grassland.

Fisheries Description: The Owenmore River / Scardan River tributary at site 11 was considered a low quality nursery for brown trout given small size and very steep gradient. The river had no spawning value due to the absence of suitable spawning gravels because of the high gradient. Holding habitat was moderate locally. No lamprey species or European eel were recorded during the survey due to gradients being unsuitable for the species. No fish were captured during the survey.

Site 12 Owenmore River / Scardan River tributary (upstream view)

Physical Description: Site 12 was situated on a tributary of the Owenmore River / Scardan River and was a 2m wide upland eroding river with boulder cascade sequences given steep gradient changes. The spate channel had depths between 0.1m and 0.3m with 2m-3m high banks. The river had a semi-natural profile with boulder, glide and pool sequences. It had a bed of bedrock, cobble and angular very coarse gravel. The riparian areas had scattered mature ash, hawthorn and ivy. The adjoining land use was improved grassland (sheep grazing).

Fisheries Description: The Owenmore River / Scardan River tributary at site 12 was considered a low quality nursery for brown trout given small size and very steep gradient. The river had no spawning value due to the absence of suitable spawning gravels because of the high gradient. Holding habitat was moderate. No lamprey species or European eel were recorded during the survey due to gradients being unsuitable for the species. No fish were recorded during the survey.

Site 13 Owenmore River / Scardan River (upstream view)

Physical Description: Site 13 was situated on the Owenmore River / Scardan River. The watercourse was a 4m-6m wide upland eroding river channel with peat stained water. The spate channel had depths between 0.2m and 1.1m with 2m-10m high banks being historically deepened. The river had a semi-natural profile with boulder glide sequences below boulder and bedrock outcrops. The upland river substrata comprised of large expanses of limestone bedrock, large boulder, cobble and localised areas of coarse gravels at the tailings of glide and pool. The riparian habitat comprised of mixed broadleaved woodland (sycamore dominated) bordering amenity grassland (lawns of private residences).

Fisheries Description: The Owenmore River / Scardan River at site 13 was considered a moderate quality nursery for brown trout and Atlantic salmon given the dominance of deeper pool and glide (more limited nursery habitat). The river had locally moderate quality salmonid spawning habitat in the tailings of deeper glides and in pools where unbedded mixed gravels and small cobbles were present. Holding habitat was very good with deep glide and pool being abundant. The river was of too high energy for lamprey but had some suitable eel habitat in terms of boulder and cobble refugia with deep water. However, no eel or lamprey were recorded.

## Erne catchment

Site 14 Cornavannoge River tributary (downstream view)

Physical Description: Site 14 was situated on a small low order, un-named tributary of the Cornavannogue River. The small upland eroding stream was 0.5m wide with boulder cascade sequences given its steep gradient. The spate channel had depths between 0.05m and 0.15m with 2.5m high banks. The river had a semi-natural profile with boulder, glide and pool sequences. It had a bed of bedrock, cobble and angular very coarse gravel. The riparian areas had mature grey willow bordering species poor wet grassland and wet semi-improved pasture.

Fisheries Description: The tributary of the Cornavannoge River at site 14 was considered a low quality nursery for brown trout given its small size and very steep gradient. The river had no salmonid spawning value due to the absence of suitable spawning gravels because of the high gradient. Holding habitat was poor due to the absence of pools. No lamprey species or European eel were recorded during the survey due to gradients being unsuitable for the species in addition to the very small size of the stream. No fish were recorded during the targeted electro-fishing survey.

Site 15 Cornavannoge River tributary (upstream view)

Physical Description: Site 15 was situated on a low order tributary of the Cornavannoge River. It was a 1m-1.5m wide upland eroding river with riffle and glide sequences with localised pools. The spate channel had depths between 0.1m and 0.2m with 3m-4m high banks. The river had a natural sinuous profile meandering through semi-improved grassland. It had a bed of small boulder, cobble and mixed gravels that had light siltation only. The riparian areas supported mature grey willow and osier. The bordering land use was semi-improved grassland (wet in nature).

Fisheries Description: The tributary of the Cornavannoge River at site 15 was considered a good quality nursery given moderate size, broken flow patterns and ample refugia in the bed subsrata. It had good quality salmonid spawning habitat in mixed gravels in the tailings of deeper glide and pool. Holding habitat for brown trout was locally good in deeper glide and pool. The channel was of too high energy for lamprey. The river had good suitability for eel, given good cover in deeper pools with coarse substrata. However, only brown trout were recorded.

Site 16 Cornavannoge River (upstream view)

Physical Description: Site 16 was situated on the Cornavannoge River. It was a 4m-6m wide upland eroding river with riffle, pool and glide sequences. The spate channel had depths between 0.1m and 0.3m with 1m high banks. The river had a natural sinuous profile meandering through mixed broadleaved woodland. It had a bed of small boulder, cobble and mixed gravels. The riparian areas supported mature sycamore, ash, alder and grey willow.

Fisheries Description: The Cornavannoge River at site 16 was considered a good quality nursery given moderate size, broken flow patterns and ample refugia in the bed subsrata. It had good quality salmonid spawning habitat in mixed gravels in the tailings of deeper glide and pool. Holding habitat was locally good in deeper glide and pool. The channel was of too high energy for lamprey. The river had good suitability for eel, given good cover in deeper pools with coarse substrata. However, only brown trout were recorded.

Site 17 Cornavannoge River tributary (upstream view)

Physical Description: Site 17 on the Cornavannoge River tributary was a 1.5m wide small upland eroding stream. The spate channel had depths between 0.1m and 0.2m with 0.5m high banks. The river had a natural profile with riffle, glide and pool sequences in a sinuous channel. The upland stream substrata comprised of boulder, cobble and large areas of mixed gravels at the tailings of glide and pool. The riparian habitat was of mature hazel woodland.

Fisheries Description: The Cornavannoge River tributary at site 17 was considered a moderate quality nursery for brown trout given ample riffle and glide sequences with a mixed substrata bed that provided oxygenated water and refugia. The river had good salmonid spawning habitat in the tailings of deeper glide and in pools where unbedded mixed gravels and small cobbles were present. Holding habitat was poor overall. Despite having some value as a trout nursery only a single 0+ brown trout was recorded. The stream was of too high energy for lamprey. The river had suitable eel habitat in terms of boulder, cobble and coarse gravel refugia. However, none were recorded.

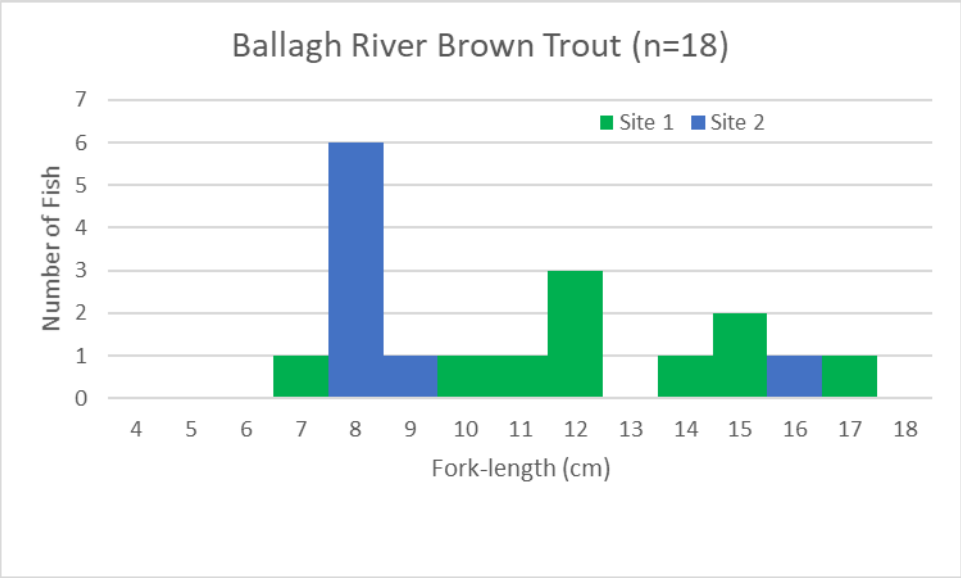
## APPENDIX 2 LENGTH FREQUENCY DISTRIBUTIONS OF BROWN TROUT AND ATLANTIC SALMON RECORDED DURING THE 27-29 SEPTEMBER 2021 ELECTROFISHING SURVEY (WATERBODY INFORMATION TAKEN FROM WWW.CATCHMENTS.IE)

Drowes catchment

Ballagh River (Ballagh_010; IE_NW_35B010400)

Length frequency distributions of brown trout recorded at sites 1 and 2 (0+ fish shown in bold)

| Length (cm) | Site 1 | Site 2 | Combined |
|---|---|---|---|
| 4 | | | |
| 5 | | | |
| 6 | | | |
| 7 | **1** | | **1** |
| 8 | | **6** | **6** |
| 9 | | **1** | **1** |
| 10 | 1 | | 1 |
| 11 | 1 | | 1 |
| 12 | 3 | | 3 |
| 13 | | | |
| 14 | 1 | | 1 |
| 15 | 2 | | 2 |
| 16 | | 1 | 1 |
| 17 | 1 | | 1 |
| 18 | | | |
| Totals | 10 | 8 | 18 |

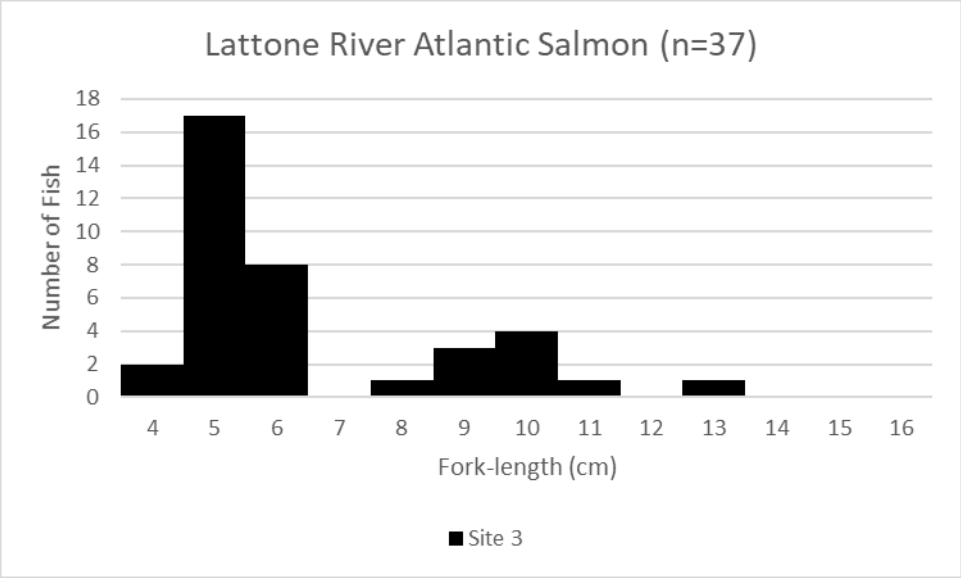



Ballagh River: length frequency distributions for brown trout at sites 1 and 2

Lattone River (Lattone_010; IE_NW_35L660960)

Length frequency of Atlantic salmon recorded at site 3 (0+ fish shown in bold)

| Length(cm) | Site 3 |
|---|---|
| 4 | **2** |
| 5 | **17** |
| 6 | **8** |
| 7 | |
| 8 | 1 |
| 9 | 3 |
| 10 | 4 |
| 11 | 1 |
| 12 | |
| 13 | 1 |
| 14 | |
| 15 | |
| 16 | |
| | |
| Totals | 37 |

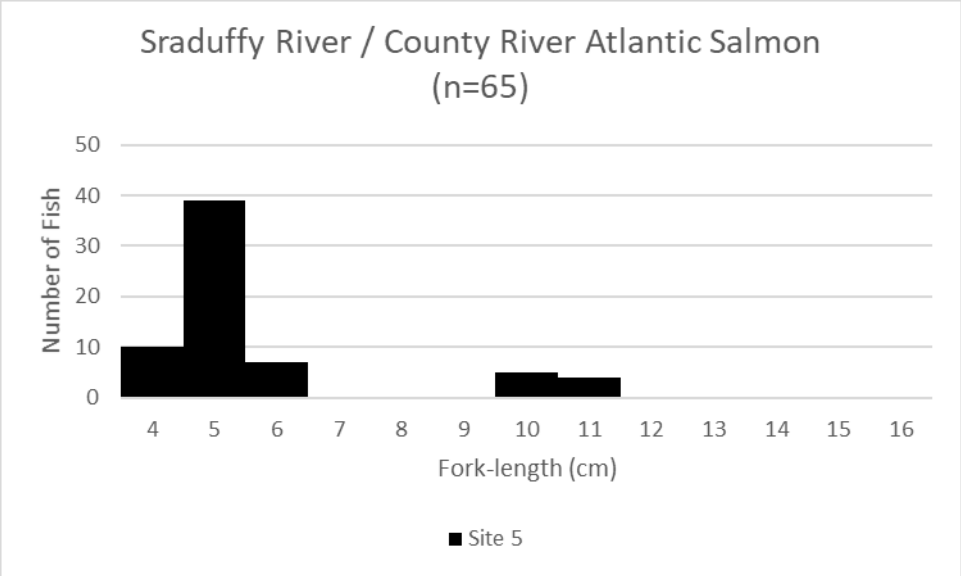



Lattone River: length frequency distribution for Atlantic salmon at site 3

Sraduffy / County River (Rosfriar_010); IE_NW_35R320460)

Length frequency of Atlantic salmon and brown trout recorded at site 5 (0+ fish shown in bold)

| | Salmon | Trout |
|---|---|---|
| Length(cm) | Site 5 | Site 5 |
| 4 | **10** | |
| 5 | **39** | **3** |
| 6 | **7** | |
| 7 | | |
| 8 | | |
| 9 | | |
| 10 | 5 | |
| 11 | 4 | |
| 12 | | |
| 13 | | |
| 14 | | |
| 15 | | |
| 16 | | |
| | | |
| Totals | 65 | 3 |



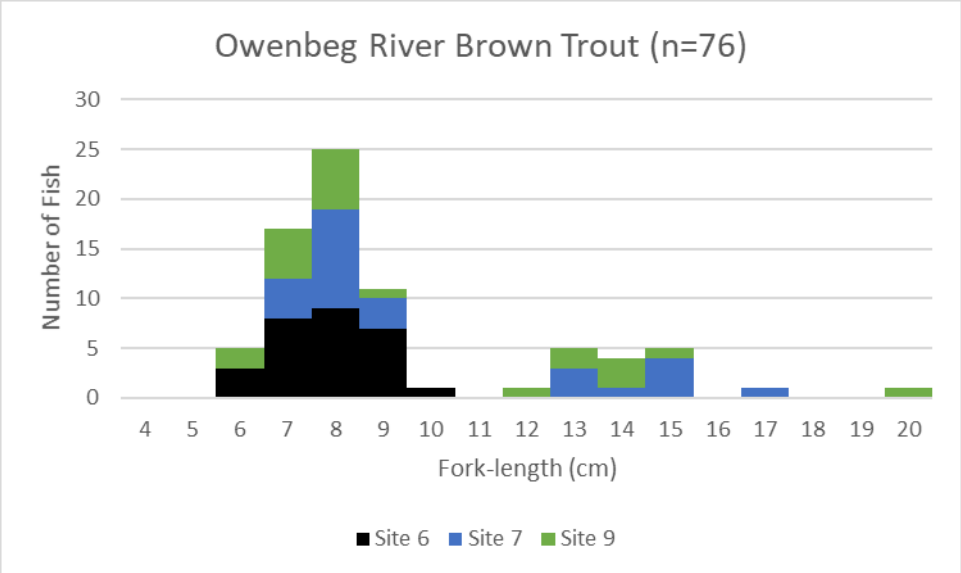

Sraduffy / County River: length frequency distribution for Atlantic salmon at site 5

Garvoge catchment

Owenbeg River (Brackary_010; IE_WE_35B100500)

Length frequency of brown trout recorded at sites 6,7 and 9 (0+ fish shown in bold)

| Length (cm) | Site 6 | Site 7 | Site 9 | Combined |
|---|---|---|---|---|
| 4 | | | | |
| 5 | | | | |
| 6 | **3** | | **2** | **5** |
| 7 | **8** | **4** | **5** | **17** |
| 8 | **9** | **10** | **6** | **25** |
| 9 | **7** | **3** | **1** | **11** |
| 10 | **1** | | | **1** |
| 11 | | | | |
| 12 | | | 1 | 1 |
| 13 | | 3 | 2 | 5 |
| 14 | | 1 | 3 | 4 |
| 15 | | 4 | 1 | 5 |
| 16 | | | | |
| 17 | | 1 | | 1 |
| 18 | | | | |
| 19 | | | | |
| 20 | | | 1 | 1 |
| | | | | |
| Totals | 28 | 26 | 22 | 76 |

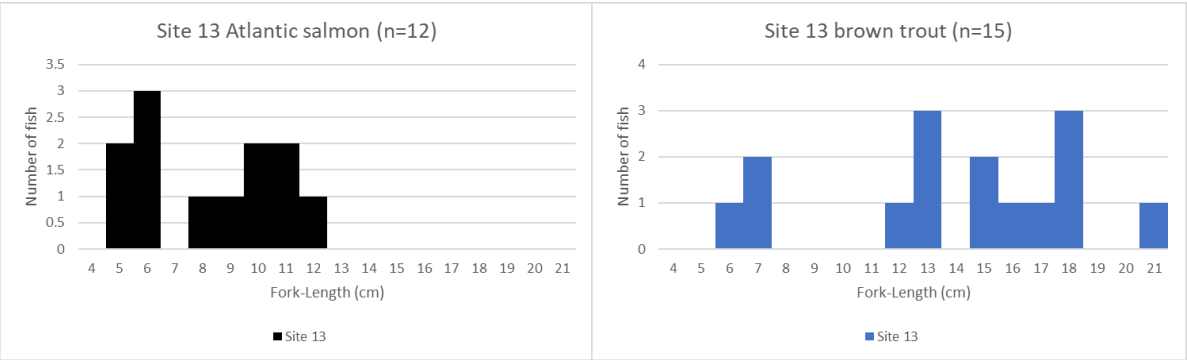



Owenbeg River: length frequency distributions for brown trout at sites 6,7 and 9

Owenmore River / Scardan River (Owenmore (Manorhamilton)_010 & Owenmore (Manorhamilton)_020; IE_WE_35O080220)

Length frequency distribution of Atlantic salmon and brown trout at site 13

| | Salmon | Trout |
|---|---|---|
| Length (cm) | Site 13 | Site 13 |
| 4 | | |
| 5 | **2** | |
| 6 | **3** | **1** |
| 7 | | **2** |
| 8 | 1 | |
| 9 | 1 | |
| 10 | 2 | |
| 11 | 2 | |
| 12 | 1 | 1 |
| 13 | | 3 |
| 14 | | |
| 15 | | 2 |
| 16 | | 1 |
| 17 | | 1 |
| 18 | | 3 |
| 19 | | |
| 20 | | |
| 21 | | 1 |
| | | |
| Totals | 12 | 15 |



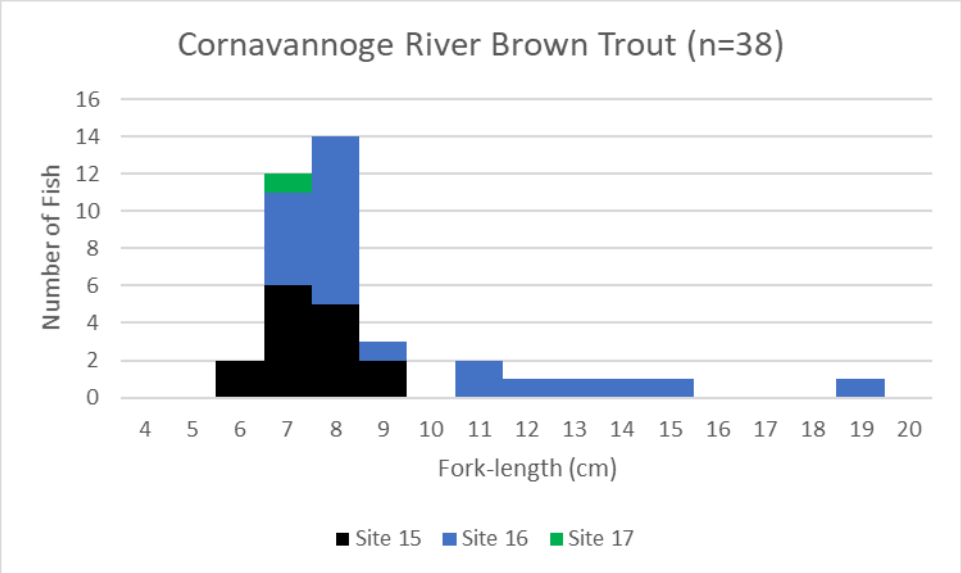

Owenmore River / Scardan River: Length frequency distributions of Atlantic salmon and brown trout recorded at site 13

Erne catchment

Cornavannoge River (Cornavannoge_010; IE_NW_36C040400)

Length frequency distributions for brown trout recorded at sites 15,16 and 17

| Length (cm) | Site 15 | Site 16 | Site 17 | Combined |
|---|---|---|---|---|
| 4 | | | | |
| 5 | | | | |
| 6 | **2** | | | **2** |
| 7 | **6** | **5** | **1** | **12** |
| 8 | **5** | **9** | | **14** |
| 9 | **2** | **1** | | **3** |
| 10 | | | | |
| 11 | | 2 | | 2 |
| 12 | | 1 | | 1 |
| 13 | | 1 | | 1 |
| 14 | | 1 | | 1 |
| 15 | | 1 | | 1 |
| 16 | | | | |
| 17 | | | | |
| 18 | | | | |
| 19 | | 1 | | 1 |
| 20 | | | | |
| | | | | |
| Totals | 15 | 22 | 1 | 38 |




Cornavannoge River: Length frequency distributions for brown trout recorded at sites 15,16 and 17

# Appendix B MACROINVERTEBRATE BASELINE REPORT (AQUAFACT, 2021)

# Lissinagroagh Windfarm
# Marcoinvertebrate
# Baseline survey

**Produced by**

## AQUAFACT International Services Ltd

**For**

## Aztec Management Consultants

**On behalf of**

## TOBIN Consulting Engineers

## November 2021

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**Report Approval Sheet**

| | |
|---|---|
| Client | Aztec Management Consultants |
| Report Title | Lissinagroagh Windfarm Marcoinvertebrate Baseline survey |
| Job Number | JN1686 |
| Report Status | Final |
| Issue Date | 23rd November 2021 |

| Rev | Status | Issue Date | Document File Name | Author (s) | Approved by: |
|---|---|---|---|---|---|
| 1 | Draft | 5th/10/2021 | JN1686 Lissinagroagh Windfarm | Kevin Mc Caffrey | Brendan O'Connor |
| 2 | Final | 17/11/2021 | JN1686 Lissinagroagh Windfarm V2 | Kevin Mc Caffrey | Brendan O'Connor |
| 3 | Final | 23/11/2021 | JN1686 Lissinagroagh Windfarm V3 | Kevin Mc Caffrey | Brendan O'Connor |
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AQUAFACT

# 1. Introduction

AQUAFACT was contracted by Aztec Management Consultants to carry out the baseline macroinvertebrate survey of the surface waters downstream of the proposed Lissinagroagh Windfarm. The sampling was carried out from the 27th to the 29th of September 2021. Kick sampling was carried out at 17 locations spread over three catchments the Drowes, Erne and Garavogue.

# 2. Methodology

## *2.1. Sampling*

Seventeen kick samples were taken over the three days (See Figure 2.1 and Table 2.1). The two-minute kick and one minute stone wash sampling method was employed to collect samples of macroinvertebrates for analysis. This involved placing a standard hand net of pore size 500µm in the river, facing upstream and disturbing the river bed in front of the net mouth. The surveyor then moved in a diagonal direction upstream to ensure that different micro-habitats were included in the sample. The kick method dislodges macroinvertebrates from the substrates and submerged plant material. This was continued for approximately two minutes and followed by one minute of stone washing (Lucey *et al.*, 1999).

The macroinvertebrate assemblages of each sample were identified and counted on the river bank. The details of the macroinvertebrate assemblages were recorded on data sheets. The resulting species list was then used to assign a Biotic Index value (Q-Value, SSRS) to the sampled streams.

The IFI's 2010 Biosecurity Protocol for Field Survey Work document was followed during sampling. Nets and all other equipment were thoroughly disinfected between stations.

**Figure 2.1: Lissinagroagh sampling sites.**

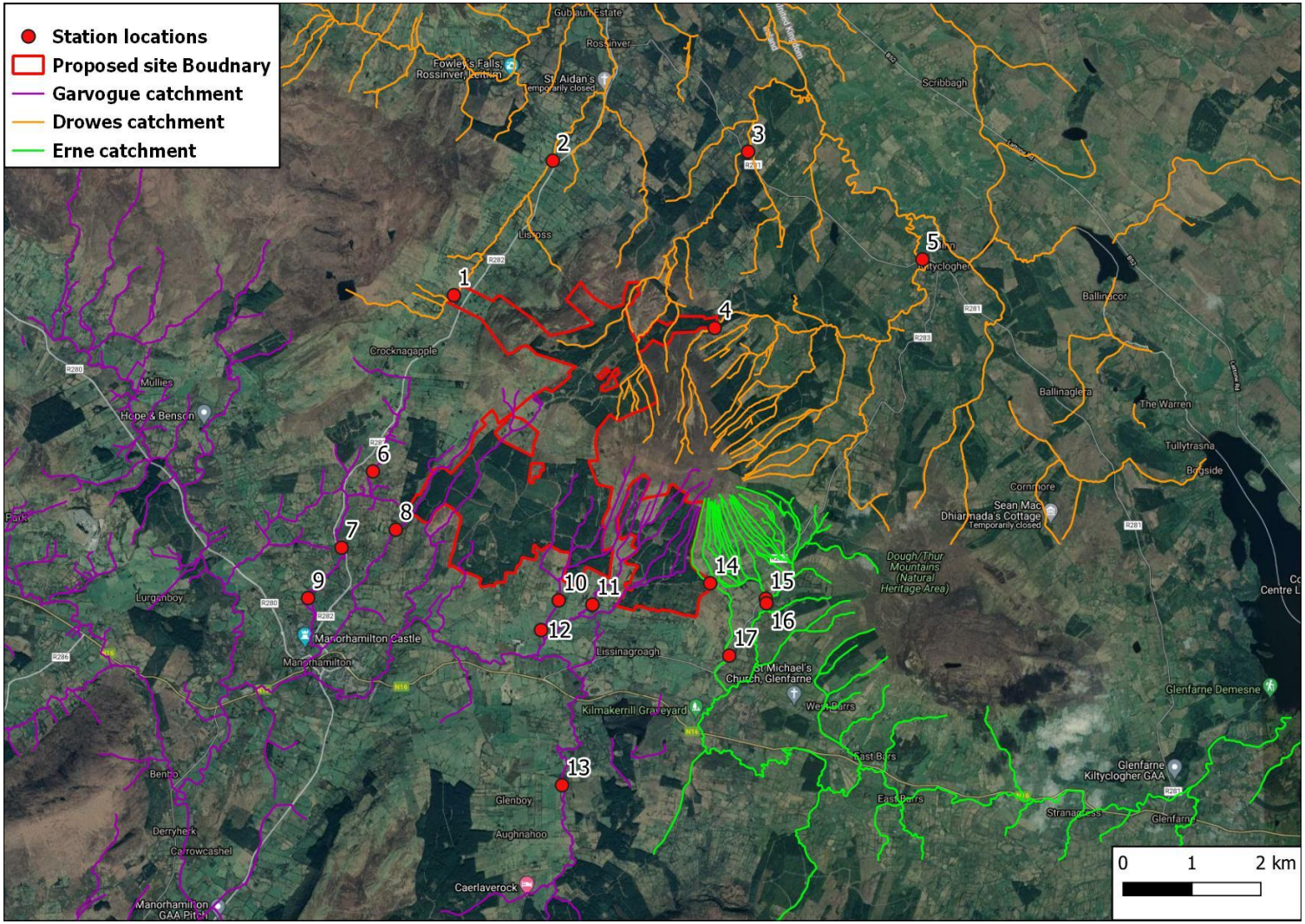


**Table 2.1: Biological monitoring stations coordinates for Lissinagroagh.**

| Station | River | Catchment | Longitude | Latitude |
|---|---|---|---|---|
| 1 | Ballagh | Drowes | -8.14616 | 54.35244 |
| 2 | Ballagh | Drowes | -8.12411 | 54.36991 |
| 3 | Lattone | Drowes | -8.08057 | 54.37108 |
| 4 | County tributary | Drowes | -8.08800 | 54.34820 |
| 5 | County tributary | Drowes | -8.04170 | 54.35710 |
| 6 | Owenbeg | Garvoge | -8.16422 | 54.32956 |
| 7 | Owenbeg | Garvoge | -8.17122 | 54.31965 |
| 8 | Owenbeg tributary | Garvoge | -8.15913 | 54.32199 |
| 9 | Owenbeg | Garvoge | -8.17867 | 54.31309 |
| 10 | Owenmore trubuta | Garvoge | -8.12278 | 54.31279 |
| 11 | Owenmore tributa | Garvoge | -8.11528 | 54.31225 |
| 12 | Owenmore tributa | Garvoge | -8.12672 | 54.30894 |
| 13 | Scardan River | Garvoge | -8.12205 | 54.28877 |
| 14 | Cornavannoge trib | Erne | -8.08902 | 54.31503 |
| 15 | Cornavannoge trib | Erne | -8.07661 | 54.31302 |
| 16 | Cornavannoge | Erne | -8.07648 | 54.31242 |
| 17 | Cornavannoge trib | Erne | -8.08477 | 54.30561 |

## *2.2. The Biological River Classification System (Q-Scheme)*

The Biological River Quality Classification System (Q-Scheme) has been in use in Ireland since 1971. It has undergone a number of modifications since then and has been included in the Local Government (Water Pollution) Act, 1977 (Water Quality Standards for Phosphorus) Regulations, 1998. It is routinely employed by the EPA. For the purpose of this assessment benthic invertebrates have been divided into five indicator groups according to tolerance of pollution, particularly organic pollution (Lucey *et al.*, 1999).

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 Table 2.2).

**Table 2.2: Biotic Index scoring system for the Q-Scheme.**

| Biotic Index | Quality Status | Quality Class |
|---|---|---|
| Q5, 4-5, 4 | Unpolluted | Class A |
| Q3-4, | Slightly Polluted | Class B |
| Q3, 2-3 | Moderately Polluted | Class C |
| Q2, 1-2, 1 | Seriously Polluted | Class D |

### *2.3. Small Stream Risk Score*

The Small Streams Risk Score (SSRS) is a biological risk assessment system for identifying rivers that are definitely 'at risk' of failing to achieve the 'good' water quality status goals of the Water Framework Directive (WFD). It was developed by the Environmental Protection Agency (EPA) in association with the Western River Basin District (WRBD) in 2006.

The SSRS method is a rapid field methodology for risk assessment that is based solely on Macroinvertebrate indicators of water quality and their well-understood response to pollution. Importantly the SSRS score indicates whether or not he stream is at risk from pollution and not the ecological health of the stream. The SSRS score ranges from 0-11.2.

**Table 2.3: SSRS Categories.**

| SSRS range | Category |
|---|---|
| <6.5 | Stream at Risk |
| >6.5-7.25 | Indeterminate stream may be at risk |
| >7.25 | Probably not at risk |

## 3. Results

All sites sampled in the Drowes catchment (Stations 1- 5) received a Q4 rating indicating that they are unpolluted and of "Good" ecological status. The SSRS score for these stations also indicated that the streams are probably not at risk of failing to meet "Good" ecological status. This included three river systems the Ballagh, Lattone and a tributary of the County River (See Table 3.1 and Figures 3.1 & 3.2).

In the Garvoge catchment a number of tributaries of the Owenmore River were sampled. Three stations were sampled on the Owenbeg River (Stations 6, 7, 9) and one on a tributary of the Owenbeg (Station 8). All of these

station received a Q4 indicating that they are unpolluted and of "Good" ecological status. However, the SSRS score for stations 6, 7 and 8 indicated that these stream are at risk of not meeting "Good" ecological status. Stations 10, 11 and 12 are located on small tributaries further upstream and station 13 is located on the upper reaches of the Owenmore River known as the Scardan River. All four stations received a Q3 indicating that they are slightly polluted and of "Moderate" ecological status. The SSRS scores for these four stations categorised the streams as at risk of not meeting "Good" ecological status.

Four stations were sampled in the Erne catchment, one on the Cornavannoge River (Station 16) and three on its tributaries (Stations 14, 15&17). Stations 14, 15 and 16 received a Q4 indicating that they are unpolluted and of "Good" Ecological status, while station 17 received a Q3 indicating that it is slightly polluted and of "Moderate" ecological status. The SSRS scores for Stations 14 and 17 were categorised as at risk of not meeting "Good" ecological status. Station 15 was categorised as indeterminate stream may be at risk of not meeting "Good" ecological status, while station 16 was classified as probably not at risk of not meeting "Good" ecological status.

White-clawed Crayfish (Austropotamobius pallipes) were recorded at both station 7 and Station 9 on the Owenbeg River (See Figure 2.1). One individual was caught at each site and both were female specimens. Both crayfish appeared healthy with no obvious infections or injuries.

**Table 3.1: Biological sampling results.**

| Station | Q-value | SSRS score | SSRS category |
|---|---|---|---|
| **1** | 4 | 8 | Probably not at risk |
| 2 | 4 | 8 | Probably not at risk |
| **3** | 4 | 8 | Probably not at risk |
| **4** | 4 | 8 | Probably not at risk |
| **5** | 4 | 9.6 | Probably not at risk |
| **6** | 4 | 4.8 | Stream at risk |
| **7** | 4 | 6.4 | Stream at risk |
| **8** | 4 | 5.6 | Stream at risk |
| **9** | 4 | 8 | Probably not at risk |
| **10** | 3 | 1.6 | Stream at risk |
| **11** | 3 | 1.6 | Stream at risk |
| **12** | 3 | 3.2 | Stream at risk |
| **13** | 3 | 3.2 | Stream at risk |
| **14** | 4 | 4.8 | Stream at risk |
| **15** | 4 | 7.2 | Indeterminate stream May be at risk |
| **16** | 4 | 8.8 | Probably not at risk |
| **17** | 3 | 5.6 | Stream at risk |

**Figure 3.1: Q-value results map.**

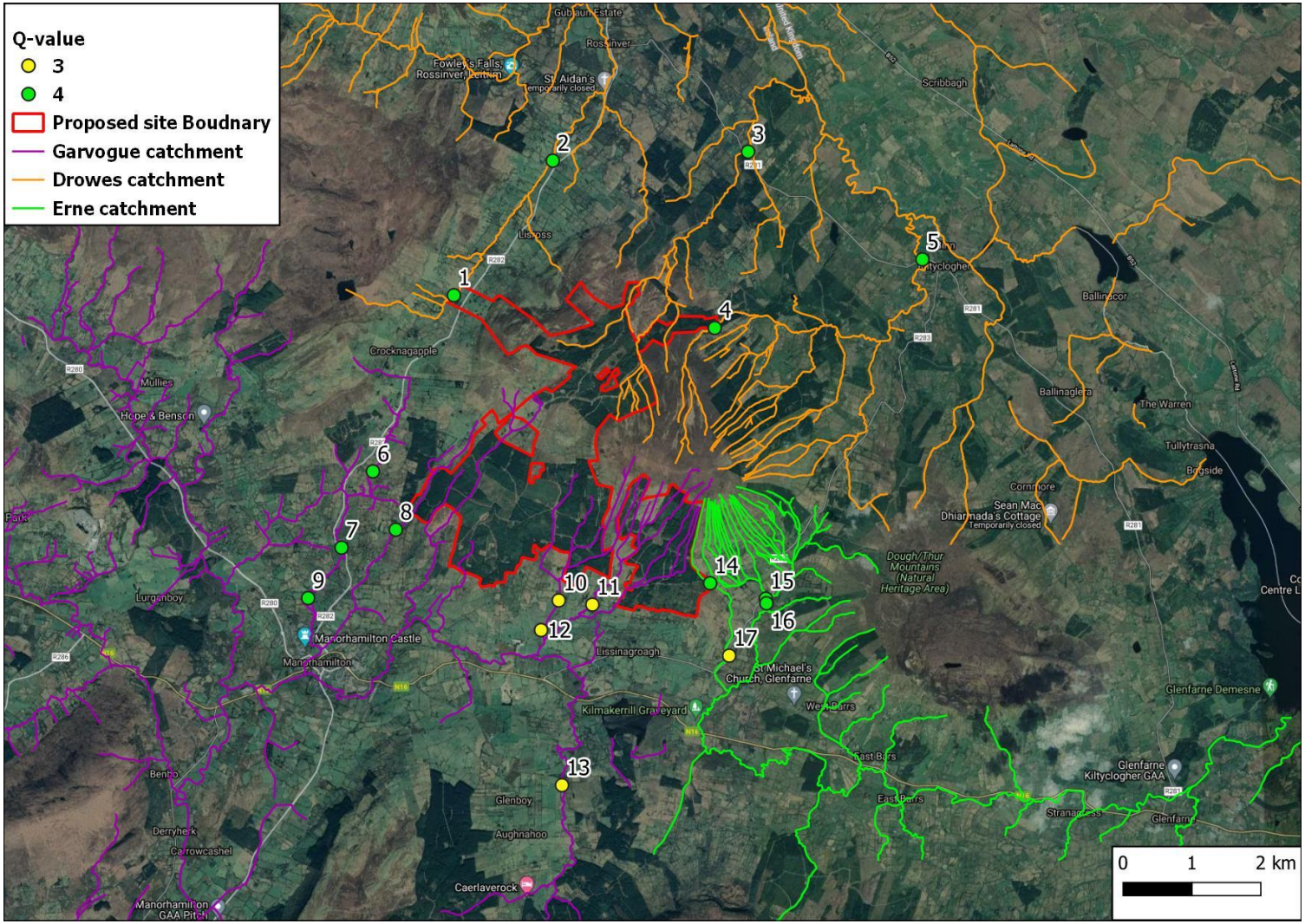
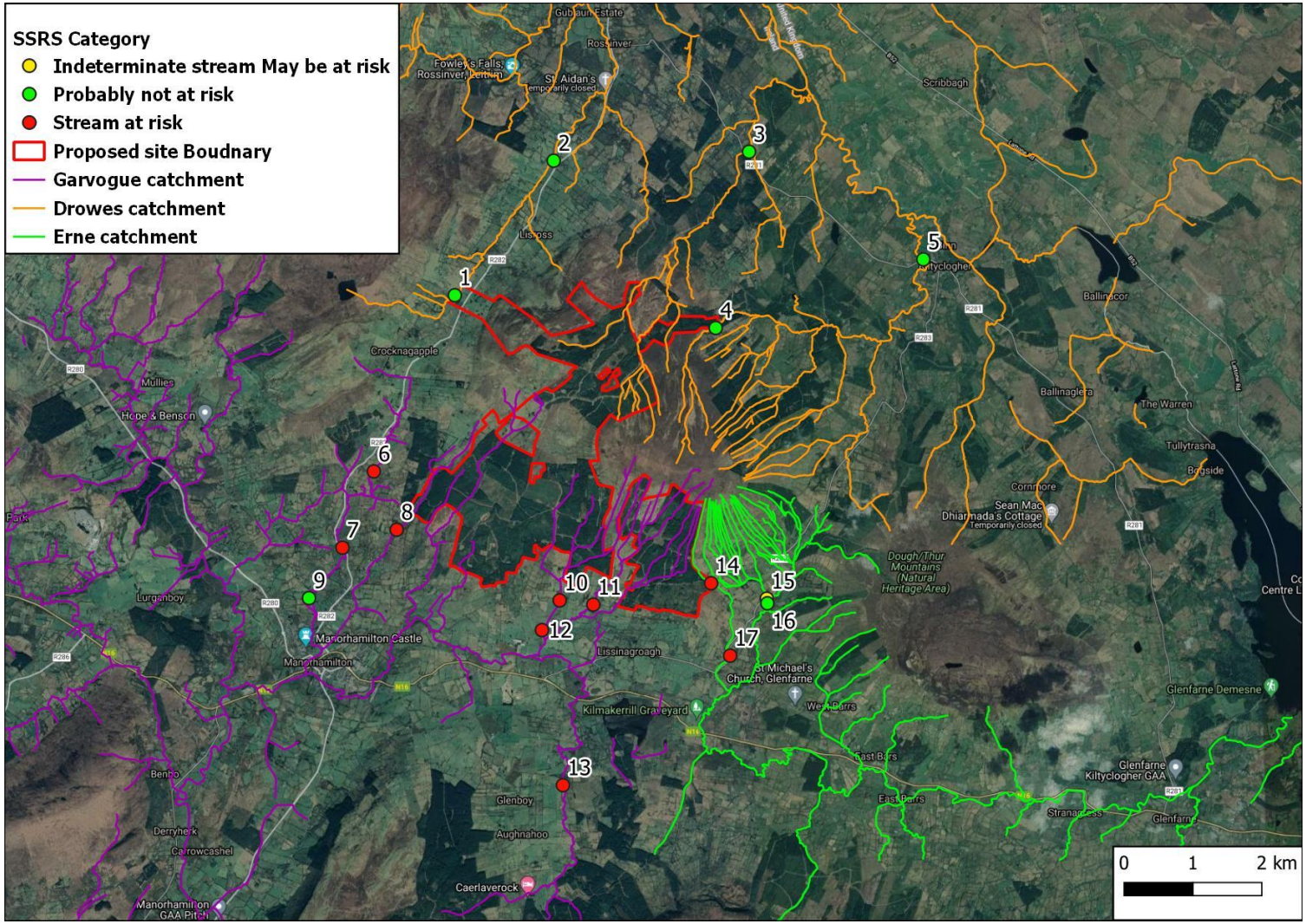


**Figure 3.2: SSRS results map**.



# 4. Discussion

The macroinvertebrate communities of the Drowes catchment are in the best condition out of the three catchments sampled, with all sampling sites categorised as of Good ecological status and probably not at risk of not meeting "Good" ecological status.

The ecological status of the Garvoge and Erne catchments is more mixed. The Owenbeg system in the Owenmore catchment is currently of "Good" ecological status, however, the SSRS score for three of the four stations found that they were at risk of not meeting "Good" ecological status. The remaining four stations in the Owenmore catchment were categorised as "Moderate" ecological status and at risk of not meeting "Good" ecological status. Similarly in the Erne catchment three stations were recorded as having "Good" ecological status and one with "Moderate ecological" status. Of the three Good status stations one was at risk, one was indeterminate may be at risk and one was probably not at risk.

Stations 10 and 12 record very low numbers of individuals. At station 10 only three individuals were recorded which were all Baetidae species. Similarly station 12 recorded only two individuals one Baetidae and one chironomid. The river bed at station 12 was entirely bedrock with little to no sediment present. It appeared that the stream at station 10 had been dredge and the eastern bank had been raised (See Appendix 2 Station 10). It is likely that the particularly low abundance of macroinvertebrates is due to these river bed conditions rather than solely a water quality issue.

Based on these results both the Garvoge and Erne catchments are under varying levels of pressure due to pollution. Two likely pressures evident in the catchments are commercial coniferous forests and agriculture. The land cover of coniferous plantations is relatively high in the area. Although the farming in the area is non intensive a number of locations were observed where streams were not fenced off and livestock have open access.

White-clawed crayfish (*Austropotamobius pallipes*) were recorded at two locations on the Owenbeg River. They were previously recorded at station 7 in 2003 and 2006 (Biodiversity Ireland, 2021). Suitable habitat for white-clawed crayfish was present at both stations with Cobbles and gravel with some boulders present. As such there is suitable availability of refuges

in both areas. The delicate gills of white-clawed crayfish are susceptible to damage due to siltation (Reynolds et al., 2010). There was no significant evidence of siltation at either station.

## 5. References

Biodiversity Ireland. 2021. Biodiversity map. https://maps.biodiversityireland.ie/Map/Terrestrial/Species/17487 Accessed November 2021.

EPA. 2015. Guidance on Application and Use of the SSRS in Enforcement of Urban Waste Water Discharge Authorisations in Ireland. https://www.epa.ie/publications/compliance--enforcement/waste-water/SSRS-in-Enforcement-of-UWWDAs.pdf Accessed September 2021.

Lucey, J., Bowman, J.J., Klabby, K.J., Cunningham, P., Lehane, M., MacCarthaigh, M., McGarrigle, M.L. and Toner, P.F. 1999. Water Quality in Ireland, 1995 – 1997. EPA.

Reynolds, J.D., O'Connor, W., O'Keeffe, C. & Lynn, D. (2010) A technical manual for monitoring white-clawed crayfish Austropotamobius pallipes in Irish lakes. Irish Wildlife Manuals, No 45, National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin.

# Appendix 1

## Species List

| **Taxa/Station** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ephemeroptera** | | | | | | | | | | | | | | | | | |
| *Ecdyonurus* sp. | 23 | 13 | 15 | | 20 | 20 | 10 | | 10 | | | | | | | | |
| *Rhitrogena sp.* | 10 | 2 | 5 | 10 | | | | 5 | | | | | | 5 | | 8 | |
| *Heptagenia sp.* | | | | | 2 | | | | | | | | | | 24 | 15 | |
| Baetidae | 100+ | 34 | 100+ | 20 | 70 | 100+ | 50 | 15 | 100 | 3 | 100+ | 1 | 5 | 10 | 20 | 5 | 15 |
| **Plecoptera** | | | | | | | | | | | | | | | | | |
| *Protonemura* sp. | | | | | 5 | | | | | | | | | | 3 | | |
| Perlodidae | | | | 3 | | | | | | | | | | | | | |
| *Leuctra* sp. | | 2 | | 1 | 4 | | 2 | | 2 | | | | | 2 | 2 | 2 | 2 |
| **Trichoptera** | | | | | | | | | | | | | | | | | |
| *Odontocerum albicorne* | 5 | | 1 | | | | | | | | | | | | | | |
| Sericostomatidae | | | 1 | | | | | | | | | | | | | | |
| Goeridaae | | | 3 | | | | | | | | | | | | | | |
| Glossosomatidae | | | | | | | | 5 | 16 | | | | | | | 18 | |
| *Rhyacophila* sp. | 5 | | | | | | | | | | | | | | | | |
| Polycentropodidae | 5 | | | 1 | | | | | | | | | | | | | 5 |
| Hydropsychidae | | | | | 5 | 10 | | | 14 | | | | 4 | | | 6 | |
| **Coleoptera** | | | | | | | | | | | | | | | | | |
| Coleoptera larvae | 10 | | 10 | | | | | | | | 2 | | | | | | |
| **Diptera** | | | | | | | | | | | | | | | | | |

| **Taxa/Station** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Simuliidae | 10 | 11 | 10 | 5 | 10 | 10 | | 10 | | | | | 25 | | 10 | 7 | 3 |
| Pediciidae | | | 5 | | | | 3 | | | | | | | | 1 | 2 | |
| Chironomidae | | | | | | 5 | | | 19 | | | 1 | | | | | |
| **Hydracarina** | | 20 | 5 | | | 12 | | | | | | | 7 | | | | |
| **Crustacea** | | | | | | | | | | | | | | | | | |
| *Gammarus* sp. | 10 | | 10 | 3 | 10 | 10 | 5 | 25 | 9 | | | | 10 | 5 | 5 | 5 | 7 |
| *Austropotamobius pallipes* | | | | | | | 1 | | 1 | | | | | | | | |
| **Gastrapoda** | | | | | | | | | | | | | | | | | |
| *Ancylus fluviatilis* | | | 3 | | | | | | | | | | | | | | |
| **Nematomorpha** | 1 | | | | | | | | | | | | | | | | |
| Q-value | Q-4 | Q-4 | Q-4 | Q-4 | Q-4 | Q-4 | Q-4 | Q-4 | Q-4 | Q-3 | Q-3 | Q-3 | Q-3 | Q-4 | Q-4 | Q-4 | Q-3 |
| SSRS | 8 | 8 | 8 | 8 | 9.6 | 4.8 | 6.4 | 5.6 | 8 | 1.6 | 1.6 | 3.2 | 3.2 | 4.8 | 7.2 | 8.8 | 5.6 |

# Appendix 2

# Photo log

Station 1

Station 2

Station 3

Station 4

Station 5 upstream

Station 5 Downstream

Station 6

Station 7 Crayfish

Station 7

Station 8

Station 9

Station 10

Station 11

Station 12

Station 13

Station 14

Station 15

Station 16

Station 17

# Appendix C DETAILED AQUATIC SURVEY SITE LOCATIONS (TOBIN, 2025)

8°7'30"W
8°7'20"W
8°7'10"W
8°7'0"W
54°20'52"N
54°20'45"N
54°20'38"N
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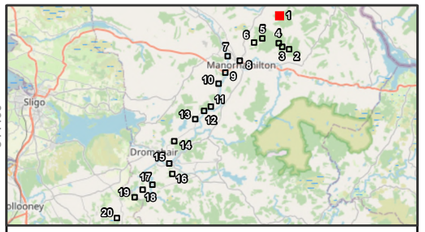
N
1
2




**Legend**

- Application Boundary
- Landpwnership Boundary
- Aquatic Survey Locations
- WFD - River Water Bodies

0 50 100
Metres

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Appendix C
Figure 2-2a:
Aquatic Survey Site Location
Sheet 1 of 20

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Draft: A

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8°6'20"W
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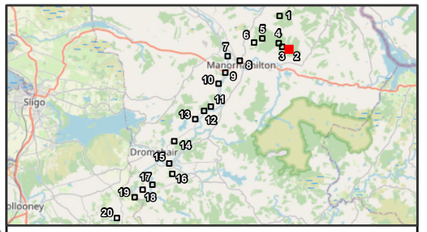
7

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- Landpwnership Boundary
- Grid Connection Route
- Aquatic Survey Locations
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8°7'0"W
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841200
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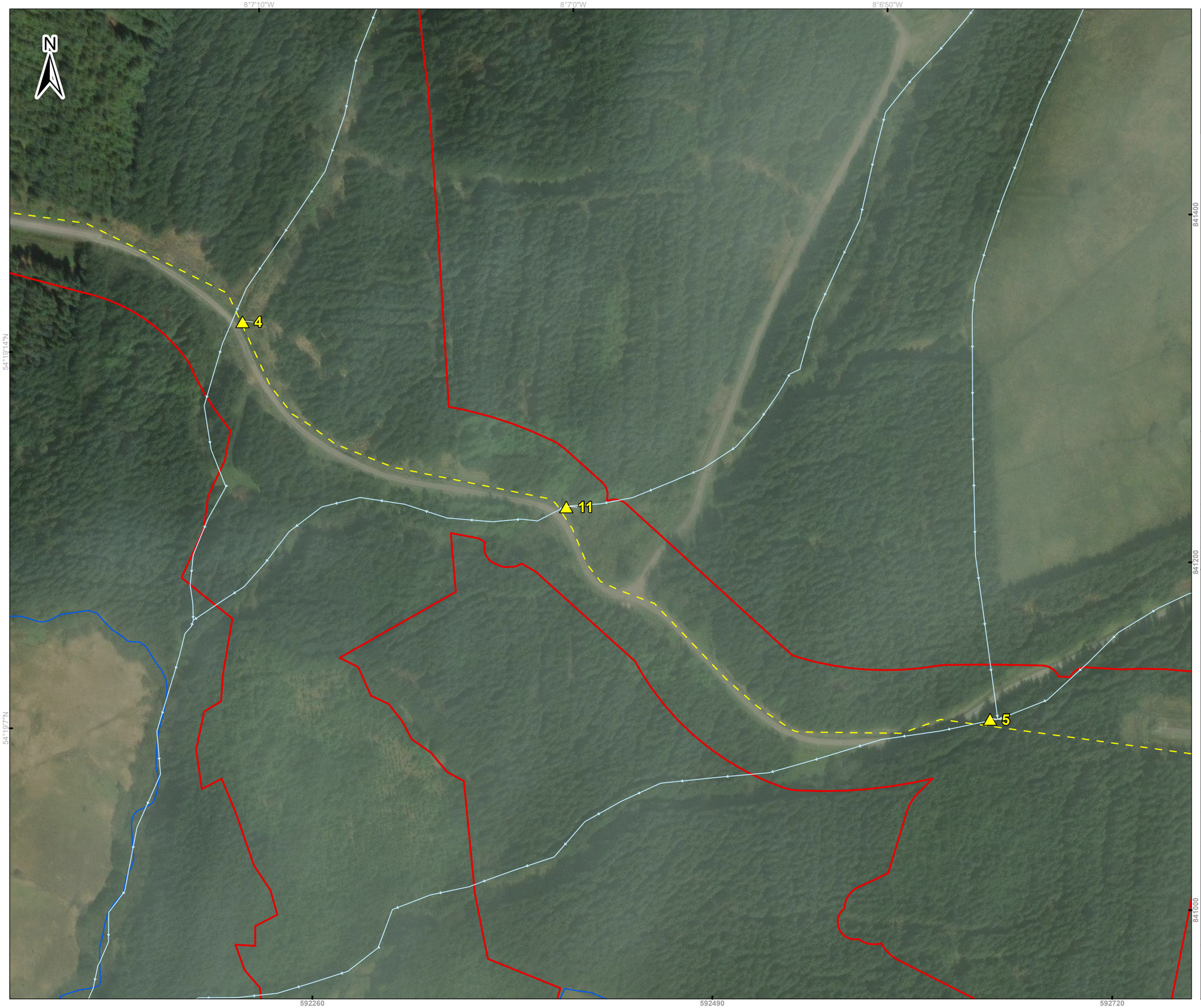
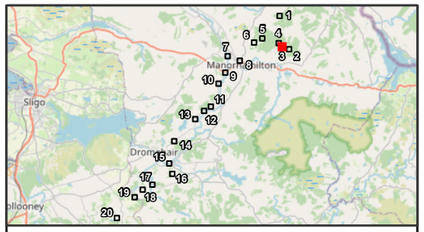
592720

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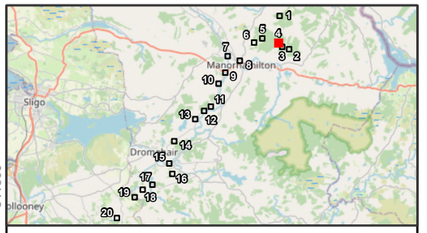


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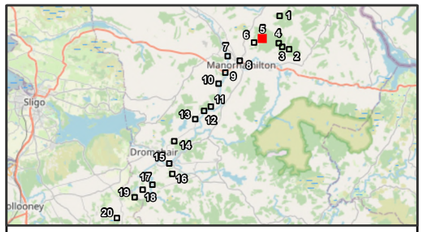


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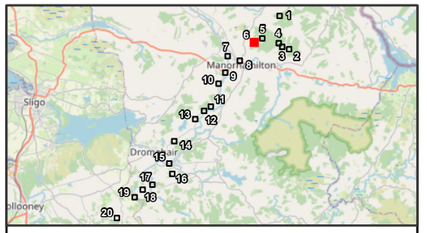


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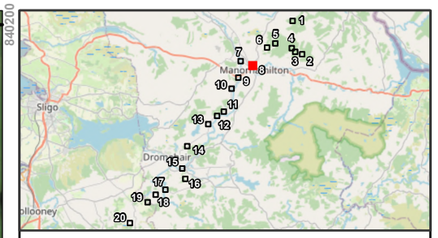


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Metres

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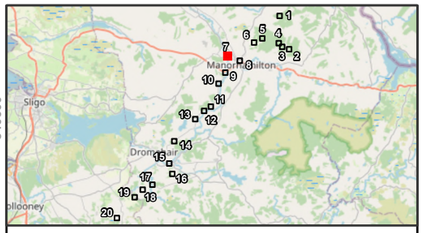


**Legend**

- Grid Connection Route
- Aquatic Survey Locations
- WFD - River Water Bodies

0 50 100
Metres

**Spatial Reference**
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Title: Appendix C
Figure 2-2h:
Aquatic Survey Site Location
Sheet 8 of 20

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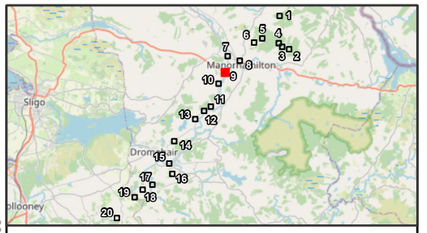


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- WFD - River Water Bodies

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Figure 2-2i:
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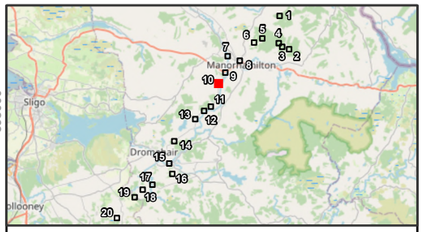


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- Aquatic Survey Locations
- WFD - River Water Bodies

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Figure 2-2j:
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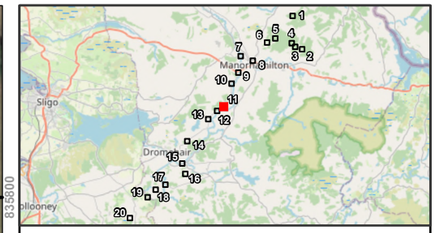


**Legend**

- Grid Connection Route
- Aquatic Survey Locations
- WFD - River Water Bodies

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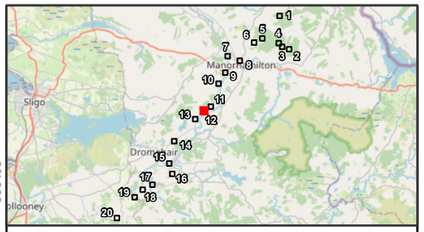


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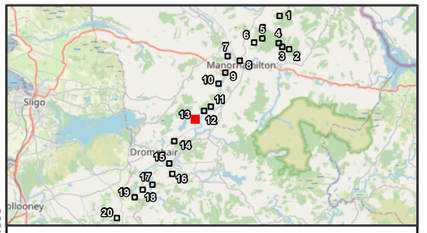


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- Grid Connection Route
- Aquatic Survey Locations
- WFD - River Water Bodies

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Metres

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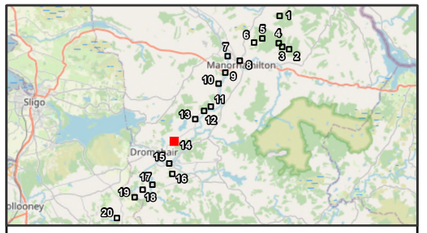


**Legend**

- Grid Connection Route
- Aquatic Survey Locations
- WFD - River Water Bodies

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8°17'0"W
8°16'50"W
8°16'40"W
8°16'30"W
54°13'17"N
54°13'10"N
830400
830200
830000
581450
581680
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N

Drumlease Road
Drumlease Road
Drumlease Road
BONET_050
BONET_050
Bonet River
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R287
R287
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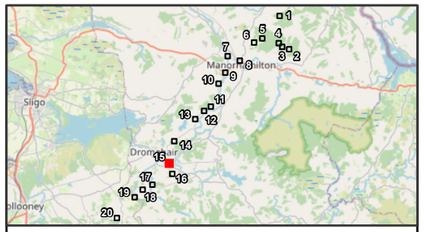


**Legend**

- Grid Connection Route
- Aquatic Survey Locations
- WFD - River Water Bodies

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Aquatic Survey Site Location
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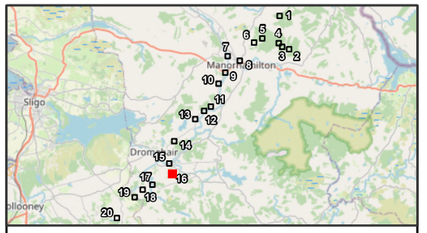


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- Grid Connection Route
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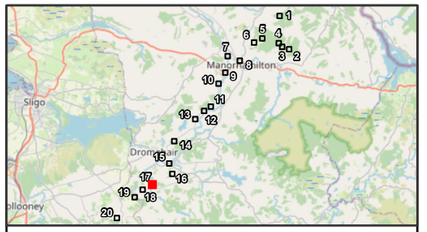


## Legend

- Grid Connection Route
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8°19'20"W
8°19'10"W
8°19'0"W
8°18'50"W
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827800
827600
54°12'0"N
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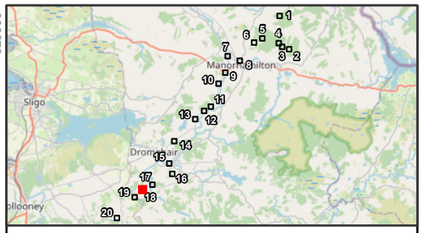


**Legend**

- Grid Connection Route
- Aquatic Survey Locations
- WFD - River Water Bodies

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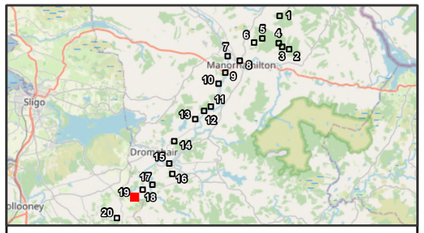


**Legend**

- Grid Connection Route
- Aquatic Survey Locations
- WFD - River Water Bodies

0 50 100
Metres

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8°21'30"W
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54°10'29"N
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576620
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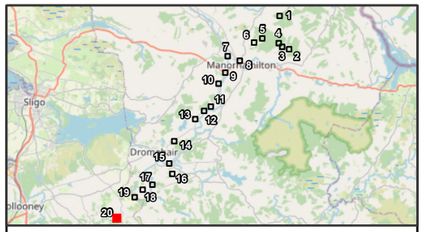
27
KILLANUMMERY_020
KILLANUMMERY_020




**Legend**

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0 50 100
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# Appendix D AQUATIC REPORT (TOBIN, 2020)

TOBIN

# FuturEnergy Ireland
# Lissinagroagh Wind Farm
# Aquatic Report 2020

BUILT ON KNOWLEDGE

| Document Control Sheet | |
|---|---|
| Document Reference | |
| Client: | FuturEnergy Ireland |
| Project Reference | 10955 |

| Rev | Description | Author | Date | Reviewer | Date | Approval | Date |
|---|---|---|---|---|---|---|---|
| D01 | First Draft | SOR | 07/10/2020 | MC | 25/03/2026 | MC | 25/04/2026 |
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# 1. INTRODUCTION

## 1.1 BACKGROUND

FuturEnergy Ireland (FEI) are proposing to develop Lissinagroagh Wind Farm in County Sligo (herein referred to as the proposed development). The proposed development is located in County Leitrim, 3km north of the village of Lissinagroagh and ca. 6km to the northeast of Manorhamilton town.

This report presents the baseline information of the aquatic habitat and species within the study area of the proposed development and is primarily based on a desktop study and field surveys to identify features of aquatic ecological importance within the study area and provide the baseline conditions of the existing freshwater ecology and potential fisheries value of the riverine watercourses within the study area, specifically for species of conservation importance.

## 1.2 RELEVANT LEGISLATION AND GUIDANCE

The assessment was carried out with regard to the following legislation:

- Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment, as amended by Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014, hereafter referred to as the EIA Directive
- Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora, hereafter referred to as the Habitats Directive
- Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds, hereafter referred to as the Birds Directive
- European Communities Environmental Objectives (Surface Waters) Regulations 2009 (S.I. No. 272/2009) and (Amendment) Regulations 2012 and 2015
- European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477/2011) (as amended)
- European Union (EU) Water Framework Directive (2000/60/EC) (WFD), transposed into Irish law in 2009 (S.I. 792 of 2009, European Communities Environmental Objective (Surface Water) Regulations 2009 as amended; hereafter referred to as the WFD Regulations
- Wildlife Act 1976 (as amended)
- Inland Fisheries Acts 1959 to 2017, hereafter referred to as the Fisheries Acts.

The European Communities Environmental Objectives (Surface Waters) Regulations 2009 (S.I. 272 of 2009) and (Amendment) Regulations 2012 and 2015 establish legally binding quality objectives for all surface waters and environmental quality standards for pollutants for the purpose of implementing provisions of EU legislation on protection of surface waters. These regulations clarify the role of public authorities in the protection of surface waters and also concern the protection of designated habitats.

Relevant guidance published by the National Roads Authority (NRA), and applicable to assessing watercourses in Ireland were followed, including '*Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes*' (NRA, 2008). Inland Fisheries Ireland (IFI) (2016) *'Guidelines on Protection of Fisheries during Construction Works in and Adjacent to Waters'*, the *'River Crossings and Migratory Fish: Design Guidance'* (Scottish Executive, 2000), *'Control of water pollution from construction sites - Guidance for consultants and contractors'* (Masters-Williams *et al.* 2001) and '*Control of water pollution from linear construction projects'* (Murnane *et al.* 2006) were also all consulted.

## 1.3 Consultation and Licence Application

Consultation with various state agencies and environmental Non-Governmental Organisations (NGOs) was undertaken in 2021 to inform them of the proposed development and to discuss potential environmental sensitivities associated with the proposed works.

TOBIN received information from IFI in response to the proposed windfarm development Environmental Impact Assessment Scoping Consultation letter on the 15th June 2021. IFI highlighted that the proposed site crosses three catchments; The Ballagh River/Sraduffy River/Lough Melvin catchment, the Glenfarne River/Lough Macnean catchment and the Owenmore River/Lough Gill catchment. IFI also outlined the significant importance of these catchments in relation to fisheries.

Lough Melvin is an important fishery and provides habitat for a range of wild Brown trout (*Salmo trutta*), Artic Charr (*Salvelinus alpinus*) and salmon (*Salmo salar*) with these species spawning in its tributary stream. This site lies adjacent to the Lough Melvin SAC which is designated for the protection of Atlantic salmon. The rivers flowing into Lough Melvin have not been allocated ecological status in the River Basin Management Plan (RBMP) but Lough Melvin has been allocated moderate ecological status and this must be improved to good to comply with the WFD. The Glenfarne River flows into Lough Macnean upper which provides habitat for perch and roach. The watercourses in this catchment have been allocated good ecological status in the RBMP and this status must be protected.

The Owenmore River provides salmon and trout spawning and nursery habitat for the Bonet River/Lough Gill fisheries and forms part of the Lough Gill SAC which is designated for the protection of Atlantic salmon, White-clawed Crayfish and Lamprey species. All but two of the Owenmore River tributaries have been allocated good ecological status in the river basin management plan. The good ecological status waterbodies must be protected and the moderate status watercourses must be improved to good status to comply with the WFD.

Based on this knowledge and information, it was recommended that all watercourses that will receive drainage from the construction site including the turbines or the access roads be

assessed in terms of aquatic biodiversity with particular emphasis on fish, the food of fish, spawning grounds and fish habitat in general. This included;

- Macroinvertebrate sampling
- Electrofishing to access the presence of Salmonids, Crayfish and Lamprey and collect quantitative data
- Detailed description of the aquatic habitat and physical nature of the sampled watercourses. This includes areas of open water, pool riffle glide sequences, density and types of aquatic vegetation, description of riparian zones to depth of at least 10 meters on either bank etc.
- There should be a particular focus on sections upstream and downstream of any point where an impact on the watercourse is likely to arise. Surveys of un-impacted (control) streams should also be included in the Environmental Impact Assessment

All concerns raised by IFI have been addressed in Section 5.2 of the Biodiversity Chapter of the EIA report.

Aztec Management Consultants on behalf of TOBIN, obtained a Section 14 Authorisation under the Fisheries Consolidation Act 1959, as substituted by section 4 of the Fisheries (Amendment) Act 1952, to conduct an electro-fishing assessment on the rivers and streams across all three sub catchments.

## 1.4 Statement of Authority

This report was prepared by Sinead O'Reilly (M.Res.), Senior Ecologist with TOBIN. She holds an honours degree in Zoology from University College Dublin and a Research Masters in Science in Freshwater Ecology from the University of Glasgow. Ms. O' Reilly has over 15 years of professional experience in scientific research in freshwater ecology and environmental consultancy specialising in fisheries. Ms. O' Reilly has prepared and delivered annual fisheries research and technical reports, fisheries research papers, Appropriate Assessment (AA) screenings, Natura Impact Statements (NIS), invasive species reports, mammal survey reports and other ecological reports. Ms. O' Reilly has a strong technical background as a freshwater ecologist and has extensive field survey experience in all freshwater and terrestrial habitats across Ireland.

# 2. METHODOLOGY

## 2.1 DESKTOP REVIEW

An ecological desktop review was carried out to collate information on aquatic species and to identify features of aquatic ecological importance within the study area. Records of aquatic faunal species and protected species in the environs of the proposed project were identified. This information was obtained by accessing the website of the National Parks & Wildlife Service (NPWS)[1], IFI[2] and the database of the National Biodiversity Data Centre (NBDC)[3]. The document *'Quantification of the Freshwater Salmon Habitat Asset in Ireland'* by McGinnity *et al.* (2003) was also reviewed to classify salmonid habitats in the study area.

Previous information for the river site was primarily taken from the NBDC mapping portal for white-clawed crayfish. A search of the NBDC database[4] was carried out for freshwater species protected under the EU Habitats Directive and for species listed under the Third Schedule of the Birds and Natural Habitats Regulations (2011) including White-clawed Crayfish (*Austropotamobius pallipes*), salmon and lamprey sp. (*Lampetra sp*), as well and invasive aquatic species within the 10km grid square G49 within which the proposed project site is situated. Characteristics of river sites were checked on Ordnance Survey (OS) maps before each survey, and previous information on the presence and distribution of freshwater species protected was consulted when selecting survey sites.

## 2.2 AQUATIC FIELD SURVEYS

The objective of the surveys was to provide the baseline conditions of the existing freshwater ecology and potential fisheries value of the riverine watercourses, specifically in terms of their importance for species of conservation importance, such as Atlantic salmon, lamprey (*Lampetra spp.*), White-clawed crayfish and otter (*Lutra lutra*).

Survey effort focused on both instream and riparian habitats at each aquatic sampling location. This approach informed the overall aquatic ecological evaluation of each site in context of the proposed development and ensured that any habitats and species of high conservation value would be detected to best inform mitigation for the project. The aquatic field surveys comprised of an evaluation of the aquatic habitats, fisheries assessment (fisheries habitat appraisal, salmonid nursery and spawning habitat), macrophyte assessment (including invasives), a biotic assessment Q-sampling) using aquatic macroinvertebrates and crayfish surveys.

Field surveys of aquatic habitats, macroinvertebrates were carried out by TOBIN ecologists in September 2020. Electrofishing surveys and additional macroinvertebrate sampling were carried out by Aztec Management Consultants and APEM on behalf of TOBIN between 27-29th September 2021. The full aquatic reports for these are in Appendix A and B.

[1] https://www.npws.ie/maps-and-data
[2] https://www.fisheriesireland.ie/
[3] http://www.biodiversityireland.ie/
[4] National Biodiversity Data Centre – A Heritage Council Programme, Documenting Ireland's Wildlife (biodiversityireland.ie) Accessed June 2023.

### 2.2.1 Watercourse Surveys Site Selection

Representative survey locations on watercourses within the study area were selected for surveying using expert judgement and consideration of the proposed development preliminary site layout.

- Sites within the proposed development – field survey sites along watercourses within the proposed works areas, including installation sites for turbines and road crossings, were, where feasible, selected. These sites were selected based on the proposed development preliminary site layout.
- Sites downstream of the proposed development – the morphology, gradient, size and flow type in terms of the potential downstream export of pollution and sedimentation through mixing zones, were considered during the selection of sites downstream of the proposed development. While survey sites downgradient of the proposed development may be influenced by external factors not related to the proposed development, downstream biota are nonetheless receptors for the proposed development, and acquisition of baseline information at these locations is considered relevant to provide a complete understanding of the receiving environment and aquatic sensitivities.
- Sites upstream of the proposed development – representative control sites not impacted by the proposed development were also selected (i.e. typically sites located immediately upstream of the proposed development). These control sites represent watercourses of similar morphology, gradient, size, and flow type as located within or downstream of the proposed development.

Sites were also selected based on safe accessibility, previous Q-Value status from Environmental Protection Agency (EPA) surveys, stream order, and providing a good representation of the overall aquatic ecology throughout the study area.

Given the proposed development is located in the headwaters of several small streams and rivers, tributaries were investigated at locations up to approximately 2km downstream of the proposed development site.

A baseline aquatic ecological assessment was carried out on watercourses within and downstream of the proposed development site, including control sites not hydrologically connected to the proposed development. A total of 25 field survey sites were selected within the study area, on known watercourses mapped by the EPA/Ordnance Survey Ireland (OSI). Surveys were conducted in September 2020 (sites 18-26) and August 2021 (site 1-17). All aquatic field survey sites were accessed using public roadways, forest tracks, and across private lands where permitted. A list of survey types and the location of sites is provided inTable 2-1. A map of the entire study area and the survey locations within the study area is shown on Figure 1. Photographs of each site (1-12) are provided in Appendix A.

### 2.2.2 Description of Watercourses in the Study Area

The study area was defined as surface waters potentially affected by the proposed development, including watercourses within the proposed development site and those downstream. There was no fixed distance applied for the study area downstream, as site specific

conditions determine the potential for pollution generation, downstream transport, and any consequential effects.

The study area is located in the WFD catchments/Hydrometric Area 35 within the Sligo Bay catchment and Hydrometric Area 36 within the Erne catchment.

The proposed development site is located within the Water Framework Directive (WFD) Erne catchment, Hydrometric Area Hydrometric Area 36 and also the Sligo Bay catchment Hydrometric Area Hydrometric Area 35 and the Drowes_SC_010, Bonet_SC_010 and the MacneanLoughsconnector_SC_010 subcatchments.

The study area includes seven watercourses, the Cornavannoge_010 (IE_NW_36C040400), Owenmore (Manorhamilton)_020 (waterbody code: IE_WE_35O080400), Lattone 010 waterbody code: (IE_NW_35L660960), Rosfrair_010 (waterbody code: IE_NW_35R320460), Ballagh_010 (waterbody code: IE_NW_35B010400) and the Brackary_010 (waterbody code: IE_WE_35B100500) which are located within the proposed development site, adjacent to or downstream of the site.

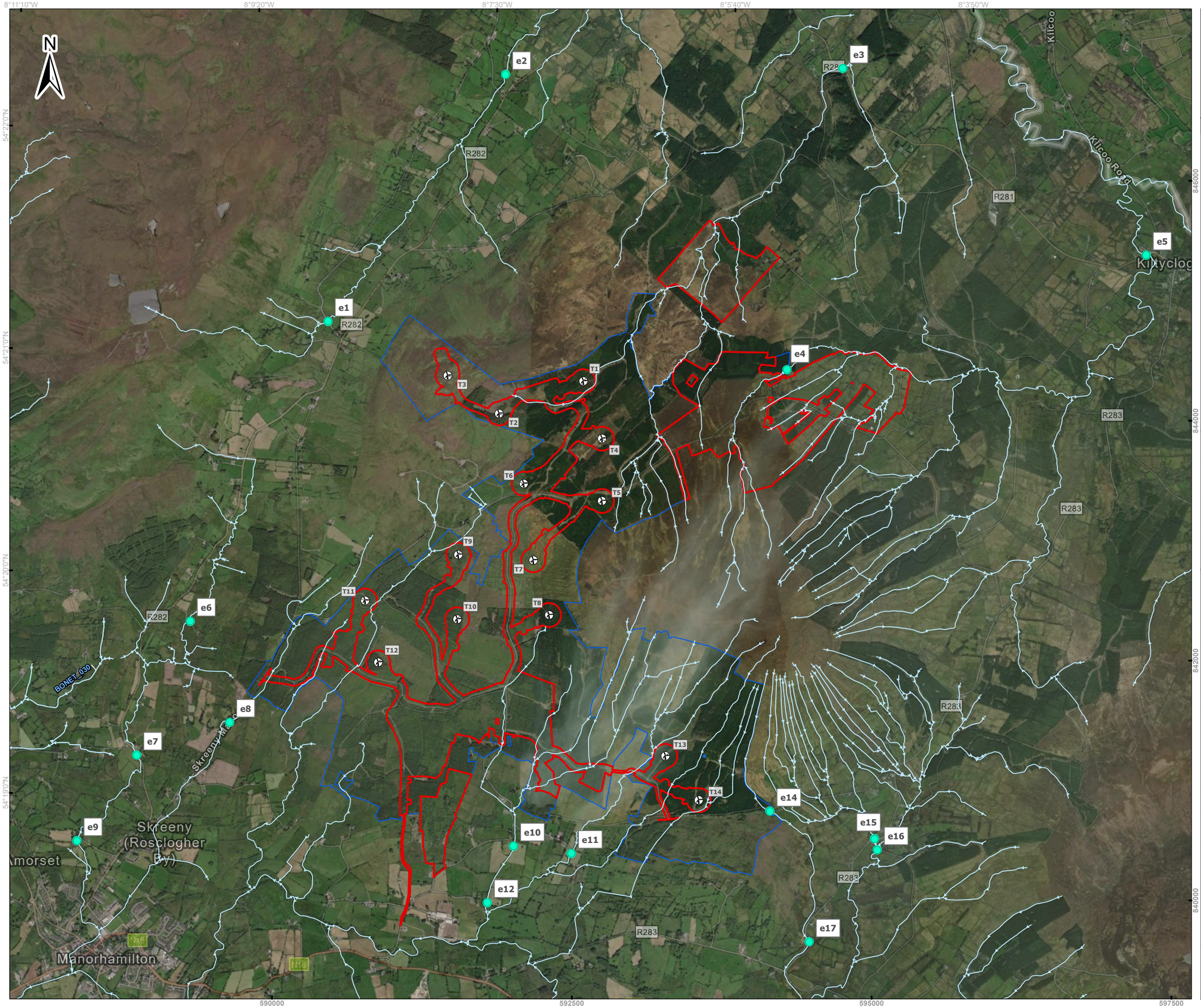
The Rosfrair_010, Lattone 010, Cornavannoge_010 and Ballagh_010 are located within the Erne 36 catchment area and the Owenmore (Manorhamilton) and Brackary_010 are located within the Sligo Bay 35 catchment area.

The Lattone 010 and the Rosfrair_010 drain the northern portion of the site which feeds into County River (waterbody code: UKGBNI1NW353504075) and flows directly into the head of Lough Melvin. The Ballagh_010 is located northwest of the proposed development, outside the boundary, and it flows directly into Lough Melvin.

The watercourses in the southern section of the proposed development, are tributaries to the Owenmore River and are in the upper reaches of this river. The Cornavannoge_010 drains the southeastern tip of the proposed development site and flows directly into the Owenmore (Manorhamilton)_010 (IE_WE_35O080220) which flows into the Owenmore (Manorhamilton)_020. The Brackary_010 is located west of the proposed development, outside the boundary, and it flows directly into Owenmore (Manorhamilton)_020. The Owenmore (Manorhamilton)_020 drains the southern portion of the site, flowing westwards, into Bonnet_040 (IE_WE_35B060400) which is a lowland depositing river and part of Lough Gill. The Bonnet_040 River is a good salmonid river, containing salmon, resident brown trout and migratory sea trout (*Salmo trutta trutta*).

The streams and rivers that flow through the proposed development area, flow towards designated European sites; Lough Gill SAC (Site Code: 001976) located southwest of the site, and Lough Melvin SAC (Site Code: 000428) located northwest of the site.

All of these waters within the study area are categorised as FW1 Eroding/Upland Rivers (Fossit, 2000). This includes natural watercourses, or sections of these, that are actively eroding, unstable, and where there is little or no deposition of fine sediment. The watercourses in the study area are illustrated in Figure 2-1.





**Legend**

- Landownership Boundary
- Application Boundary
- Turbine Locations
- Electrofishing Survey Sites
- WFD - River Water Bodies

0 0.5 1
Kilometers

**Spatial Reference**
Datum: IRENET95
EPSG: 2157

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Client:
Ireland
FuturEnergy

Project:
Lissinagroagh Wind Farm

Title:
Figure 1:
Electrofishing Survey Sites

Scale @ A3: 1:29,000

Prepared by: S.Pezzetta
Checked by: S.Ryan
Date: March 2026

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Map Ref: 10955-003..AqR-E.FISH-P.App.BO-TOB-A

Draft: A

Table 2-1: Aquatic Survey Types, and Survey Locations on Watercourses Within the Study Area of the Proposed Project

| Site Number | Survey Type<br>KS- Kick Sampling<br>Electro-fishing (EF) | WFD River Sub-Catchment | WFD River Name | EPA Name | EPA Code | EPA Segment Code | ITM (x) | ITM (y) |
|---|---|---|---|---|---|---|---|---|
| Site 1 | EF\|KS | Drowes_SC_010 | Ballagh_010 | Ballagh 35 | 35B01 | 36_6370 | 590498 | 844872 |
| Site 2 | EF\|KS | Drowes_SC_010 | Ballagh_010 | Ballagh 35 | 35B01 | 36_7042 | 591935 | 846813 |
| Site 3 | EF\|KS | Drowes_SC_010 | Lattone_010 | Lattone 35 | 35L66 | 36_6324 | 594764 | 846940 |
| Site 4 | EF\|KS | Drowes_SC_010 | Rosfrair_010 | Rosfrair | 35R32 | 36_6811 | 594278 | 844394 |
| Site 5 | EF\|KS | Drowes_SC_010 | Rosfrair_010 | Rosfrair | 35R32 | 36_7263 | 597289 | 845382 |
| Site 6 | EF\|KS | Bonet_SC_010 | Brackary_010 | Brackary | 35B10 | 35_2956 | 589318 | 842328 |
| Site 7 | EF\|KS | Bonet_SC_010 | Brackary_010 | Brackary | 35B10 | 35_3284 | 588860 | 841226 |
| Site 8 | EF\|KS | Bonet_SC_010 | Brackary_010 | Curraghfore | 35C68 | 35_3221 | 589647 | 841485 |
| Site 9 | EF\|KS | Bonet_SC_010 | Brackary_010 | Brackary | 35B10 | 35_3284 | 588373 | 840497 |
| Site 10 | EF\|KS | Bonet_SC_010 | Owenmore (Manorhamilton)_020 | Mt_Dough | 35M62 | 35_3906 | 592010 | 840456 |
| Site 11 | EF\|KS | Bonet_SC_010 | Owenmore (Manorhamilton)_020 | Moneenshinnagh 35 | 35M60 | 35_4204 | 592498 | 840395 |
| Site 12 | EF\|KS | Bonet_SC_010 | Owenmore (Manorhamilton)_020 | Mt_Dough | 35M62 | 35_3906 | 591753 | 840028 |
| Site 13 | EF\|KS | Bonet_SC_010 | Owenmore (Manorhamilton)_010 | Owenmore [Manorhamilton] | 35O08 | 35_965 | 592053 | 837783 |
| Site 14 | EF\|KS | MacneanLoughsconnector_SC_010 | Cornavannoge_010 | Lughawnagh | 36L67 | 36_2553 | 594207 | 840702 |

| Site Number | Survey Type<br>KS- Kick Sampling<br>Electro-fishing (EF) | WFD River Sub-Catchment | WFD River Name | EPA Name | EPA Code | EPA Segment Code | ITM (x) | ITM (y) |
|---|---|---|---|---|---|---|---|---|
| Site 15 | EF\|KS | MacneanLoughsconnector_SC_010 | Cornavannoge_010 | Lughawnagh | 36L67 | 36_2553 | 595014 | 840478 |
| Site 16 | EF\|KS | MacneanLoughsconnector_SC_010 | Cornavannoge_010 | Lughawnagh | 36L67 | 36_2553 | 595023 | 840411 |
| Site 17 | EF\|KS | MacneanLoughsconnector_SC_010 | Cornavannoge_010 | Lughawnagh | 36L67 | 36_2553 | 594482 | 839654 |
| Site 18 | KS | Drowes_SC_010 | Lattone_010 | Lisdarush | 35L68 | 36_7150 | 593107 | 844971 |
| Site 19 | KS | Drowes_SC_010 | Lattone_010 | Lattone 35 | 35L66 | 36_6324 | 593024 | 841071 |
| Site 20 | KS | Bonet_SC_010 | Owenmore (Manorhamilton)_020 | Skreeny | 35S46 | 35_4030 | 594283 | 844410 |
| Site 21 | KS | Bonet_SC_010 | Owenmore (Manorhamilton)_020 | N/A | N/A | 35_3726 | 594272 | 846109 |
| Site 22 | KS | Bonet_SC_010 | Owenmore (Manorhamilton)_020 | Moneenshinnagh 35 | 35M60 | 35_2999 | 591888 | 846780 |
| Site 23 | KS | Bonet_SC_010 | Owenmore (Manorhamilton)_020 | Lissinasgroagh 35 | 35L59 | 35_4210 | 590667 | 841919 |
| Site 24 | KS | Bonet_SC_010 | Owenmore (Manorhamilton)_020 | Mt_Dough | 35M62 | 35_3906 | 592027 | 840637 |
| Site 25 | KS | Bonet_SC_010 | Owenmore (Manorhamilton)_020 | Owenmore [Manorhamilton] | 35O08 | 35_3550 | 589341 | 839335 |

### 2.2.3 Riverine Habitat Assessment

The aquatic ecological assessment included a habitat assessment of the receiving watercourses within the study area. The habitat assessment of the watercourses followed methodologies outlined in the Environment Agency's *'River Habitat Survey in Britain and Ireland Field Survey Guidance Manual'* (EA, 2003) and the Irish Heritage Council's *'A Guide to Habitats in Ireland'* (Fossitt, 2000).

Aquatic surveys were conducted along the selected sites and consisted of kick sampling for invertebrates to assess water quality.

All watercourse survey locations were assessed in terms of physical habitat variables:

- Stream width and depth, bank height and width and other physical characteristics including associated evidence of historical drainage;
- Substrate type, listing substrate fractions in order of dominance, i.e. bedrock, boulder, cobble, gravel, sand, silt etc;
- Flow type and rate, listing percentage of riffle, glide and pool in the sampling area;
- In-stream macrophyte and bryophytes occurring and their percentage coverage at the sampling sites; and
- Riparian vegetation composition on banksides and percentage of overhead shade.

Each sampling site along the watercourse was described in terms of the important aquatic habitats and species recorded (i.e. based on their conservation value). This determined the ecological evaluation of each aquatic survey site and informed site-specific mitigation for the proposed project.

Watercourses were photographed at survey site locations throughout the study area. Anthropogenic and livestock influences on fluvial and riparian habitats were noted along the surveyed stretches.

### 2.2.4 General Fisheries Habitat

River fisheries assessment was carried out utilising elements of the approaches in the Fishery Assessment Methodology (O'Grady, 2006) and '*Ecology of the Atlantic Salmon'* (Hendry & Cragg-Hine, 2003) to broadly characterise the river sites (i.e. channel profiles, substrata etc.).

A broad appraisal/overview of the upstream and downstream habitat at each site was undertaken to evaluate the wider contribution to salmonid and lamprey spawning, to assess if the watercourse could support salmonids and to access the general fisheries habitat.

An assessment was made on the suitability of the habitat to support aquatic species of conservation concern (e.g. white-clawed crayfish, river lamprey (*Lampetra fluviatilis)*, brook lamprey (*Lampetra planeri*) and Atlantic salmon. Suitable salmonid spawning and nursery habitat was assessed.

This included identifying the overall habitat diversity provided by natural features in the channel and river corridor. The presence of features such as point, side and mid-channel bars, eroding riverbanks, large woody debris, waterfalls, backwaters and floodplain wetlands were noted if present. Additionally, channel substrata, flow-types, in-channel vegetation, and also the distribution of bank-side trees and hedgerows and the extent of near-natural land-use adjacent

to the river were accessed. It was also noted if there was evidence of artificial modification to the river channel morphology. This information provided a broad assessment of the naturalness of the channel and its ability to support these species.

An evaluation of potential lamprey habitats within the study area was made with reference to methodologies outlined in '*Ecology of the River, Brook, and Sea Lamprey'* (Maitland, 2003) and also NPWS Irish Wildlife Manuals lamprey surveys (O'Connor, 2007). A visual assessment was carried out on the habitat suitability for lamprey such as slower flowing water, nursery areas of sandy silt beds, an assessment on potential barriers on migration route, potential spawning areas, suitable hiding places and clean spawning gravels over stretches of running water. Juvenile lamprey habitat was identified from the descriptions given in Maitland (2003). Substrate depth and composition was examined for potential ammocoete habitat, especially focusing on the composition of mud, silt, or silt and sand and its suitability for ammocoetes. Areas where suitable spawning gravels may occur, were searched, especially at tails of pools where the gravels have been deposited from upstream and the scouring of pools were examined for potential spawning habitats for adults.

### 2.2.5 Macrophytes

Aquatic plants as well as rare and/or protected plant species and non-native flora were identified and recorded at each site where present. Plant species nomenclature followed '*New Flora of the British Isles*' (Stace 2019). An assessment of the aquatic vegetation community to identify any rare macrophyte species (Flora Protection Order or Wyse-Jackson *et al*., 2016) or habitats corresponding to the Annex I habitats, e.g., 'Water courses of plain to montane levels, with submerged or floating vegetation of the *Ranunculion fluitantis* and *Callitricho-Batrachion* (low water level during summer) or aquatic mosses [3260]' (more commonly referred to as 'floating river vegetation').

### 2.2.6 Biological Water Quality Sampling

The biological water quality establishment provides baseline readings against which future water quality targets can be gauged. These values should not deteriorate as a result of the proposed project. According to the WFD (2000/60/EC) target 'good status' i.e. Q4 is required in all Irish rivers. The water quality within each site was obtained from Q-values obtained at each accessible site from kick sampling as part of addition aquatic surveys in relation to the proposed project.

#### *2.2.6.1 Kick Sampling*

Semi-quantitative sampling of benthic (or bottom dwelling) macroinvertebrates was undertaken at seven sites using standard EPA kick-sampling methods (Toner *et al*., 2005). A two-minute kick-sample was collected from the riverbed from the faster flowing riffle habitats where possible. A standard 500µm mesh D-shaped kick net was submerged on the riverbed with the mouth of the net directed upstream. The substrate just upstream of the net was disturbed (with the foot, in a kicking motion) in order to dislodge invertebrates into the net. The surveyor moved in a diagonal direction upstream to ensure that different micro-habitats in the waterbody, such as fast-moving riffles, glides and pools were included in the sample during the two minutes.

A further one-minute hand search was carried out to locate macroinvertebrates that may have remained attached to the underside of the cobbles (Toner *et al.*, 2005). This sampling approach is sufficient to achieve a suitable representation of taxa for bioassessment. Occasionally, when the substratum (e.g. bedrock) or flow conditions made kick-sampling difficult, or the abundance of macroinvertebrates collected was extremely low, it was necessary to spend a longer amount of time sampling the river to accumulate a sufficient diversity and abundance of macroinvertebrates. This sampling approach requires avoidance of obvious localized disturbance (e.g. cattle access points) which may adversely influence the sample taken. Stone washings were also undertaken to ensure a representative sample of the fauna present at each site was collected. Large cobbles collected within the net from the riverbed were gently wash inside the net to remove anything macroinvertebrates attached. Once a live sample was collected, the macroinvertebrate assemblages of each sample were places in a white tray and identified and counted on the riverbank. Once all taxa and their relative abundance were recorded, the sample was returned to the river.

#### *2.2.6.2 Biotic Indices*

Four Biotic Indices were used to calculate the water quality of the rivers within the study area. These include the Biological River Quality Classification System Quality Rating (Q) System, the Biological Monitoring Working Party (BMWP) and Average Score Per Taxon (ASPT) and Small Streams Risk Score (SSRS). Details of the scoring system of these is provided in Appendix C.

##### *The Biological River Classification System (Q-Scheme)*

The Biological River Quality Classification System Quality Rating (Q) System (Toner *et al.,* 2005) was used to obtain a water quality rating and risk status for each site.

The resulting species list was used to assign a Biotic Index value (Q-Value) to the sampled streams. This involved recording the taxa present at a suitable and attainable taxonomic resolution and their categorical relative abundance determined using approximate counts. The relative proportions of taxonomic groups were recorded based on the EPA categories (i.e. 8 categories ranging from present to excessive) (Appendix I of Toner *et al.*, 2005).

The Biotic Index is a quality measurement for freshwater bodies. 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 macroinvertebrate data were used to derive a Q-value using the EPA methodology (McGarrigle *et al.*, 2002) and assigned to WFD status classes. This Q-value system is a five point scale (Q1-Q5: with intermediate scores obtainable, e.g. Q3-4) based on the proportions of five groups of macroinvertebrates, with different pollution tolerances with Q1 being of poorest quality and Q5 being pristine/unpolluted (see Appendix B). The system facilitates rapid and effective assessment of the water quality of rivers and streams. Each site was assigned a biological status on a scale of High-Good-Moderate-Poor-Bad.

##### *Biological Monitoring Working Party (BMWP)*

The BMWP scheme (Walley and Hawkes, 1997) biotic index of water quality, each family recorded in the sample is assigned a habitat specific score. The score is based on the presence of pollution-tolerant to pollution-sensitive families with each family assigned a score. The BMWP score is the sum of these family scores at each site. Families that are sensitive to pollution are

assigned higher scores than pollution-tolerant families. A high overall score indicates that the water quality is good.

#### *Average Score Per Taxa*

Each site was allocated an Average Score Per Taxa (ASPT). The ASPT index calculation is determined by dividing the BMWP score by the number of scoring taxa yielding a score between 1 and 10. A high ASPT index values indicate high ecological status, and low values indicate bad/degraded ecological status. In general, the higher the number of taxa present, the better the biological quality of the reach, especially where the ASPT values are high (greater than 5.5) indicating excellent water quality.

#### *Small Streams Risk Score (SSRS)*

The Small Streams Risk Score (SSRS) is a biological risk assessment system for identifying rivers that are definitely 'at risk' of failing to achieve the 'good' water quality status goals of the Water Framework Directive (WFD). It was developed by the Environmental Protection Agency (EPA) in association with the Western River Basin District (WRBD) in 2006. The SSRS method is a rapid field methodology for risk assessment that is based solely on Macroinvertebrate indicators of water quality and their well-understood response to pollution. Importantly the SSRS score indicates whether or not the stream is at risk from pollution and not the ecological health of the stream. The SSRS score ranges from 0-11.2.

In addition, the taxon richness and the percentage of Ephemeroptera/Plecoptera/Trichoptera (%EPT) were determined. Biological water quality was also assessed using the EPT index. The EPT index (Lenat, 1988) uses three orders of aquatic insects that are easily sorted and identified: Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies), and this index is commonly used as an indicator of water quality. The EPT index is calculated by summing the number of taxa represented by these three insect orders. The EPT Index is based on the premise that high-quality streams usually have the greatest species richness. Many aquatic insect species are intolerant of pollutants and will not be found in polluted waters. The greater the pollution, the lower the species richness expected.

### 2.2.7 Fish Stock Assesment (Electrofishing)

#### *2.2.7.1 Methodology*

A single anode Smith-Root LR24 backpack (12V DC input; 300V, 100W DC output) and electrofishing dip nets were used to electrofish sites on watercourses in the vicinity of the proposed project. Electrofishing was conducted under licence following a Section 14 application to the Department of the Environment, Climate and Communications (DECC) to conduct the surveys. Ten-minute electrofishing surveys were carried out following the methodology set out by Beaumont (2016) and Matson *et al.*, (2018). The electrofishing methodology and technique also complied with the European Committee for Standardisation (CEN) guidelines for fish stock assessment in wadable rivers (CEN, 2003) and Section 14 licensing requirements. Water temperature and conductivity were measured at each site and habitat characteristics were recorded, including sediment type, water depth, flow type, shading, channel modification etc.

Electro-fishing was conducted in an upstream direction at each site for a standard ten-minute fishing (Matson *et al.*, 2018). Catch Per Unit Effort (CPUE). Due to the relatively high water

conditions, electro-fishing survey sites varied in size. Survey length ranged from 10-80m and the survey width ranged from 0.5-5m. No stop nets were deployed and typically, electrofishing sections started and finished at the upstream limits of riffle sections which acted as a form of natural stream delineator.

#### *2.2.7.2 Electrofishing Settings*

One fishing methodology was employed that would target both Salmonids and lamprey. A 35-40 Hz pulsed DC (PDC) waveform with a pulse width of <4ms (13-14 percent duty cycle) at applied voltages of approximately 300-500 was deployed, depending on measured ambient conductivities at each site (Beaumont 2016).

#### *2.2.7.3 Fish Handling and Processing*

Once immobilised, salmonids and other captured fish species were transferred to a holding container with oxygenated water following capture. To reduce stress on the captured fish and aid processing and recovery times, anaesthesia (clove oil) was applied. All fish were speciated and measured to the nearest centimetre (standard length (SL) for eel and lamprey; fork length (FL) for all other species).

Fish were then placed into a freshly oxygenated bucket of water to recover and allowed sufficient time to recover before being returned to the river. Any fish that struggled to recover, were given additional time to do so until they were able to swim. Lamprey were returned to the silt habitat they were removed from. Handling of live fish was kept to a minimum when processing any captured individuals. Fish were only humanely euthanised if showing no sign of recovery. This is carried out with blunt force to the top of the head. For detailed survey methodology, refer to the accompanying Electro-fishing report in Appendix B.

### 2.2.8 Protected Aquatic Species Survey

#### *2.2.8.1 White-clawed Crayfish*

White-clawed Crayfish habitat was assessed at each survey site following methodologies outlined in '*Guidance on Habitat for White-clawed Crayfish'* (Peay, 2002). This include and visual and hand search for suitable refuge such as boulders, crevices, burrows in the bank, the presence of a partial, or even a complete barrier, food source including leaf litter, instream macrophytes, aquatic invertebrates and fish and good water quality absent of pollution.

#### *2.2.8.2 Otter*

Otter surveys were undertaken along accessible waterbodies (which included rivers and drainage ditches) within the proposed development site plus a 150m buffer of the site (including upstream and downstream of waterbodies), to account for noise disturbance impacts, following methodologies outlined within the NRA (2006) guidelines and Chanin (2003) '*Monitoring the Otter Lutra Lutra'*. The survey comprised examining all visual evidence of otter habitation or

use, both within suitable areas. Any evidence of otter such as tracks, spraints, couches, slides, feeding remains or holts, were recorded.

### 2.2.9 Biosecurity

A biosecurity protocol, recommended by IFI, was also adhered to during the surveys. All equipment and Personal Protection Equipment (PPE) was disinfected with Virkon® prior to and post-survey completion, and best practice precautions were employed to prevent the potential spread of invasive species and water-borne pathogens between sites, according to standard IFI biosecurity protocols (IFI 2010).

### 2.2.10 Survey Limitations

Conditions on site meant that some areas were difficult to access. Due to the topography of the site, high density of bog land, thick dense forestry, deep drainage ditches, sink holes and general rough terrain, there was limited access within the proposed development site boundary. Therefore, the aquatic survey locations were not directly within the footprint of any proposed turbine. Electrofishing within the boundary of the proposed development was not possible largely due to the nature of the streams been very steep in profile and deemed unsuitable (i.e. too steep and high in altitude) for safe and effective wadable/bank electrofishing. Sites were therefore selected outside the site boundary and based on accessibility and safety and chosen to provide as broad a characterisation as possible across the three catchments. At some study sites, it was not possible to complete electrofishing over a 10-minute elapsed time period due to channel access issues. At other survey sites, the absence of fish was determined after a few minutes of electrofishing, and it was deemed unnecessary to continue for the full 10-minute elapsed time period.

# 3. RESULTS

This section provides the results of the baseline aquatic surveys within the study area for Lissinagroagh Wind Farm.

## 3.1 DESKTOP REVIEW

### 3.1.1 Invasive Aquatic Species

Results from NBDC show records of no Third Schedule aquatic plant species or other invasive plant species within the 10km G94 grid square which encompass the proposed development within the past 20 years.

The aquatic mollusc Jenkins' Spire Snail (*Potamopyrgus antipodarum*) has five records in 2015 from the national macroinvertebrate dataset collected for the biomonitoring of Ireland's river network, 2007–2018 (EPA) database. These species are listed as Medium Impact Invasive species under the Regulation S.I. 477 (Ireland).

### 3.1.2 Fisheries

There is no fisheries data available of watercourses within the proposed development. Currently, existing data available online regarding fisheries data is available for IFI fish stock surveys for WFD carried on nearby lakes that are fed by the watercourses draining the proposed development. As previously stated, six river waterbodies are present within the boundary of the proposed development which ultimately lead downstream to the Lough Melvin (Rosfrair_010, Lattone 010 and Ballagh_010) and Lough Gill (Cornavannoge_010, Owenmore Manorhamilton_020 and Brackary_010).

Lough Melvin

Previous fish stock surveys on Lough Melvin were carried out by IFI in 2021[5]. A total of seven fish species and two types of cyprinid hybrid were recorded. and included perch (*Perca fluviatilis*), brown trout, salmon, rudd (*Scardinius erythrophthalmus*), arctic char, roach (*Rutilus rutilus*), roach x bream hybrid (*Rutilis rutilus x Abramis brama*), roach x rudd hybrid (*Rutilus rutilus x S. erythrophthalmus*) and European eel (*Anguilla anguilla*)*.

Lough Melvin was assigned an ecological status of 'Good' for 2021 based on the fish populations present. In previous years the lake was assigned a fish status of 'Good' in 2017, 'Good' in 2014 and 'High' in 2011.

Lough Gill

Previous fish stock surveys carried on Lough Gill were carried out by IFI in 2017[6]. Results showed six fish species and one type of hybrid were recorded, perch, brown trout, roach, roach x bream hybrid, pike (*Esox lucius*) and European eel.

Lough Gill has been assigned an ecological status of "Good" for 2017 based on the fish populations present. In previous years the lake was assigned a fish status of High in 2008

[5] http://wfdfish.ie/index.php/melvin-lough-2017/
[6] http://wfdfish.ie/index.php/gill-lough-2017/

and2011 and Good in 2014. In the 2010 to 2015 surveillance monitoring reporting period, the EPA assigned Lough Gill an overall ecological status of "Poor".

### 3.1.3 Barriers

A review of the current barrier atlas map of Europe[7] (Adaptive Management of Barriers in European Rivers [AMBER]) and IFI National Barriers Dataset[8] was undertaken across the study site. Data relating to manmade barriers to fish migration upstream was assessed which showed barrier structures such as culverts (90%) and others (3%) present within the study area. The AMBER website details a ford present on the Bonet River and a weir on the Owenmore River near Manorhamilton. The IFI barrier data set shows evidence of barriers located within the study site (Figure 3-1). On the map, the yellow circles are structures not causing a barrier. The purple circles are instream structures and acting as barriers and the orange triangles are landmarks. The purple circles (barriers) are located on the Ballagh_010,Lattone_010, Rosfrair_010, County River, Owenmore (Manorhamilton)_020 and Cornavannoge_010 River.

These purple circles highlight migration barriers to diadromous fish species such as sea lamprey (*Petromyzon marinus*), river lamprey, sea trout and Atlantic salmon.

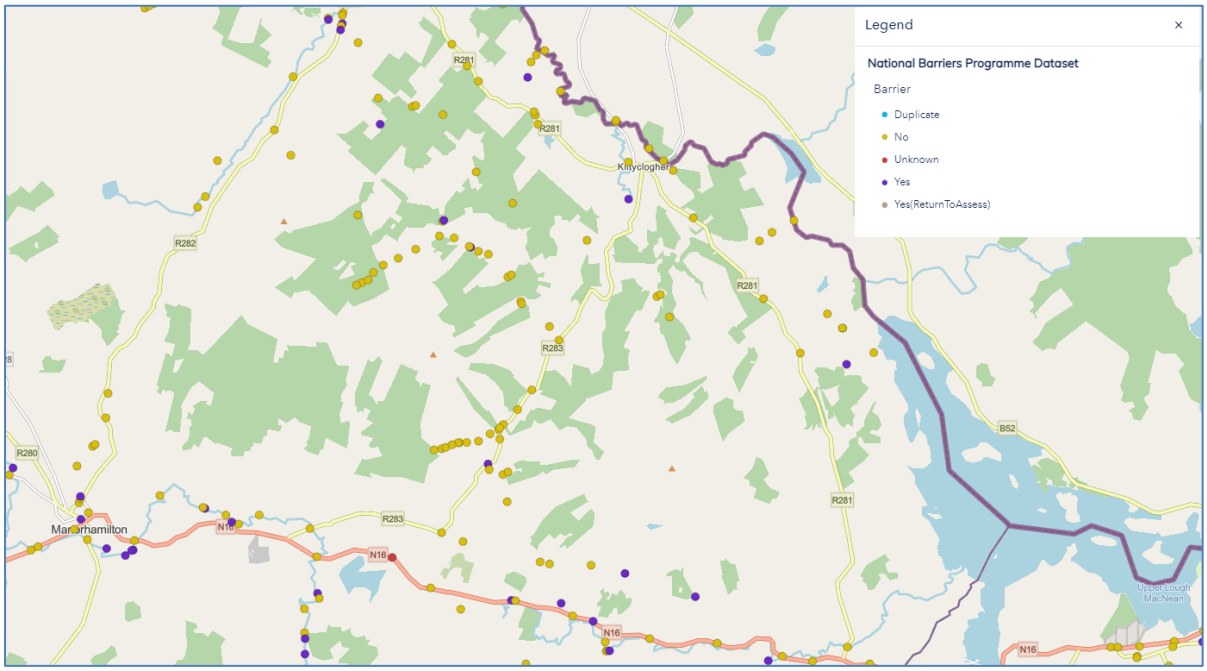


Figure 3-1: A Map of The Physical Barriers on Rivers Located Within the Study Area

[7] https://amber.international/european-barrier-atlas/ Accessed June 2023 and November 2024
[8] https://opendata-ifigeo.hub.arcgis.com/datasets/ifigeo::national-barriers-programme-dataset/explore?filters=eyJCYXJyaWVyIjpbIlllcyIsIlVua25vd24iLCJZZXMoUmV0dXJuVG9Bc3Nlc3MpIiwiFllcyhSZXR1cm5Ub0Fzc2VzcykiXX0%3D&location=53.995716%2C-7.343604%2C11.82
Accessed June 2023 and November 2024

### 3.1.4 Protected Aquatic Species

A comprehensive desktop review of available data (NPWS, NBDC, BSBI and other data) for 10km grid square containing and adjoining the project (G94) identified White-clawed Crayfish previously recorded at Site 7 on the Brackary_010 River in 2003 and 2006 (Biodiversity Ireland, 2021). No other records of rare and or protected aquatic species were identified within the vicinity of the proposed project.

### 3.1.5 Existing Water Quality Records

#### *3.1.5.1 EPA Water Quality Data*

The most recent EPA biological water quality results at WFD monitoring stations in the study area are presented in Table 3-1. The WFD monitoring stations located downstream of the proposed development indicate that the overall moderate water quality status in this area is Good and High which indicates it is meeting the requirements of the Water Framework Directive (2000/60/EEC). The WFD Risk status also shows these watercourses are not at risk.

**Table 3-1: Most Recent EPA Biological Quality Ratings (Q-values) at Stations Within the Study Area**

| River | Station Code | Station Name | Year | Status | WFD River Waterbody Approved Risks |
|---|---|---|---|---|---|
| Ballagh_010 | RS35B010200 | Bridge W. of Tullyskeherny | 1990 | High | Not at Risk |
| Ballagh_010 | RS35B010400 | Bridge u/s Lough Melvin | 1990 | High | Not at Risk |
| Brackary_010 | RS35B100300 | Manorhamilton: Garrison Rd Br | 1990 | High | Not at Risk |
| Brackary_010_010 | RS35B100200 | Bridge nr Curraghfore School | 2021 | High | Not at Risk |
| Cornavannoge_020 | RS36C040400 | Br NW of Ardvarney | 2022 | Good | Not at Risk |
| Cornavannoge_020 | RS36C040600 | Br u/s L Macnean | 2002 | Good | Not at Risk |
| Owenmore (Manorhamilton)_010 | RS35O080200 | Bridge W. of Munakill Loughs | 1990 | High | Not at Risk |
| Owenmore (Manorhamilton)_020 | RS35O080400 | Bridge u/s Bonet River confl | 2021 | Good | Not at Risk |
| Owenmore (Manorhamilton)_020 | RS35O080220 | Br near Black Park House | 2021 | Good | Not at Risk |

## 3.2 AQUATIC FIELD SURVEY RESULTS

This section provides a description of the aquatic habitats, invasives species, physical characteristics, overall fisheries habitats, fish, white-clawed crayfish, macroinvertebrates and macrophyte communities in the study area, based on each of the 25 survey sites examined from Section 3.2.1 to 3.2.6. Biological water quality (Q-sample) and electrofishing results are

presented from Table 3-2 to Table 3-5. Fish length frequency distribution graphs for each watercourse are presented in Appendix D.

### 3.2.1 Aquatic Invasive Species

There were no invasive aquatic macrophytes or fauna recorded at any of the sampling sites.

### 3.2.2 Fisheries Habitats

Due to the elevation of the proposed project site and its location in the environs of the catchments' watershed, the watercourses within the proposed project site are no larger than 2rd order rivers and categorized as eroding/upland rivers with reference to Fossit (2000). Sections of the natural watercourses draining the proposed project are typically medium to high gradient channels, actively eroding, unstable with little or no deposition of fine sediment.

The channels have also been slightly modified within sections of the study area, with drainage networks consisting of culverts located at bridges and channels been straightened within forestry plantations. The natural physical and ecological features of the river corridors have remained intact with the rivers natural hydromorphology present. The general physical habitat assessment is discussed below for each watercourse in each subcatchment within the study area.

#### Drowes_SC_010 subcatchment

The Ballagh_010, Lattone_010 and Rosfrair_010 watercourse that flow through the proposed development that are part of the Drowes_SC_010 subcatchment. These watercourses are no larger than 2rd order rivers and categorized as eroding/upland rivers with reference to Fossit (2000). The watercourses are typically medium to high gradient channels over mudstone, sandstone & evaporite bedrock. They are actively eroding, unstable with little or no deposition of fine sediment.

They have a semi natural hydromorphology with profiles containing sequences of riffles, pools and glides profiles. Within these waterbodies is a mix of boulders, cobble and mixed gravels with some having evidence of peat stained waters and historic embankment work. These watercourses had a water depth of 5-30cm and range in wet width of 1-10m with bank heights of up to 3m.

The Ballagh_010 River (Site 1 and 2) is suitable for salmonid species and holds moderate quality salmonid spawning and nursery habitat with mixed gravels between boulders and cobble substrata. As this section of river is fast flowing and of high energy, it did not offer suitable habitat for lamprey at either site.

The Lattone_010 (Site 3, 18 and 19), contained good quality nursery for salmonids given ample riffle and glide sequences and a mixed substrata bed at Site 3. The river had good spawning in the tailings of deeper glide and in pools where mixed gravels and small cobbles were present. There were no lamprey ammocoete burial areas identified within the survey reach at this site however spawning habitat was present. The river did provide suitable eel habitat in terms of riverbed substrata however, this species was not recorded present. At Site 18 and 19, the watercourse contained a good riffle, pools, glide profile. The sites contained good holding pools for larger salmonids and eel however the river lacked suitable substrata for salmonid spawning or nursery habitat at these sites and there was no sediment for lamprey ammocoete.

The Rosfrair_010 River, at Site 4, was considered to provide poor quality salmonids spawning and nursery habitat with very steep gradient, predominance of coarse substrata and high energy flow present. It lacked suitable fine sediment habitat for lamprey ammocetes. Any holding habitat present was restricted to isolated plunge pools. The river had some suitable eel habitat in terms of boulder, cobble and coarse gravel but the channel was very high energy and steep gradient reducing its value for eel.

Downstream at Site 5 on the Rosfrair_010, good salmonid spawning and nursery habitat was present, given the ample riffle and glide sequences (well oxygenated water) and mix of cobble and gravel present, especially at tailings of deeper glide and in pools. This site also lacked suitable fine sediment habitat for lamprey ammocetes.

### MacneanLoughsconnector_SC_010

The Cornavannoge_010 River (Site 14, 15, 16 and 17), is part of the MacneanLoughsconnector_SC_010 subcatchment and is located within close proximity to the proposed development. This upland eroding river contains watercourses of typically medium to high gradient channels over mudstone, sandstone & evaporite bedrock.

The sites surveyed on this river were of semi natural and natural meandering profile with sequences of riffle, glide and pool throughout. The substrata found within these upland streams and rivers contain large boulders, cobble, mixed gravels and some siltation in places. The streams and rivers range in width from 0.5-6m and have a bank height that ranges from 0.5-4m in places. The water depth ranges from 5cm -200cm.

Site 14 was considered very small in size and had a very steep gradient. There was absence of suitable spawning gravels present and it also lacked good salmonid holding habitat due to the absence of pools. It lacked suitable fine sediment habitat for lamprey ammocetes.

Site 15 and 16 were considered to contain good quality nursery habitat given moderate size, with broken flow patterns and ample refugia in the bed substrate. It contained good quality salmonid spawning habitat in mixed gravels in the tailings of deeper glide and pool. Holding habitat for salmonids was also present with deep pools and glides mixed throughout. The channel was of too high energy for lamprey andlacked suitable fine sediment habitat for lamprey ammocetes. The river had good suitability for eel, given good cover in deeper pools with coarse substrata.

Downstream at site 17, nursery habitat of moderate quality was available for salmonids with the presence of numerous riffle and glide sequences throughout over a bed of mixed substrata. Good salmonid spawning habitat was also present in the tailings of deeper glides and in pools containing mixed gravels and small cobbles. The holding habitat at this site however was overall poor for salmonids. The stream was also too in high energy to provide suitable habitat for lamprey and lacked suitable fine sediment habitat for lamprey ammocetes. This section of river contained suitable eel habitat in terms of boulder, cobble and coarse gravels.

### The Bonet_SC_010 Catchment

The upper Bonet_SC_010 catchment which contains the Brackary_010, and Owenmore (Manorhamilton)_020 watercourses flows through the proposed development site and consists of a mixture of upland eroding waterbodies that flow over Limestone & calcareous shale bedrock. These small streams and rivers are spate in nature and have a slow to moderate

velocity in areas. They have a natural profile that meanders through the catchment, with some channels situated in shallow sloping V-shaped valleys that cut through steep wooded habitat. These upland waterbodies have a natural cascade of riffle, pool and glide sequence with some locations having high energy. The substrate within these waterbodies is composed of boulders, cobble, mixed gravels and sand with some areas having small abouts of siltation present. The water depts range between 5cm-60cm and the wetted width of the channels ranging from 1m-6m and bank height ranging from 1m-4m.

Within the survey sites 6, 7, 8 and 9 on the Brackary_010 River, good spawning habitats and holding habitats were recorded present within tailings of deeper glide and in pools of mixed gravels and small cobbles. They were considered to also have very good quality nursery for salmonids given ample riffle and glide sequences with a mixed substrata bed that provided oxygenated water and refugia. The river had no lamprey ammocoete burial areas in any of the survey reaches but spawning habitat was present. However the river was of high energy and therefore not suitable for lamprey.

The Owenmore (Manorhamilton)_020 River at sites 10, 11 and 12 were small streams with shallow water depth and steep gradients. There is absence of suitable spawning gravels due to the high gradients, with moderate holding habitat for salmonids. The river had no lamprey ammocoete burial areas in any of the survey reaches. Site 20, 21, 22, 23 and 25 contained optimal to good spawning gravels and holding habitat however lacked sediment for lamprey given the nature of the river and its high energy. Site 24 contained minimal spawning and nursery habitat and lacked sediment deposits for lamprey. During kick sampling at Site 25, one Three spine stickleback fish of approximately 4cm was captured in the sample and brown trout were recorded feeding on the surface.

The Owenmore (Manorhamilton)_010 River at Site 13 contained moderate quality salmonid spawning habitat in the tailings of deeper glides and in pools with unbedded mixed gravels and small cobbles present. The holding habitat was very good with deep glide and pools located throughout. The river was of too high energy for lamprey but had some suitable eel habitat in terms of boulder and cobble refugia with deep water.

As noted in Section 3.1.2, culverts within watercourses are considered barriers for upstream migrating fish. There are numerous culverts located on the watercourses within the study, representing an upstream migration barrier for some species including salmon, sea lamprey, river lamprey and perhaps European eel also. Other natural barriers may be present on the watercourses, especially in mountainous regions. A large weir of approximately 5m height was recorded at Site 24 on the Owenmore (Manorhamilton)_020 River, preventing all fish migration upstream (Plate 3-1).

Plate 3-1: Natural weir located at Site 24 on the Owenmore (Manorhamilton)_020 River.

### 3.2.3 Electrofishing Survey

Electrofishing site characteristics at aquatic survey sites examined for the proposed project are provided in Appendix D.

Overall, two salmonid species, brown trout and salmon were recorded during the electrofishing surveys conducted across the three catchments and were present in eleven of the seventeen sites electrofished. A total of 263 fish were recorded during the electrofishing surveys, brown trout (n=149), and salmon (n=114). No lamprey or any other fish species were recorded during these surveys. Brown trout were the most frequent species recorded throughout the rivers and tributaries, recorded in ten of the seventeen sites (58.8%) while salmon were only present in three of the seventeen sites (17.6%). Both species were recorded together in two of these sites. Site 6 contained the highest abundance of brown trout (18.7%) caught and Site 3 contained the highest abundance of salmon (57%) caught. Site 17 had the lowest abundance of brown trout (0.6%) and Site 13 had the lowest abundance of salmon (10.5%).

The lengths of the fish caught during the electrofishing can be seen in Appendix A. The overall results of fish caught at each site is presented in Table 3-2.

The results of the surveys are discussed below in terms of fish population structure, stability and value of each of the surveyed catchments as suitable fisheries habitat including nursery and spawning grounds.

Table 3-2: Total Number of Each Fish Species Captured at Each Site Within the Study Area

| Site No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Brown Trout | 10 | 8 | 0 | 0 | 3 | 28 | 26 | 0 | 22 | 0 | 0 | 0 | 15 | 0 | 15 | 22 | 1 |
| Salmon | 0 | 0 | 37 | 0 | 65 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 | 0 | 0 | 0 | 0 |
| **Total** | **10** | **8** | **37** | **0** | **68** | **28** | **26** | **0** | **22** | **0** | **0** | **0** | **27** | **0** | **15** | **22** | **1** |

## The Drowes_SC_010 Catchment

There were five sites surveyed within this catchment including the Ballagh_010 River (Site 1 and 2), the Lattone_010 River (Site 3) and the Rosfrair_010 River (Site 4 and 5). The Drowes catchment supports both species of salmonids. Brown trout were present within Sites 1, 2 and 5 and salmon were present in Site 3 and 5. There was no fish caught within Site 4.

### The Ballagh_010 River

The Ballagh river supports a population of juvenile brown trout (*n*=18) that are of age class 0+ and >0+ based on the length frequency data obtained (average fork length 11cm). The average minimum density for 0+ fish is 0.05/m² and for >0+ fish is 0.02/m² at these sites. The Ballagh river within this catchment offers good spawning and nursery habitat for these fish and supports up to 1+ aged fish. No salmon were recorded present within this river.

The altitude of these survey sites on the Ballagh River was 160m and 88m respectively and it may be a case that salmon can not migrate up this far or there may be a barrier present to prevent the upstream migration of mature salmon on this river. Also no lamprey species were recorded present however, this is likely reflective of the lack of suitability of the sites surveyed (lack of soft sediment for ammocoetes) as opposed to their absence in the river.

### The Lattone_010 River

Only salmon were recorded within the Lattone River, with a total number of salmon recorded been *n*=37. Based on the length frequency of salmon at Site 3, the average length was 7cm, representing the age class of 0+ and >0+ fish. This indicates that this river contains good spawning and nursery habitat to support these juvenile fish. Based on the length frequency the age class of salmon present at this site, it offers suitable spawning, nursery and holding grounds for salmon at the altitude of 62m.

The results show that the Lattone River support salmon, indicating that there is no barrier to the upstream migration of mature salmon downstream of the locations. No lamprey species were recorded from this river survey and it lacked suitability (lack of soft sediment for ammocoetes) as opposed to their absence in the river.

### The Rosfrair_010 River

No fish were recorded at Site 4. This survey site was at an altitude of 210m and does not offer suitable spawning, nursey or holding habitat for salmonids due to the fast flowing nature of the first order stream which is located in a step valley. Salmon parr were the abundant species recorded at site 5 (*n*=65) with low numbers of brown trout also present at this site (*n*=3). The average length of salmon was 6.1cm and brown trout was 5.5cm, representing the age class of 0+ and >0+ fish. This indicates that this river contains good spawning and nursery habitat to support salmonids. The river contained no lamprey ammocoete burial areas in the survey reach but spawning habitat was present. No lamprey species were recorded during the survey. The river had suitable eel habitat in terms of boulder, cobble and coarse gravel refugia however, none were recorded.

### The Bonet_SC_010 Catchment

Three rivers, the Brackary_010, Owenmore (Manorhamilton)_010 and the Owenmore (Manorhamilton)_020 are found within this catchment and were selected for surveying along with some of their tributaries. Sites 6, 7, 8 and 9 are located on the Brackary_010 River. Site 13 is located on the Owenmore (Manorhamilton)_010 River and sites 10, 11 and 12 are located on the Owenmore (Manorhamilton)_020 River.

Within the Bonet catchment, again both species of salmon and brown trout were present. The dominant species was the brown trout as it was located at four sites compared to the salmon which was located at one.

#### The Brackary_010

At survey Sites 6, 7 and 9 on the Brackary_010 River, only was brown trout were recorded present (n=76). The altitude of these sites where the brown trout were present was 111m ,107m and 68m, respectively. Salmon were not recorded within these sites of the river, their absence here may be due to the higher altitude of this river.

The overall average length of brown trout combined from these three sites was 9.8cm, representing the age groups 0+ and >0+ fish. Brown trout recorded at 12cm and longer are considered to be >0+ fish and it is probable that the vast majority of these fish are 1+ fish. Based on the length frequency of these fish, they represent the age groups 0+ and 1+ fish indicating that this river provides good a good stretch of spawning, nursery and holding habitat for this species.

No fish were recorded at Site 8 during the survey which was at a higher altitude of 133m. This site was considered to be of poor quality for nursery habitat for salmonids given very shallow water, steep gradient and absence of deeper glides and pools. It offered poor quality spawning with the absence of suitable mixed gravels and the presence of heavy siltation. The absence of deeper glides and pools did not offer suitable holding habitat. The stream was considered to hold no value for lamprey and eel due to its steep gradient. The river had suitable eel habitat in terms of boulder, cobble and coarse gravel refugia. However, given the higher gradient of the river, the channels would be less accessible to eel and none were recorded.

#### Owenmore (Manorhamilton)_020 River

Site 10, 11 and 12 are located on the Owenmore (Manorhamilton)_020 River, downstream of Site 13. These sites were recorded to be at altitudes of 119m, 143m and 101m respectively. No salmon or brown trout were recorded at any of these three sites. No lamprey species or European eel were recorded during the surveys also due to gradients being unsuitable for the species.

All three survey sites offered no spawning value due to the absence of suitable spawning gravels and the high gradient and also considered to offer low quality nursery habitat for salmonids given the small size and shallow water depth steep gradients of these streams. The holding habitat for salmonids was moderate. The low fisheries value of the channels was exemplified by the absence of fish captured during targeted electro-fishing.

#### Owenmore (Manorhamilton)_010 River

The Owenmore (Manorhamilton)_010 River at Site 13 contained suitable habitat for salmonids. Both salmon (n=12) and brown trout (n=15) were recorded present at this site. This site which is at an altitude of 100m contained habitat suitable for salmonid species and was considered a moderate quality nursery for salmonids with the presence of deep pools and glides (more limited nursery habitat). The average length of salmon was 8.7cm and the average length of brown trout was 14.4cm. The length frequency distribution of these species indicates an age profile of 0+ and 1+ salmonid fish and there is the possibility of 1+ brown trout considered present owing to the good spawning and nursery habitat of this river supports. The presence of these species also indicates there is no barrier to migration located downstream. No eel or lamprey were recorded at Site 13.

#### MacneanLoughsconnector_SC_010 Catchment

Surveys were conducted on the Cornavannoge_010 River at Site 14 to 17. Only one species of fish, brown trout was recorded at three sites (15, 16 and 17). These fish were captured at altitudes of 123m, 118m and 106m respectively. The length frequency of these fish ranged from 6cm to 19cm which are 0+ and >0+ fish.

A total of n=15 brown trout were recorded present at site 15 with an average length of 7.9cm. Within site 16, a total of n=16 brown trout were recorded present. The average length of this species at this site was 10cm. Despite having some as a salmonid spawning and nursery habitat value, only n=1 brown trout was recorded at site 17. This fish was 7.3cm in length, a 0+ fish.

No fish were captured at site 14 which had an altitude of 226m. This site was considered a low quality nursery for salmonids and other fish species given its small size and its very steep gradient. This stream offered no salmonid spawning value due to the absence of suitable spawning gravels because of the high gradient and also the stream lacked good salmonid holding habitat due to the absence of pools.

Salmon were not recorded within these sites of the river, again their absence here may be due to the higher altitude of these tributaries. No lamprey species or European eel were recorded at any of the four sites within this river due to gradient and altitude also being unsuitable for the species.

Overall these tributaries offered good spawning and nursery habitat for brown trout albeit only one fish was recorded present at site 17. The length frequency distribution of these species indicates both 0+ and >0+ fish present overall indicating good spawning and nursery habitat present within the tributaries of this river.

## 3.2.4 Protected Fauna

### *3.2.4.1 Otter*

During the aquatic surveys, signs of otters were searched for along all seven watercourses the where accessible, and along drainage ditches located within the proposed development site. No signs of otter (tracks, slides and spraints) or holts/resting sites were found within the study area.

## 3.2.5 Invertebrates

### *3.2.5.1 White Clawed Crayfish*

White-clawed Crayfish were recorded at Sites 7 and 9 on the Brackary_010 River. A total of two female crayfish were captured during the electrofishing surveys. Suitable habitat for white-clawed crayfish was present at both sites with suitable cobbles and gravel with some boulders present at these sites. Suitable habitat was also recorded on the Owenmore (Manorhamilton)_020 River at Site 20 and 25, however there was an absence of instream vegetation providing refugia.

## 3.2.6 Macroinvertebrates

Biological water quality data, as prescribed by the EPA (Toner *et al.* 2005), group invertebrates into classes whereby species highly intolerant to pollution and low dissolved oxygen levels are denoted Class A, and species with greater tolerance to pollution and dissolved oxygen levels fall into the successive classes B through E respectively. As such the presence or absence of these groups and their relative abundances facilitates an assessment of biological river health. The results from these sites are discussed in this context in order to interpret potential changes in the riverine community composition.

The macroinvertebrate communities recorded at the survey sites comprised a wide range of macroinvertebrate taxa. A detailed list of the macroinvertebrate taxa recorded at each survey location with the classification of macroinvertebrate species recorded in terms of their pollution sensitivity is provided in Table 3-3. The species listed are separated by the EPA taxonomic classes as prescribed above and colour coded for clarity.

A total of 30 taxa were recorded during the survey, with individual sites recording between 1 and 12 taxa in the single, kick sample taken at each site (Table 3-3). Overall, the list of species was well represented by the more pollution tolerant groups, including Baetidae, Simuliidae, Heptageniidae and Gammarus making up almost half of the taxon richness. The Ephemeroptera and Plecoptera were well represented, in good numbers, probably down to low levels of pollution. Trichoptera were also rich in diversity however in low numbers probably as a result of the lack of in-stream and marginal vegetation and lack of sheltered habitats in places.

### *3.2.6.1 Diversity and Abundance*

Several metrics were applied to the benthic invertebrates collected at each site. The Q-values were assigned on the basis of the sensitivity groups present in abundance, % representation and taxon richness (Table 3-4). It is clear that all sites were dominated by Group C. Group A and B taxa were present in smaller numbers and with Group A present in all sites with exception of Site 10-13, 17 and 24. Group B present in low numbers in all the majority of sites with exception to Site 10-13 and 18-25. No macroinvertebrates representing Group D and Group E were recorded in the sample sites.

Note, the EPT (Ephemeroptera, Plecoptera, Trichoptera) were well represented in terms of the abundance with Baetis been the dominant species present. ETP were recorded in all sites with exception to Site 18.

Only three families of Ephemeroptera and four families of Plecoptera were present, with the majority but these largely made up the pollution sensitive Ecdyonurus spp. and those considered less sensitive, *Baetis*. Seven families of Tricoptera were recorded in total, with four cased (Group B) and three caseless (Group C). The most prevalent cased caddisflies were *Hydropsychidae sp.*

Overall, the flow was good for pollution sensitive Group A and B taxa, this indicates the substrate is of good quality for these groups as well as a lack of sedimentation. There was riffle, pools and glide profile within the majority of the sites, presenting suitable habitat for mayflies and stoneflies.

Dipteran larvae accounted for a moderate proportion of the macroinvertebrate community at the study sites. The most common true fly larvae were pollution tolerant chironomids and Simulidae which were prevalent across the majority of sites.

Beetles only had two families were recorded: Elmidae and Halipliidae (scarce numbers).

The crustaceans Gammarus sp. were recorded present, in a large proportion of the macroinvertebrate community at the study sites. This species was numerous and widespread however it was absent at Site 2, 10-12, 18-20 and Site 2.

One family of Gastropods were recorded, Ancylidae, at Site 3 and one family of Hydracarina was recorded at Site 2, 3, 6 and 13. These were overall scarce in numbers throughout the study area.

Table 3-3: Macroinvertebrates Recorded During Biological Sampling on Watercourses Within the Study Area of the Proposed Project

| Group/Organism | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | EPA Class Pollution sensitivity group |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mayfly (Ephemeroptera)** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Baetidae** | | | | | | | | | | | | | | | | | | | | | | | | | | C |
| *Baetis rhodani* | 100+ | 34 | 100+ | 20 | 70 | 100+ | 50 | 15 | 100 | 3 | 100+ | 1 | 5 | 10 | 20 | 5 | 15 | 7 | | | | 5 | 2 | 20 | 12 | |
| **Heptageniidae** | | | | | | | | | | | | | | | | | | | | | | | | | | A |
| *Heptagenia sp.* | | | | | 2 | | | | | | | | | | 24 | 15 | | | | | | | | | | |
| *Ecdyonurus spp.* | 23 | 13 | 15 | | 20 | 20 | 10 | | 10 | | | | | | | | | 5 | 15 | 9 | 15 | 2 | 3 | | 8 | |
| *Rhitrogena sp.* | 10 | 2 | 5 | 10 | | | | 5 | | | | | | 5 | | 8 | | | | | | | | | | |
| **Stonefly (Plecoptera)** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Leuctridae** | | | | | | | | | | | | | | | | | | | | | | | | | | B |
| *Leuctra hippopus* | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Leuctra* sp. | | 2 | | 1 | 4 | | 2 | | 2 | | | | | 2 | 2 | 2 | 2 | | | | | | | | | |
| **Nemouridae** | | | | | | | | | | | | | | | | | | | | | | | | | | A |
| Nemouridae sp. | | | | | | | | | | | | | | | | | | | 3 | 3 | | | | | | |
| *Protonemura* sp. | | | | | 5 | | | | | | | | | | 3 | | | 5 | | 3 | | 1 | | | | |
| **Perlodidae** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Perlodidae sp.* | | | | 3 | | | | | | | | | | | | | | | | | | | | | | |
| **Chloroplidae** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Chloroplidae sp.* | | | | | | | | | | | | | | | | | | | | | 2 | | | | | |
| **Cased Caddisflies (Tricoptera)** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Goeridae** | | | | | | | | | | | | | | | | | | | | | | | | | | |

| Group/Organism | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | EPA Class Pollution sensitivity group |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Goeridae sp. | | | 3 | | | | | | | | | | | | | | | | | | | | | | | B |
| *Goera pilosa* | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Glossosomatidae** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Glossosomatidae sp.* | | | | | | | | 5 | 16 | | | | | | | 18 | | | | | | | | | | |
| **Sericostomatidae** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Sericostomatidae* | | | 1 | | | | | | | | | | | | | | | | | | | | | | | |
| **Odontoceridae** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Odontocerum albicorne* | 5 | | 1 | | | | | | | | | | | | | | | | | | | | | | | |
| **Rhyacophilae** | | | | | | | | | | | | | | | | | | | | | | | | | | C |
| *Rhyacophila* sp. | 5 | | | | | | | | | | | | | | | | | | | 1 | 1 | | | | | |
| **Polycentropodidae** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Polycentropodidae* | 5 | | | 1 | | | | | | | | | | | | | 5 | | | 1 | | | 1 | | | |
| **Hydropsychidae** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Hydropsychidae sp.* | | | | | 5 | 10 | | | 14 | | | | 4 | | | 6 | | | 2 | | 2 | | | | | |
| **Beetle (Coleoptera)** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Coleoptera larvae | 10 | | 10 | | | | | | | | 2 | | | | | | | | | | | | | | | C |
| **Elmidae** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Elmidae sp.* | | | | | | | | | | | | | | | | | | | | | 1 | | | | 1 | |
| **Haliplidae** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Haliplidae sp.* | | | | | | | | | | | | | | | | | | | | | 1 | | | | | |
| **Two Winged Flies (Diptera)** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Chironomidae** | | | | | | | | | | | | | | | | | | | | | | | | | | C |
| *Chironomidae* | | | | | | 5 | | | 19 | | | 1 | | | | | | | 1 | 1 | | | | | | |

| Group/Organism | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | EPA Class Pollution sensitivity group |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Simuliidae** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Simuliidae sp.* | 10 | 11 | 10 | 5 | 10 | 10 | | 10 | | | | | 25 | | 10 | 7 | 3 | | | | | | | | | |
| **Pediciidae** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Pediciidae sp.* | | | 5 | | | | 3 | | | | | | | | 1 | 2 | | | | | | | | | | |
| **Tipulidae** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Tipulidae sp.* | | | | | | | | | | | | | | | | | | | | | | | 1 | | | |
| **Crustaceans** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Gammaridae** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Gammarus* sp. | 10 | | 10 | 3 | 10 | 10 | 5 | 25 | 9 | | | | 10 | 5 | 5 | 5 | 7 | | | | 2 | 1 | 8 | | 2 | C |
| **Astacidae** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Austropotamobius pallipes* | | | | | | | 1 | | 1 | | | | | | | | | | | | | | | | | |
| **Watermites (Hydracarina)** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Hydracarina** | | | | | | | | | | | | | | | | | | | | | | | | | | C |
| *Hydracarina sp.* | | 20 | 5 | | | 12 | | | | | | | 7 | | | | | | | | | | | | | |
| **Snails and Limpets (Gastropoda)** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Ancylidae** | | | | | | | | | | | | | | | | | | | | | | | | | | C |
| *Ancylus fluviatilis* | | | 3 | | | | | | | | | | | | | | | | | | | | | | | |
| **Nematomorpha** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Nematomorpha sp.* | 1 | | | | | | | | | | | | | | | | | | | | | | | | | N/A |
| **SSRS** | 8 | 8 | 8 | 8 | 9.6 | 4.8 | 6.4 | 5.6 | 8 | 1.6 | 1.6 | 3.2 | 3.2 | 4.8 | 7.2 | 8.8 | 5.6 | 4.8 | 7.2 | 8 | 5.6 | 4 | 5.6 | 6.4 | 3.2 | |

Table 3-4: The Representation of Each Invertebrate Group as Separated by Q-value System in Each Sampling Site

| Q-Value Grouping | Site 1 | Site 2 | Site 3 | Site 4 | Site 5 | Site 6 | Site 7 | Site 8 | Site 9 | Site 10 | Site 11 | Site 12 | Site 13 | Site 14 | Site 15 | Site 16 | Site 17 | Site 18 | Site 19 | Site 20 | Site 21 | Site 22 | Site 23 | Site 24 | Site 25 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Total Abundance*** | | | | | | | | | | | | | | | | | | | | | | | | |
| Group A | 33 | 15 | 20 | 13 | 27 | 20 | 10 | 5 | 10 | 0 | 0 | 0 | 0 | 5 | 27 | 23 | 0 | 10 | 18 | 15 | 17 | 3 | 3 | 0 | 8 |
| Group B | 5 | 2 | 5 | 1 | 4 | 0 | 2 | 5 | 18 | 0 | 0 | 0 | 0 | 2 | 2 | 20 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Group C | 140 | 67 | 148 | 29 | 95 | 157 | 9 | 50 | 143 | 3 | 102 | 2 | 51 | 15 | 41 | 25 | 30 | 7 | 3 | 3 | 7 | 6 | 12 | 20 | 15 |
| Group D | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Group E | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ***Percentage*** | | | | | | | | | | | | | | | | | | | | | | | | |
| Group A | 18.5 | 17.8 | 11.5 | 30.2 | 21.4 | 11.3 | 47.6 | 8.3 | 5.8 | 0 | 0 | 0 | 0 | 22.7 | 38.5 | 33.8 | 0 | 58.8 | 85.7 | 83.3 | 70.8 | 33.3 | 20 | 0 | 53.3 |
| Group B | 2.8 | 2.3 | 2.8 | 2.3 | 3.2 | 0 | 9.5 | 8.3 | 10.5 | 0 | 0 | 0 | 0 | 9.1 | 2.8 | 29.4 | 6.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Group C | 78.6 | 79.7 | 85.5 | 67.5 | 75.4 | 88.7 | 42.8 | 83.3 | 83.6 | 100 | 100 | 100 | 100 | 68.1 | 58.5 | 36.7 | 93.7 | 41.2 | 14.2 | 16.6 | 29.1 | 66.6 | 80 | 100 | 46.6 |
| Group D | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Group E | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ***Number of Taxa*** | | | | | | | | | | | | | | | | | | | | | | | | |
| Group A | 2 | 2 | 2 | 2 | 3 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 2 | 1 | 0 | 2 | 2 | 3 | 2 | 2 | 1 | 0 | 1 |
| Group B | 1 | 1 | 3 | 1 | 1 | 0 | 1 | 1 | 2 | 0 | 0 | 0 | 0 | 1 | 1 | 3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Group C | 8 | 3 | 7 | 4 | 4 | 6 | 4 | 3 | 5 | 1 | 2 | 2 | 5 | 2 | 4 | 5 | 4 | 1 | 2 | 3 | 5 | 2 | 4 | 1 | 3 |
| Group D | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Group E | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

### 3.2.7 Biological Water Quality

The Q-ratings, the ecological status, BMWP scores and EPT indices derived from the diversity and relative abundance of the macroinvertebrates at detailed study sites are given in Table 3-5.

The biological water quality survey results indicate that the overall biological water quality in the watercourses draining the proposed project site range between Q3, Poor status (Moderately Polluted) moderately polluted and Q4, Good status (Unpolluted), with the majority of polluted waters located within the Owenmore (Manorhamilton)_020 and Owenmore (Manorhamilton)_010 River.

Overall, the watercourses provide waters quality adequate to support a range of pollution sensitive mayfly and stonefly larvae, as well as salmonids and are present in abundance in the majority if some sites.

The generally low BMWP scores, are a reflection of the sensitivity of macroinvertebrates to oxygen depletion and show poor to moderate biological diversity of these species within the watercourses of study area with the exception of Site 3 which had the highest taxon richness, was clean however slightly impacted. All sites scored <100, so biological water quality is rated using the BMWP water quality categories. These have interpreted the watercourses as 'Polluted or impacted', 'Moderately impacted' or Clean but slightly impacted which is the case for Site 3. The ASPT indicates that the community was mixed with sensitivity and tolerant taxa with values ranging from 3-7.8.

The BMWP and SSRS scores and categories are in line with the ASPT values and the Q-values assigned (Table 3-5).

The EPT index of water quality indicates moderate to good water quality and biological stability in the water courses assessed, ranging from 17-100% in the watercourses. The % EPT show that most of the taxa belonged to this group, in terms of their abundance. The lowest EPT % was recorded at Site 13, a river with a Q3 value rating, and the highest recorded at Site 18, a river with a Q4 value rating.

Table 3-5: Biological Water Quality and Interpretations at Study Sites on Watercourses Draining the Proposed Project

| Site | Q-value | WFD Ecological Status | SSRS Score | SSRS category | BMWP Score | BMWP Category | BMWP Interpretation | ASPT | EPT taxa (%) | Taxon Richness |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4 | Good status (Unpolluted) | 8 | Probably not at risk | 67 | Moderate | Moderately impacted | 7.1 | 83 | 11 |
| 2 | 4 | Good status (Unpolluted) | 8 | Probably not at risk | 39 | Poor | Polluted or impacted | 7.8 | 63 | 6 |
| 3 | 4 | Good status (Unpolluted) | 8 | Probably not at risk | 76 | Good | Clean but slightly impacted | 7.6 | 75 | 12 |
| 4 | 4 | Good status (Unpolluted) | 8 | Probably not at risk | 52 | Moderate | Moderately impacted | 7.4 | 81 | 7 |
| 5 | 4 | Good status (Unpolluted) | 9.6 | Probably not at risk | 57 | Moderate | Moderately impacted | 7.1 | 84 | 8 |
| 6 | 4 | Good status (Unpolluted) | 4.8 | Stream at risk | 32 | Poor | Polluted or impacted | 5.3 | 79 | 7 |
| 7 | 4 | Good status (Unpolluted) | 6.4 | Stream at risk | 30 | Poor | Polluted or impacted | 7.5 | 57 | 6 |
| 8 | 4 | Good status (Unpolluted) | 5.6 | Stream at risk | 25 | Poor | Polluted or impacted | 6.2 | 41 | 5 |
| 9 | 4 | Good status (Unpolluted) | 8 | Probably not at risk | 37 | Poor | Polluted or impacted | 6.1 | 83 | 8 |
| 10 | 3 | Poor status (Moderately Polluted) | 1.6 | Stream at risk | 4 | Poor | Polluted or impacted | 4 | 100 | 1 |
| 11 | 3 | Poor status (Moderately Polluted) | 1.6 | Stream at risk | 9 | Poor | Polluted or impacted | 4.5 | 100 | 2 |
| 12 | 3 | Poor status (Moderately Polluted) | 3.2 | Stream at risk | 6 | Poor | Polluted or impacted | 3 | 50 | 2 |
| 13 | 3 | Poor status (Moderately Polluted) | 3.2 | Stream at risk | 20 | Poor | Polluted or impacted | 5 | 17 | 5 |
| 14 | 4 | Good status (Unpolluted) | 4.8 | Stream at risk | 30 | Poor | Polluted or impacted | 7.5 | 77 | 4 |

| Site | Q-value | WFD Ecological Status | SSRS Score | SSRS category | BMWP Score | BMWP Category | BMWP Interpretation | ASPT | EPT taxa (%) | Taxon Richness |
|---|---|---|---|---|---|---|---|---|---|---|
| 15 | 4 | Good status (Unpolluted) | 7.2 | Indeterminate stream May be at risk | 42 | Moderate | Moderately impacted | 7 | 77 | 7 |
| 16 | 4 | Good status (Unpolluted) | 8.8 | Probably not at risk | 50 | Moderate | Moderately impacted | 7.1 | 79 | 9 |
| 17 | 3 | Poor status (Moderately Polluted) | 5.6 | Stream at risk | 32 | Poor | Polluted or impacted | 6.4 | 68 | 5 |
| 18 | 4 | Good status (Unpolluted) | 4.8 | Stream at risk | 21 | Poor | Polluted or impacted | 7 | 100 | 3 |
| 19 | 4 | Good status (Unpolluted) | 7.2 | Indeterminate stream May be at risk | 24 | Poor | Polluted or impacted | 6 | 95 | 4 |
| 20 | 4 | Good status (Unpolluted) | 8 | Probably not at risk | 40 | Moderate | Moderately impacted | 6.6 | 94 | 6 |
| 21 | 4 | Good status (Unpolluted) | 5.6 | Stream at risk | 48 | Moderate | Moderately impacted | 6.8 | 91 | 7 |
| 22 | 4 | Good status (Unpolluted) | 4 | Stream at risk | 27 | Poor | Polluted or impacted | 6.7 | 88 | 4 |
| 23 | 3 | Poor status (Moderately Polluted) | 5.6 | Stream at risk | 32 | Poor | Polluted or impacted | 6.4 | 40 | 5 |
| 24 | 4 | Good status (Unpolluted | 6.4 | Stream at risk | 4 | Poor | Polluted or impacted | 4 | 100 | 1 |
| 25 | 4 | Good status (Unpolluted | 3.2 | Stream at risk | 25 | Poor | Polluted or impacted | 6.2 | 91 | 4 |

# 4. DISCUSSION

## 4.1 FISH AND FISHERIES HABITAT

Fisheries suitability and value was taken into account during the aquatic surveys. Suitable spawning and nursery habitat for salmonids was assessed. The potential for lamprey (river and brook) habitat and presence was also assessed at each survey site.

There are several factors which collectively define lotic habitat in terms of its suitability for fish, and in this instance for salmonids (salmon and brown trout) and lamprey. Mature fish must be able to reach the habitat, or close to it, for spawning purposes. The watercourse must contain suitable spawning habitat and at least some suitable nursery habitat for 0-group salmonids during some or all of their first year of life and lamprey ammocetes. Lotic habitat might be suitable for adult salmonid spawners, ova and newly emerged alevins, but if suitable habitat in terms of physical attributes or stream flows is not available, then recently emerged parr will vacate spawning areas and drop downstream.

Overall it can be seen that salmonids are present within the rivers and tributaries of these catchments where good spawning and nursery habitat is available in the majority or sections within the watercourses and also at a suitable altitude for these species.

Within the proposed development, the upper reaches of the Lattone_010 River, Brackary_010, Owenmore (Manorhalmilton)_020 and Rosfrair_010 comprised of moderate to steep gradient habitat with bedrock, boulders, mixed gravels and an absence of sediment. These watercourses are of good water quality and contained spawning gravels, with suitable salmonid spawning and nursery habitat. However they lacked suitable holding pools for larger salmonids decreasing the habitat value and quality for fish.

Downstream, the watercourse profiles of these rivers maintain a good riffle glide sequence throughout, with holding pools becoming more present for larger fish at these lower altitudes and a slower velocity. The mixed gravels and cobble substrata increase with less bedrock exposure. These watercourses provide heterogenous fluvial habitat ideal for spawning and early life stages of salmonids which is reflected by the electrofishing results. These watercourses contained riffles, instream mix of cobble and gravel base with dappled shade from over hanging banks or riparian vegetation provide good salmonid nursery habitat.

Artificial structures such as bridge foundation aprons and culverts such as the culverts, may affect the distribution of fish in the study area. As mentioned in Section 3.1.3, there is numerous culverts located within the study area and most of the roadways within the proposed project site feature concrete pipe culverts as well as the large nature rock weir at Site 24 on the Owenmore (Manorhalmilton)_020. Such features can prevent the migration or limit the distribution of salmonids, lamprey and eel as they can prevent upstream passage. In the case of the current road network within the study site, these possible barriers may block or fragment the migration of these species to the upper reaches of the watercourses within the proposed development. However with record of salmon and trout recorded above these culverts and fords, it shows that these are not impeding salmon upstream migration unduly and their absence at higher levels is based on various other factors such as altitude and unsuitable habitat. Based on the height of the natural rock weir at Site 24, on the Owenmore River, it is a complete barrier to fish migration and passage upstream.

### 4.1.1 Salmonids

The suitability of waterbodies within and downstream of the proposed development were assessed for their potential to support salmonid species.

Overall, two salmonid species, brown trout and salmon were recorded from the electrofishing surveys conducted across the three catchments and were present in eleven of the seventeen sites electrofished. Brown trout were the most frequent species recorded throughout the watercourses, recorded in ten of the seventeen sites while salmon were only present in three of the seventeen sites.

Overall it can be seen that salmonids are present within the rivers and tributaries of these catchments where good spawning and nursery habitat is accessible and available in the majority or sections within the watercourses and also at a suitable altitude for these species. The finding of young salmon and brown trout young 0+ age parr shows good recruitment of salmonids on the watercourse and a good indication of good spawning and nursery conditions as well as water quality and absence of barriers to migration upstream.

The absence of salmonids in the upper reaches of the surveyed watercourses may be related to the steep gradient and high altitudes. Salmon were recorded present at altitudes up to 100m and brown trout were recorded present up to altitudes if 160m. No fish were recorded at site 4 at 210m or at site 14 at 226m. The absence of fish at sites 10, 11 and 12 in the Owenmore (Manorhamilton)_020 may be related to poor water quality or a barrier downstream as these sites are within suitable altitude for salmonids.

### 4.1.2 Lamprey

Habitat suitability for lamprey species was assessed at all river waterbodies within and downstream of the proposed development. Lamprey have similar spawning habitat requirements as salmonids. There is adequate lamprey spawning habitat by way of finer, unbedded gravels present at the majority of sites located on the seven watercourses with exception to Site 14 on the Cornavannoge_010 and Site 24 on the Owenmore (Manorhamilton)_020, downstream of the proposed project. However given the altitude and steep slopes of some of these watercourses within and downstream of the proposed development, and their absence within all the electrofishing survey sites, the migration upstream to these upper reaches may prove very difficult, especially given the presence of barriers on some watercourses.

The majority of sites within and downstream of the proposed project represented unmodified, steep, fast flowing, eroding watercourses and naturally such sites lack the deposition of fine, organic rich sediment required by larval lamprey (Goodwin *et al.*, 2008; Aronsuu & Virkkala, 2014). Aquatic surveys determined that moderate to fast flowing high gradient nature of watercourses in the study area of the proposed development did not provided suitable conditions for lamprey larvae, which require soft finer sediment accumulations into which they can burrow. No lamprey were recorded present in the sampling sites within and downstream of the proposed development site. Lamprey may occur in low densities in the lower reaches of the rivers assessed, where flows are sufficiently slower to allow accumulation of fine substrates.

### 4.1.3 European Eel

The European eel is subject to European Council Regulation 1100/2007 '*Establishing measures for the recovery of the stock of European eel*'. European eel is listed as '*Critically endangered*' both a global and Irish scale and is now 'Red Listed' according to 'Red List No. 5: Amphibians, Reptiles & Freshwater Fish' (Pike *et al.*, 2020; King *et al.*, 2011).

The watercourses within the study area were considered sub optimal for this species given the often high gradient and energy profiles of the channels within the study area, especially the watercourses within the proposed development. The presence of instream refugia such as large boulders and cobble provided optimal eel habitat however the majority of sites lacked large woody vegetation and macrophyte beds which offer vital diurnal refugia for eel populations (Laffaille *et al.*, 2003).

### 4.1.4 Other Fish Species

Other fish species including three-spined stickleback, stone loach, lamprey, eel and minnow are likely to occur in most of the watercourses downstream of the proposed project, in the lower gradient reaches of these watercourses.

## 4.2 INVERTEBRATES

### 4.2.1 Macroinvertebrates

The habitats for macroinvertebrates in the seven watercourse draining the proposed project site are generally optimal to good for macroinvertebrate production. It is clear that these rivers have been modified in places the past, for forestry and agricultural drainage. This has provided limited suitable habitat for the deposition of materials and the formation of a healthy marginal vegetation, which would provide suitable habitat for taxa that require more sheltered habitats (such as cased Trichoptera, various Coleoptera and Hemiptera).

Along with the Plecoptera, both Ephemeroptera and Tricoptera are often good indicators of cool, well oxygenated waters and are sensitive to pollution. Their presence reflects suitable good water quality and habitat within the watercourses.

Ephemeroptera was present throughout all the samples however this class was only represented by two families, Baetidae which are not sensitive to pollution and Heptageniidae which are sensitive to pollution. Heptageniidae were absent within the Owenmore (Manorhamilton)_010 and Owenmore (Manorhamilton)_020, an indication of poor water quality.

Plecoptera, were recorded present within the majority sampled sites and represented by only four family, in very low numbers. Plecoptera are herbivores and are generally found in cold, well oxygenated, fast-moving streams. Their presence at sites (albeit in low numbers and species diversity) indicates oxygenated, clean streams. This class was also absent from kick samples within the Owenmore (Manorhamilton)_010 and Owenmore (Manorhamilton)_020 rivers, another indication of poor water quality in these rivers.

The uncased sensitive species of Tricoptera were absent or in very low numbers in the majority or the sites, this may reflect a case of unsuitable habitat more so then poor water quality.

Along with the Plecoptera, both Ephemeroptera and Tricoptera are often good indicators of cool, well oxygenated waters and are sensitive to pollution. Their presence reflects suitable water quality and habitat within the watercourses.

The highest EPT taxa % were present at sites were assigned a Q3 and Q4, representing poor to good ecological status, this was due to the high number of *Baetis rhodani* and *Serratella ignita* and therefore represents poorer water quality.

BMWP score for all the watercourses of the study area indicated these are poor and polluted/impacted or moderate and moderately impacted with the exception of Site 3. While this is conflicting with sites assigned a Q4 values, it is a good indication that these rivers are possibly been impacted by organic or chemical pollution based on the lower numbers of sensitive macroinvertebrate species present.

### 4.2.2 White-Clawed Crayfish

White-clawed crayfish is assessed as Endangered on the IUCN Red List (Füreder *et al.*, 2010) and the Irish population is considered to be of substantial conservation importance within Europe (Reynolds, 1998). White-clawed crayfish is a protected species under European and national legislation; it is listed on Annex II and Annex V of the EU Habitats Directive (92/43/EEC), the European Union (Invasive Alien Species) (Freshwater Crayfish) Regulations 2018 (S.I. 354/2018) and is protected in Ireland under the Wildlife Acts (as amended). In addition, this species is listed in Appendix III of the Bern Convention. White-clawed crayfish are present in the Brackary_010 River downstream of the proposed development, with captures from the electrofishing survey in addition to previous record of this species in this watercourse.

The remaining watercourses located within and downstream of the proposed project site lacked good habitat to support crayfish populations with the exception of Site 20 and 25 on the Owenmore (Manorhamilton)_020 River. According to the invertebrate sampling, all of the sampling sites range from moderately polluted to unpolluted. The Q values ranged from Q3 to Q3-4. The moderate to good water quality in these rivers are within the target value for crayfish, which is moderate water quality. Their absence within these rivers may be due to a number of factors including, high attitude, channel modification, unsuitable habitat, lack of foraging, resting and burrowing habitat.

## 4.3 WATER QUALITY

### 4.3.1 Biological

The latest EPA biological monitoring of watercourses in the study area showed water quality to range from moderate to good as indicated by the latest EPA Q-ratings. The biotic indices derived at the study sites also indicate water quality of the majority of the watercourses within and downstream of the proposed project are achieving satisfactory water quality.

Water quality results (Q-values) at the sampled locations indicate moderate to good ecological quality within watercourses of the study area. The Q-values on the Ballagh_010, Lattone_010, Rosfair_010, Brackary_010, (Manorhamilton)_020 and Cornavannoge_010 indicate the overall water quality is good and are reaching the target Q4 good status water quality required under the WFD. However it is evident that the Q-value reduces to Q3 downstream of the proposed

development on the Owenmore (Manorhamilton)_010 and Owenmore (Manorhamilton)_020 in places. This may be due to the factors such as diffused agriculture and forestry pollution and domestic/urban waste discharging into the watercourses and are contributing factors to the localised declines in water quality.

# 5. CONCLUSION

The proposed development is located high up Dough Mountain which contains small narrow first order steams that are of steep gradient. Given the results of baseline aquatic surveys across all seven watercourses within the study area, it can be assumed there is no fish present within the streams located within the site boundary however there is the presence of two Annex II freshwater species (salmon and white clawed crayfish) located downstream. Therefore, any instream works within these rivers will require appropriate mitigation measures to be implemented to protect the protected aquatic species and the habitats which supports them and to maintain the water quality of these watercourses both with and downstream of the site boundary.

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# Appendix C BIOTIC INDEX SCORING SYSTEM

**Table C 1: Biotic Index Scoring System For The Q-Scheme and Equivalent WFD Water Quality Status Classes**

| Biotic Index | Quality Status | Quality Class |
|---|---|---|
| Q5 or 4-5 | High status (Unpolluted | Class A |
| Q4 | Good status (Unpolluted) | Class B |
| Q3-4, | Moderate status (Slightly Polluted) | Class C |
| Q3, 2-3 | Poor status (Moderately Polluted) | Class D |
| Q2, 1-2, 1 | Bad status (Seriously Polluted) | Class E |

**Table C 2: BMWP Scoring System**

| BMWP score | Category | Interpretation |
|---|---|---|
| 0-10 | Very poor | Heavily polluted |
| 11-40 | Poor | Polluted or impacted |
| 41-70 | Moderate | Moderately impacted |
| 71-100 | Good | Clean but slightly impacted |
| >100 | Very good | Unpolluted, unimpacted |

**Table C 3: SSRS Categories**

| SSRS range | Category |
|---|---|
| <6.5 | Stream at Risk |
| >6.5-7.25 | Indeterminate stream may be at risk |
| >7.25 | Probably not at risk |

# Appendix D ELECTROFISHING SITE CHARACTERISTICS AND GRAPH DATA

**Table D 1: Electrofishing Site Characteristics at Survey Sites Examined of the Proposed Development**

| Site Number | Length Fished (m) | Width Fished (m) | Area Fished ($M^2$) | Time Fished (sec) | Voltage | Pulse (Hz) | Temp (C°) | Conductivity (µ/s) |
|---|---|---|---|---|---|---|---|---|
| 1 | 80 | 2 | 160 | 400 | 300 | 40 | 11.4 | 236.4 |
| 2 | 30 | 4 | 120 | 180 | 500 | 40 | 10.1 | 262 |
| 3 | 25 | 4 | 100 | 234 | 375 | 40 | 11.7 | 63.4 |
| 4 | 40 | 1.5 | 60 | 130 | 450 | 40 | 11.5 | 41 |
| 5 | 25 | 6 | 150 | 271 | 400 | 40 | 12 | 105.9 |
| 6 | 25 | 2.5 | 62.5 | 229 | 400 | 40 | 12.3 | 330 |
| 7 | 40 | 2.5 | 100 | 295 | 300 | 40 | 10 | 284.2 |
| 8 | 10 | 1 | 10 | 94 | 300 | 40 | 10.2 | 362 |
| 9 | 40 | 5 | 200 | 280 | 500 | 40 | 10.2 | 208.9 |
| 10 | 20 | 2 | 40 | 66 | 300 | 40 | 9.7 | 107.4 |
| 11 | 30 | 1.5 | 45 | 92 | 300 | 40 | 10.6 | 149 |
| 12 | 30 | 2 | 60 | 68 | 300 | 40 | 9.6 | 107.4 |
| 13 | 35 | 5 | 175 | 253 | 400 | 35 | 11.2 | 161.5 |
| 14 | 30 | 0.5 | 15 | 68 | 300 | 40 | 11.2 | 135.2 |
| 15 | 40 | 2 | 80 | 213 | 400 | 40 | 11 | 184.2 |
| 16 | 70 | 4 | 280 | 292 | 300 | 40 | 10.7 | 151.2 |
| 17 | 30 | 1.5 | 45 | 126 | 400 | 35 | 11.2 | 161.5 |

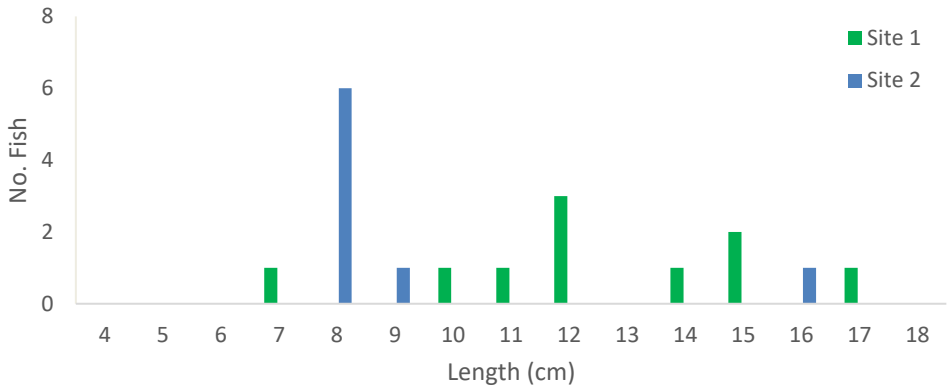


Figure D 1: Length-Frequency Distribution Plot for Brown Trout Recorded in the Ballagh River

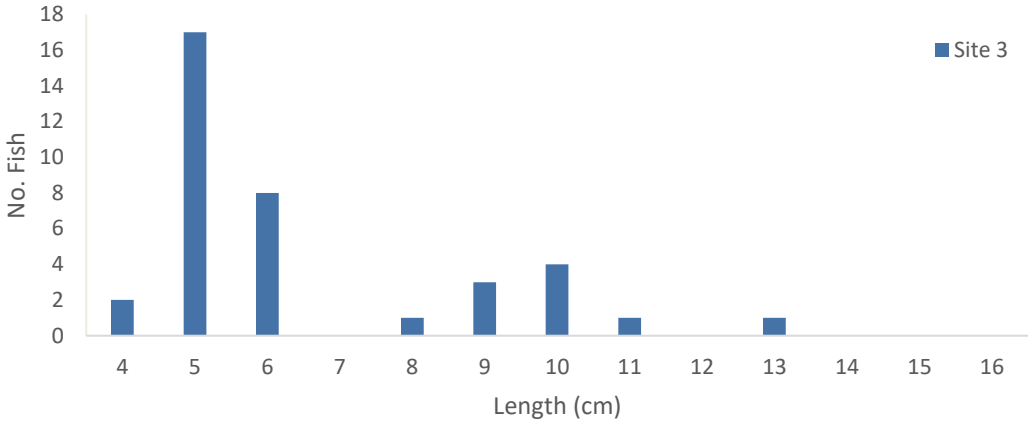


Figure D 2: Length-Frequency Distribution Plot for Salmon Recorded in the Lattone River

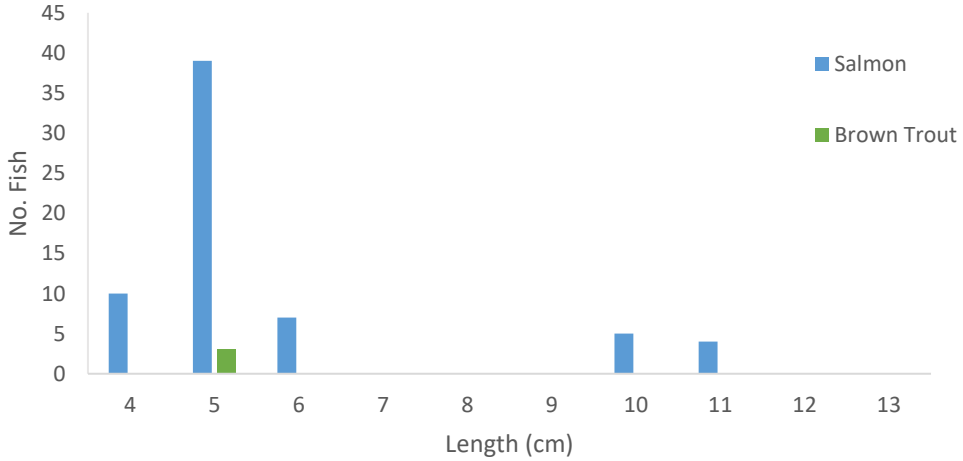


Figure D 3: Length-Frequency Distribution Plot for Salmon and Brown Trout Recorded in the Rosfrair River.

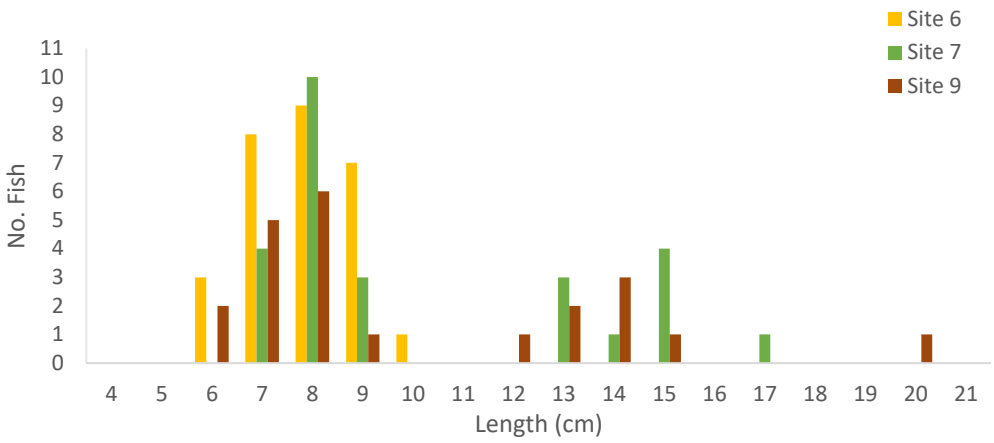


Figure D 4: Length-Frequency Distribution of Brown Trout Recorded in the Brackary_010 River

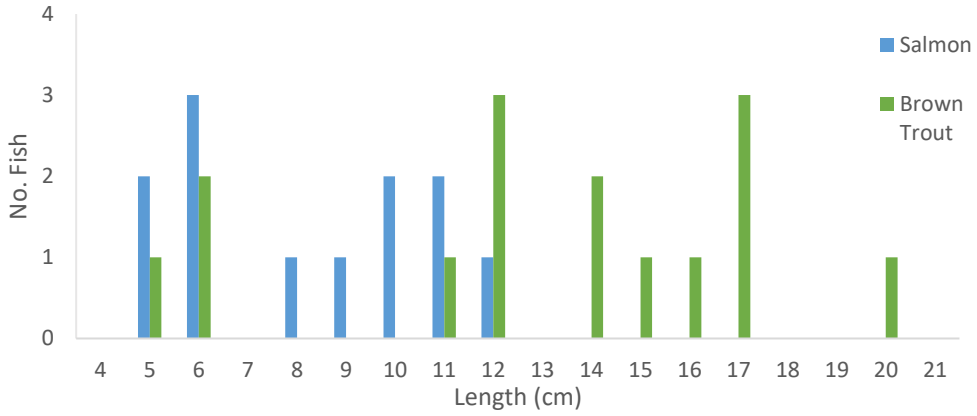


Figure D 5: Length-Frequency Distribution of Salmon and Brown Trout Recorded in Owenmore (Manorhamilton)_010 River

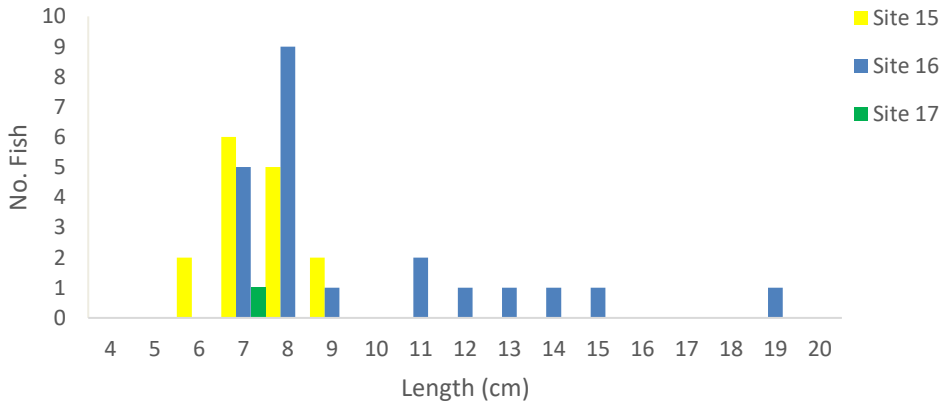


Figure D 6: Length-Frequency Distribution of Brown Trout Recorded within Cornavannoge_010 River

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