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Rooaunalaghta Green Energy Project

Appendix 6-5

Aquatic Ecology Baseline Report

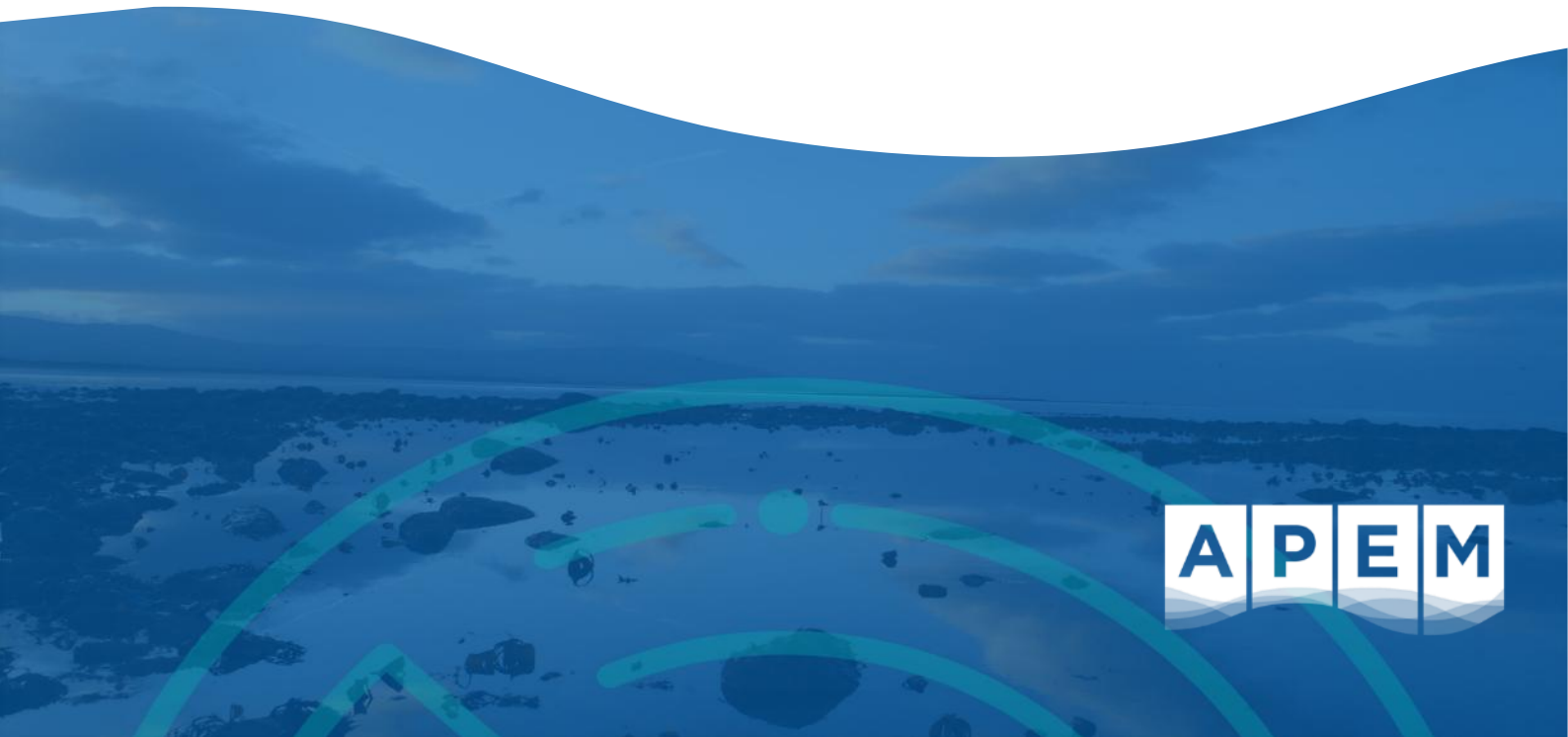
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Chapter 6 Biodiversity

Appendix 6-5: Aquatic Ecology Baseline Report



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1. Introduction

1.1. Background

Rooaunalaghta Green Energy Ltd is planning to construct a wind farm at Rooaunalaghta in County Mayo, with the grid connection route (GCR) extending into County Galway. Requiring detailed baseline ecological surveys in and around the proposed development area. The aim of this work is to provide a baseline understanding of ecological conditions in rivers draining the development site and along the proposed GCR, in order to design appropriate mitigation to avoid negative impact during construction, operation and in due course decommissioning of the wind farm. This document provides a summary of the methods used to survey rivers in the vicinity of the proposed development for water quality and ecological status, and presents the results obtained.

1.2. Site Description

The proposed wind farm site, referred to hereafter as "the Site", is located approximately 4.5 km northwest of Headford, Co. Galway. Rooaunalaghta Wind Farm site is centred at 523798, 750942 ITM, and covers an area of ca. 222 ha (see **EIAR Chapter 2: Description of the Proposed Project**). The Site is located in an agricultural environment which consists mainly of grazing pastures bordered by a mix of stonewalls and hedgerows. The proposed GCR runs from the northeast of the site, extending eastward along the L21044 road, where it connects to the proposed 110 kV substation, centred at 531178, 751054 ITM.

There are no surface waters within the Site, but the Site is located in the catchment of the Black River (EPA code 30B02), part of the Lough Corrib SAC [000297]. There are a number of freshwater species that are Qualifying Interests for the SAC that could occur at the site: these are *Margaritifera margaritifera* (Freshwater Pearl Mussel) [1029], *Austropotamobius pallipes* (White-clawed Crayfish) [1092], *Petromyzon marinus* (Sea Lamprey) [1095], *Lampetra planeri* (Brook Lamprey) [1096], *Salmo salar* (Salmon) [1106] and *Lutra lutra* (Otter) [1355]. Also potentially present is a habitat Qualifying Interest: Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation [3260]. The Black River is situated to the south of the Site, and flows in a south westerly direction; a tributary, the Rooaunalaghta (EPA code 30R03), rises close to the Rooaunalaghta Wind Farm site. A second tributary, the Cloughmoyne (EPA code 30C80), rises to the southwest of the Rooaunalaghta Wind Farm site. The Black River and the two tributaries were therefore the focus of this study.

An aquatic assessment was also undertaken of the location on the Black River where it is crossed by the GCR, along with a single location on the Shancloon Stream (EPA code 30S32) downstream of the proposed substation (refer to **Figure 1**).

1.3. Purpose of this Report

The purpose of this report is to describe the results of the aquatic surveys undertaken to describe the baseline conditions in watercourses draining the proposed wind farm location, and to identify any potential ecological constraints within the aquatic environment.

The report covers the elements surveyed as a series of separate chapters, describing the methods and results for water quality, macroinvertebrates, white-clawed crayfish (WCC), freshwater pearl mussel (FPM), fish and fish habitats. A general discussion then summarises the results and their implications. Most of the surveys were completed in 2023. However, FPM surveys were delayed due to poor weather and therefore deferred to 2024, while the GCR aquatic surveys were carried out in April 2025 following finalisation of the preferred route.

1.4. Evidence of Technical Competence and Experience

Summaries of the qualifications and experience of the personnel involved in the work, and their role in delivering it, are outlined below.

- Fiona Bracken conducted the initial field survey assessment.
- Adon McFarlane and Gráinne Keogh conducted the water quality and macroinvertebrate surveys.
- Adon McFarlane conducted the WCC and fish habitat surveys.
- Adon McFarlane and Jenny Kiely conducted the FPM surveys
- Adon McFarlane and James O'Connor conducted the GCR aquatic surveys
- Adon McFarlane and James O'Connor conducted the aquatic walkover resurvey

This report was prepared by Adon McFarlane and Fiona Bracken and technically reviewed by Michael Dobson.

Dr Adon McFarlane is a freshwater biologist, specialising in protected species. He is an experienced field scientist, with extensive skills in the fields of freshwater habitat assessment; FPM survey; WCC survey, macroinvertebrate survey, fish habitat assessment and electrofishing survey. He has built up skills in the collection of data both in the field and laboratory, analysis of data using statistical software programs such as R, BORIS, RAVEN and Minitab, creation of distribution maps using GIS. Adon has very strong technical skills in both freshwater and marine laboratory and fieldwork instrumentation and equipment usage. Adon has worked on a number of ecological reports, including Appropriate Assessments, Ecological Impact Assessments (EcIA), Preliminary Ecological Appraisal Reports (PEAR) and Invasive Species Reports.

Dr Michael Dobson FLS MCIEEM is a freshwater biologist with over 35 years' experience. He spent 20 years as a research scientist, specialising in ecology and management of rivers and freshwater wetlands throughout Europe and East Africa, along with developing biotic indices for river quality assessment in Central America. He was Director of the Freshwater Biological Association for six years before joining APEM in 2013, working initially in the limnology and water quality team before setting up its dedicated invasive species team in 2019 and moving to APEM Ireland in 2022. Mike has written many peer- reviewed papers in ecology and biogeography, along with two undergraduate textbooks for Oxford University Press (both in their second editions) and seven identification guides to freshwater invertebrates of Britain and Ireland. He has extensive experience of survey design, data analysis and reporting, including publication and verbal reporting for non-technical audiences. He has written and reviewed Habitats Directive assessments in both Ireland and the UK.

Dr James O'Connor is a Senior Ecologist with APEM group Woodrow who has a PhD in aquatic sciences and a primary technical specialism in freshwater ecology. James has prior experience in monitoring wild bird populations with Birdwatch Ireland and is heavily involved in ornithological work as part of his role with Woodrow. Here, he regularly carries out mammal surveys and also performs a supporting role as Ecological Clerk of Works (ECoW). James is first author of several peer-reviewed academic research papers and has helped draft reports to disseminate key research findings to state agencies such as the Irish Environmental Protection Agency (EPA) as well as Irish county councils.

Jenny Kiely is an Ecologist at APEM Ireland. Jenny holds a BSc (Hons) in Ecology and Environmental Biology. Jenny has carried out field and lab work across terrestrial, and freshwater environments; these include chemical and biological water quality analysis including SSRS and Q-value assessments, diatom sampling, fish habitat surveys, FPM bank managing, habitat surveys and mapping, bird surveys, bat surveys and protected species surveys. Jenny also has experience in interpreting data using IBM SPSS and RStudios. Jenny understands the impact assessment processes and Irish and EU wildlife

legislation. Jenny has participated in several Appropriate Assessments, Natura Impact Statements, and Ecological Impact Assessments. Additionally, Jenny has completed Safepass and First Aid training. Jenny conducted several surveys as part of the Rooaunalaghta Green Energy Ltd project including FPM, flow gauging, water quality, macroinvertebrate kick sampling, and fish habitat surveys.

Dr Fiona Bracken (Technical Specialist in Freshwater) holds a BSc (Hons) in Zoology from University College Dublin, Ireland and a Ph.D. in Biological sciences from Durham University, UK with a thesis focusing on European lamprey (*Lampetra* spp) ecology. She subsequently secured funding for her postdoctoral research utilising environmental DNA (eDNA) to identify lamprey spawning sites in freshwater systems. Fiona has 15+ years ecological research experience and has worked for regulatory agencies, NGO's and Universities across Europe and Africa. Fiona has significant expertise surveying aquatic habitats and species with a particular interest in species of conservation concern. She has dedicated much of her recent career to the research and development of non-invasive monitoring methods such as eDNA and has lead projects developing eDNA assays and monitoring techniques for aquatic species worldwide as well as providing technical expertise for many stakeholders in the development and application of these methods. Fiona has a strong track record in the design and implementation of field surveys as well as managing projects and field teams. Fiona has an excellent understanding of wildlife legislation and is experienced in community and broader stakeholder consultation and participation.

Gráinne Keogh was a Senior Ecologist at APEM Ireland until her departure in November 2023 and holds an MSc in Marine Biology and a BSc in Ecology and Environmental Biology. Gráinne has carried out field and lab work across marine, terrestrial, and freshwater environments; these include habitat surveys and mapping, species identification, FPM surveys, electrofishing surveys and chemical and biological water quality analysis including SSRS and Q Value assessments. She has previously worked on the Climate Change Mitigation Research Project in Inland Fisheries Ireland, and she has also spent time at sea on research vessels conducting fisheries surveys with the Marine Institute. Grainne has a robust understanding of the impact assessment processes, and Irish and EU wildlife legislation and has written a number of Appropriate Assessments, Natura Impact Statements and Ecological Impact Assessments to support planning applications.

2. Initial Assessment

A desk-based study and an initial field walkover were undertaken to inform this report, as described below.

2.1. Desk Study

The Site and the surrounding area were viewed remotely using available satellite imagery[1]. The National Parks and Wildlife Service (NPWS) website[2] was accessed for information on sites designated for nature conservation in the surrounding area. Potential connectivity between the Site and the surrounding area, through features such as surface water pathways, was examined using the EPA Maps[3]. The National Biodiversity Data Centre (NBDC)[4] website and NPWS website[5] were accessed for information on rare and/or protected habitats and species known in the surrounding area.

The desk study highlighted that the Site lies in close proximity to the Lough Corrib SAC (c. 150 m) where a number of freshwater species which are Qualifying Interests could occur: these are FPM, WCC, Sea Lamprey, Brook Lamprey, Salmon and Otter.

2.2. Field Walkover

The Site was visited by Fiona Bracken on 15 May 2023. The Site was walked in order to identify any aquatic habitats suitable for surveying. Any incidental sightings of invasive species or signs of these were noted during the field survey. For the purposes of this report invasive species are those that are subject to Regulation 49 of the European Communities (Birds and Natural Habitats) Regulations 2011 - 2021 listed in Part 1 and Part 2 of the Third Schedule within the Directive.

Weather conditions were suitable to carry out all walkover and aquatic surveys. The entire study area was accessed. The walkover highlighted that the watercourses lie within agricultural habitat, with the habitat surrounding WQ01 on the Rooaunalaghta tributary consisting of intensive dairy farming and cattle grazing; the substrate was covered with a layer of macrophyte growth, particularly *Fontinalis* and *Cladophora*. Along the Black River the catchment was also dominated by grazing pasture, with some less intensively managed areas and riparian trees. There was occasional algal growth observed in the channel of both the Black River and Rooaunalaghta tributary. No invasive species were observed while conducting the field walkover.

A supplementary walkover resurvey was undertaken on 26 November 2025 to verify that land use, riparian condition and surface water features had not materially changed since the primary aquatic surveys completed during the 2023 to 2024 survey period. The resurvey confirmed that land use within the study area remained broadly consistent with that described in the baseline assessment, and no obvious deviations from the baseline aquatic conditions were identified.

2.3. Aquatic Ecology Survey Site Selection

The Site boundary is situated in close proximity to tributaries which flow into the Black River and the Black River itself. Survey sites were therefore chosen close to the site boundary or downstream of it.

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[1] https://www.google.com/maps/@53.4622267,-9.0403252,2319m/data=!3m1!1e3 (Website accessed 07 May 2025)

[2] https://www.npws.ie/protected-sites (Website accessed 07 May 2025)

[3] https://gis.epa.ie/EPAMaps/ (Website accessed 07 May 2025)

[4] https://maps.biodiversityireland.ie/Map (Website accessed 07 May 2025)

[5] https://www.npws.ie/maps-and-data (Website accessed 07 May 2025)

The GCR crosses the Black River upstream of the Site and terminates close to one of its upper tributaries. All drainage runs eventually into the Black River which then flows westerly into Lough Corrib. As no water courses lie within the wind farm site boundary and therefore, any impacts on the sites chosen would be indirect. Survey locations were therefore selected on relevant watercourses and features surrounding the site as follows (**Figure 1**: WQ refers to water quality and macroinvertebrate sampling point; WCC to white-clawed crayfish survey reach; FH to fish habitat survey and FPM to freshwater pearl mussel survey reach):

- WQ01 is located on the Rooaunalaghta tributary, ca. 200 m southeast of the Site boundary.
- WQ02 is on the Black River ca. 200 m downstream of the east Site boundary.
- FPM01 is on the Black River in between site WQ02 and WQ03, ca. 400 m downstream from the Rooaunalaghta tributary confluence.
- WQ03, WCC01 and FH01 are on the Black River ca. 1 km downstream of the Rooaunalaghta confluence at Moyne Bridge.
- WQ04 and WCC02 are on the Black River within the vicinity of the Cloughmoyne confluence, ca. 1.2 km southwest of the Site boundary.
- WQ05 and FH02 are on the Black River at the GCR crossing point ca. 500 m upstream of the east Site boundary.
- WQ06 and FH03 are on the Shancloon Stream, ca 750 m downstream of the proposed substation.

Macroinvertebrate surveys and water quality analysis provide an overview of ecological quality, and were assessed at six locations, illustrated in **Plates 1-6**.

Surveys for specific species were targeted to cover suitable locations. Three fish habitat survey (**Plates 7-13**) and two WCC surveys (**Plates 14-15**) were undertaken. One FPM stage 1 survey (**Plate 16-17**) was undertaken.

3. Water Quality

3.1. Methods

3.1.1. Field survey

A total of six sites (WQ01 – WQ06) were selected for water quality analysis. The sites surveyed are shown in **Figure 1**. See **Plates 1 –4** for photographs of sites.

Water samples were collected in pre-sterilised sampling bottles and rinsed with river water before the sample was taken. Water samples were taken from just below the surface, ensuring that the riverbed was not disturbed during sampling. Once sample bottles were filled, they were stored on ice and transported to an INAB accredited laboratory for analysis within the recommended holding time for the selected water quality parameters as shown in **Table 1**.

No water quality samples were taken in the GCR assessment. However; water quality parameters were measured in the field at two sites (WQ05 – WQ06) using an In-Situ® Aqua TROLL 500 Multiparameter Water Quality Probe; these locations correspond with the location of the Black River where it is crossed by the GCR (WQ05) and the location of the Shancloon Stream downstream of the proposed substation and where it is crossed by the GCR (WQ06) (refer to **Figure 1** for the location of the sites surveyed, and **Plates 5 –6** for photographs of sites). Parameters were measured in on 08 April 2025, including temperature (°C), pH, DO (% and mg/L), conductivity (µs/cm) and turbidity (NTU).

3.1.2. Data interpretation

Water quality results are compared against a number of standards, as summarised in **Table 1**. Water Framework Directive (WFD) standards were used where available, with the threshold for Good status applied. Standards are derived from DEHLG (2019).

1. Where water quality parameters were not listed under the WFD but were in the Quality of Salmonid Water Regulations 1988, these were used. Standards are derived from Department of Environment (1988).
2. The nitrate standard was derived from Water Quality in 2023 (EPA, 2024).

WFD standards are normally based on statistics derived from multiple readings (such as mean and 95th percentile). Where multiple readings were available these were calculated. Where only one or two readings were available per site, no such calculations could be carried out, and data were simply compared with the appropriate standard numerical value. Results are compared to these standards for indicative purposes only. This does not constitute an assessment of the overall official status of a water body.

Table 1. Standards used to compare with river water quality readings

Parameter	Threshold value(s) (maximum acceptable value unless otherwise stated)	Source	Notes
Temperature	21.5°C	Quality of Salmonid Water Regulations 1988	98%ile
pH	4.5-9 (acceptable range)	Irish WFD standards	Range for soft waters (hardness < 100 mg/L $CaCO_3$)
Dissolved oxygen – concentration	6 mg/L (minimum value)	Quality of Salmonid Water Regulations 1988	
Dissolved oxygen – saturation	80-120% (acceptable range)	Irish WFD standards	Acceptable range
Nitrite as N	0.05 mg/L	Quality of Salmonid Water Regulations 1988	95%ile
Nitrate as N	1.8 mg/L	EPA (2024) Water Quality in 2023	95%ile Good threshold
Orthophosphate as PO_4-P	0.035 mg/L	Irish WFD standards	WFD mean Good threshold
Arsenic	25 mg/L*	Irish WFD standards	Range for soft waters (hardness < 100 mg/L $CaCO_3$)
Copper	5 mg/L*	Irish WFD standards	Range for soft waters (hardness < 100 mg/L $CaCO_3$)
Zinc	50 mg/L*	Irish WFD standards	Range for soft waters (hardness 10 - 100 mg/L $CaCO_3$)
Ammonia as N	0.065 mg/L	Irish WFD standards	WFD mean Good threshold
Suspended Solids	25 mg/L	Quality of Salmonid Water Regulations 1988	Maximum allowable
BOD	1.5 mg/L	Irish WFD standards	WFD mean Good threshold

*MAC – Maximum Allowable Concentration. Where there are multiple readings, actual maximum is used here rather than an annual mean.

3.2. Results

Results are provided in **Table 2** for WQ01 – WQ04. Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) were below the limit of detection (LoD) at all four sites, demonstrating no evidence for organic pollution at the time of sampling. Suspended solids concentrations were also low at all sites, indicating a low level of particulate material.

Concentrations of metals were low at all sites, with no evidence for metal contamination or pollution sources. Dissolved iron concentrations were higher at sites WQ02-WQ04 compared withWQ01.Due to the absence of other indicators of contamination, these concentrations are considered likely to reflect natural background conditions associated with the local geology rather than an anthropogenic pollution source.

Nutrient concentrations were low at all sites on the Black Rive. Orthophosphate readings being within the 0.025 mg/l threshold for achieving High status under the WFD, this indicated that phosphorus enrichment was not evident at the time of sampling. However, the nitrate level at Site WQ01, located

on the Rooaunalaghta tributary, were elevated and significantly above the Guideline value to support Good ecological status of 1.8 mg/L N (EPA, 2024). The elevated nitrate concentration at WQ01 indicates a localised source of nutrient enrichment within the Rooaunalaghta tributary catchment, rather than a more widespread nutrient issue within the Black River based on the results from the other monitoring locations. However, the source cannot be determined from a single sampling event.

Total Petroleum Hydrocarbon (TPH) is an indicator of contaminants such as oil-based fuels; however, in this case all TPH readings were defined as 'Unknown Pattern' or below LoD. The unknown patterns did not correspond to a recognised petroleum hydrocarbon fingerprint, such as diesel or kerosene. In the absence of an identifiable petroleum hydrocarbon pattern, these hydrocarbons are considered likely to be naturally derived organic compounds associated with the peat-dominated catchment. Water quality readings from the GCR assessment (WQ05 and WQ06) are shown in **Table 3**. They indicate moderate specific conductivity at both sites (600–673 µS/cm), typical of rivers draining limestone catchments. Dissolved oxygen saturation was high at site WQ05 (93%) but was below the 80% limit for the acceptable range of Irish WFD standards at site WQ06. Turbidity was also slightly elevated at Site WQ06, which may be attributed to the slow-flowing nature of the watercourse and the dense growth of fool's watercress (*Apium nodiflorum*) within the channel.

Table 2. Laboratory analysis of physico-chemical water quality parameters
Readings below the laboratory LoD are highlighted in green.

Parameter	Unit of Measurement	Site WQ01	Site WQ02	Site WQ03	Site WQ04
Pollution indicators					
BOD	mg/l	<1	<1	<1	<1
COD	mg/l	<10	<10	<10	<10
Suspended Solids	mg/l	3	<2	<2	4
Ammonia as N	mg/l	0.04	0.193	0.017	0.017
Metals					
Iron, total	ug/l	<10	180	140	137
Iron, dissolved	µg/l	<10	81	61	21
Copper, dissolved	µg/l	<1	<1	<1	<1
Arsenic, dissolved	µg/l	<0.5	<0.5	<0.5	<0.5
Zinc, dissolved	µg/l	<5	<5	<5	<5
Hydrocarbons					
TPH	µg/l	26 **	<20	23 **	<20
Nutrients					
Nitrate as N	mg/l	8.24	1.83	1.62	1.61
Nitrite as N	mg/l	<0.017	<0.017	<0.017	<0.017
Orthophosphate (filtered) as P (Low Level)	mg/l	<0.01	<0.01	<0.01	<0.01
Total Phosphorus as P	mg/l	<0.05	<0.05	<0.05	<0.05
Others					
Dissolved Organic Carbon (DOC)	mg/l	1.4	7.17	6.09	5.74
Alkalinity Total by Autotitration	mg/l $CaCO_3$	364	363	349	346

** Unknown Pattern indicates the presence of naturally forming hydrocarbons in the sample. They cannot be attributed to a hydrocarbon with a known 'fingerprint' such as diesel or Kerosene.

Table 3. Summary of water quality from readings taken in situ

Parameter	Unit of Measurement	Site WQ05	Site WQ06
Date of reading (2025)		08/04	08/04
Time of reading		10:30	14:00
Temperature	°C	11.6	10.98
Dissolved Oxygen	% Saturation	93.05	69.96
Dissolved Oxygen	mg/l	10.23	7.68
Conductivity (Specific)	µS/cm	600.07	673.25
pH		7.86	7.14
Turbidity	NTU	1.54	14.63

4. Macroinvertebrate Survey

4.1. Methods

Kick-sampling was carried out at sites WQ01 – WQ04 on 23 May 2023 and at sites WQ05 – WQ06 on 08 April 2025, in accordance with the standard methodology used by the EPA (Toner *et al*., 2005). Sites surveyed are shown in **Figure 1**. See **Plates 1 – 6** for photographs of sites.

A two-minute macroinvertebrate kick sample was conducted at each site using a standard 1 mm mesh size long-handled net, principally from the faster flowing riffle habitats, but glides, margins and pools were included according to their proportional presence. A further one-minute hand search was carried out to locate macroinvertebrates that attached themselves to solid structures such as the underside of cobbles. Each sample was preserved on site with >90% Isopropanol solution and returned to the laboratory for further analysis. Specimens were identified, under a binocular microscope, to family level in the laboratory using the standard range of identification keys published by the Freshwater Biological Association, AIDGAP and others, and their relative abundance was recorded.

An EPA Q value classification was assigned to each site. The Q values were assigned based on the presence and relative abundance of sensitive groups and the consideration of additional qualifying criteria, as described by Toner *et al.* (2005) and outlined in more detail in **Appendix A**.

Q values were calculated for indicative purposes only. This does not constitute an assessment of the overall official status of a water body.

4.2. Results

Results are shown in **Table 4** and a full taxa list is provided in **Appendix A**, **Table 7**. The Q value scores indicate that sites WQ01 and WQ02 are indicative of Poor WFD ecological status with very few Group A or B taxa and some Group D taxa present. Indicating a macroinvertebrate community dominated by more pollution tolerant taxa and a low population of pollution sensitive taxa. In contrast, sites WQ03 and WQ04 would meet the WFD's threshold of Good ecological status, with a high proportion of the more sensitive Group A and B taxa and an absence of Group D taxa. Indicating good water quality, with limited evidence of pollution-related impacts.

The substrate at the majority of surveyed sites on the Black River (WQ02, WQ03, and WQ04) was covered by a dense layer of aquatic macrophytes, particularly *Fontinalis* spp. and *Cladophora* spp. These species were notably absent at site WQ05, likely due to the high degree of channel shading observed at that location. Site WQ01 exhibited a comparatively higher percentage of overlaying fine silt on the substrate relative to the other sites. Water velocity at site WQ02 was relatively high, with flow rates exceeding 50 cm/s, distinguishing it from the lower flow rate conditions recorded at the other sites.

Regarding the aquatic surveys taken along the GCR, site WQ05 supported a diverse and sensitive macroinvertebrate community, with four Group A taxa and no Group D taxa recorded, meeting the WFD's threshold of Good ecological status. In contrast, site WQ06 had few sensitive taxa, with only one Group A taxon present, alongside an increase in tolerant species — six Group C taxa and one Group D taxon. The presence of Group D fauna and the near absence of Group A taxa at the site WQ06 suggest a slight pollution impact and it has a Moderate WFD classification.

These results indicate that water quality matches the result recorded by the EPA in 2023 at Site WQ03 and in 2024 2.5 km upstream of Site WQ05, where Q value Classifications of Q4 were recorded[6].

Table 4. Q-values assigned, and total number of taxa observed at each site

Parameter		Wind Farm Site				GCR	
		Site WQ01	Site WQ02	Site WQ03	Site WQ04	Site WQ05	Site WQ06
Q-value Classification		Q3	Q3	Q4	Q4	Q4	Q3-4
Number of taxa	Group A (sensitive)	-	-*	3	2*	4	1
	Group B (less sensitive)	1	-*	-	4	1*	1
	Group C (tolerant)	7	6*	8	8*	4	6
	Group D (very tolerant)	3*	1	-	-	-	1*
	Group E (most tolerant)	-	-	-	-	-*	-
	Total	12	10	11	18	13	11

*Other taxa were present and counted in the total number of taxa but either had only one individual and were therefore discounted from Q value classification, or were not a taxon considered in the classification system

[6] EPA Maps (Website accessed 07 May 2025)

5. Fish and Fish Habitat Surveys

5.1. Methods

5.1.1. Fish species present

Presence of fish species within watercourses in the wider study area was determined from pre-existing data and designations. Existing datasets, which have the advantage of being collected at multiple times, show what has been recorded. Habitat walkover surveys were undertaken to identify suitable habitat for the key species and their relevant life stages. The baseline fisheries data was obtained from the WFD fish ecological status 2008 to recent river layer[7], and supplemented by the IFI publication *Fish in Rivers Factsheet 2025 No. 02: Lough Corrib Catchment* (IFI, 2025), which presents the results of fish surveys undertaken throughout the Black River sub catchment.

5.1.2. Fish habitat surveys

Fish habitat surveys were conducted at three sites (FH01, FH02 and FH03). A walkover habitat survey was undertaken along a 350 m section of the Black River at site FH01. The extensive length surveyed was considered appropriate to understand the range and variability of fish habitats present in this section of the river. The survey was conducted on 23 May 2023. Weather conditions were clear and dry, with a slight breeze, approximately 40% cloud cover, and an air temperature of 16°C. The river flow at this time was considered close to baseflow and therefore instream fish habitats were clearly visible.

Walkover habitat surveys at site FH02 and FH03 were conducted on 08 April 2025, the length surveyed at each site is considered appropriate to understand the range of fish habitats in this part of the river, with survey reaches of 325 m and 145 m undertaken at FH02 and FH03 respectively. Weather conditions were clear and dry, with a slight breeze, approximately 15% cloud cover, and an air temperature of 13°C. The river flow at this time was considered close to baseflow and therefore instream fish habitats were clearly visible.

Surveys considered habitats suitable for salmonids and lamprey; an outline of the requirements for each survey is detailed in **Appendix B**. The location of fish habitat surveys is shown in **Figure 1**.

The methodology applied to the habitat survey follows Hendry & Cragg-Hine (1997). This field mapping technique involves hand drawing onto a high-resolution map (1 km tiles) at a scale of 1:10,000 using a field tablet. The riverbank was walked, noting habitat features along the river channel and drawing these directly onto the map, with the boundaries of the different habitat classifications being drawn to represent their actual position within the river, and with annotations as required. Prominent features, such as log jams, macrophyte beds, weirs and bridges, were noted and their locations confirmed using a handheld GPS unit. This allows exact representation of the areas of individual habitat types encountered. In this manner, a mosaic of the different habitat types can be drawn along the whole section of the river. The drawings of the habitat types along the section of the river were subsequently digitised using ArcMap GIS.

[7] Water Framework Directive Rivers Fish Ecological Status 2008 to recent | IFI Open Data Portal

5.2. Results

5.2.1. Fish species present

Inland fisheries Ireland (IFI) conducted surveys of this part of the Black River in 2022, ca. 11 km upstream of the Site**,** at Kilshanvy Bridge. The Black River site fish status was given as Good, and the species recorded from this survey are listed in **Table 5**.

IFI surveys undertaken in 2025 at stations within the Black River catchment, including Kilshanvy Bridge, recorded brown trout (*Salmo trutta*) throughout, with Atlantic salmon (*Salmo salar*), lamprey spp., minnow (*Phoxinus phoxinus*) and three-spined stickleback (*Gasterosteus aculeatus*) also recorded at selected locations. Ecological status classifications at surveyed sites ranged from High to Poor, reflecting local variations in habitat and water quality conditions within the catchment.

Although lamprey was not recorded within the Black River during the 2020 surveys, they were recorded at low abundance during 2025 at upstream sites within the catchment (e.g. Kilshanvy Bridge). These records are considered most likely to represent juvenile brook lamprey (Lampetra planeri), although identification was not resolved to species level. Contrary to the 2020 survey results, lamprey were not recorded at the River Cullagh monitoring station in 2025.

Notwithstanding this, as the Site drains to Lough Corrib SAC (000297), additional lamprey species included as Qualifying Interests of the SAC must be assumed to be present within suitable habitat in the catchment and considered in the assessment. This includes sea lamprey (Petromyzon marinus) [1095]. For the full list of species recorded during the IFI surveys, refer to **Table 3**.

Table 5. Fish species recorded by IFI on the Black River and its tributaries

Fish species	2022 Survey (Black River)	2020 Survey (River Cullagh)	2025 Survey (Black River)	2025 Survey (River Cullagh)
Brown Trout	✓	✓	✓	✓
Salmon	✓		✓	
Lamprey sp.		✓	✓	
Minnow			✓	✓
Three-spined stickleback	✓	✓	✓	✓

5.3. Fish Habitat Survey

Site FH01

The section surveyed (

Figure 2, **Plate 7 – Plate 10**) was ca. 350 m long and ca. 5 m wide. It was characterised mainly by glide and run with occasional riffle and mixed juvenile habitat. The substrate was composed of cobble and boulder covered with a layer of macrophyte growth, particularly *Fontinalis* and *Cladophora* (**Plate 10**), and occasional algal growth, with areas of gravels present throughout the channel. Salmonid spawning habitat was observed at the downstream stretch of the survey, but this was considered mostly suboptimal owing to siltation. Mixed juvenile habitat was present throughout, and salmonids were observed feeding during the survey. Undercut banks and tunnelled vegetation were also present in areas along the water course, tunnel vegetation mainly consisted of a canopy of broadleaved trees and hawthorn.

Overall, the Black River provides a good mix of aquatic habitats, favoured by a range of fish and invertebrate species, with potential salmonid and lamprey spawning habitat being observed on the reach surveyed. Although the surveyed area included substrate types and flow conditions potentially suitable for lamprey, no definitive lamprey ammocoete (larval) habitat was observed during the walkover. Fine, silt-laden or soft sediment areas suitable for ammocoete burrowing were absent or limited.

Site FH02

The section surveyed (**Figure 3**, **Plate 11**) was ca. 325 m long and ca. 5 m wide with a moderate flow. This river reach exhibited a good mix of fish habitat types, including riffle, mixed juvenile, run, and glide habitats, with glide being the most dominant. The substrate was mainly composed of gravel, cobble, and boulder, with some bryophyte and filamentous algae growth noted. Abundant shading was provided by steep limestone banks and tunnel vegetation, mainly consisted of a canopy of hawthorn (*Crataegus monogyna*) and *Salix* sp. Salmonids were observed actively feeding within glide habitats during the survey. Due to the extensive shading, macrophyte growth was minimal, although *Nymphoides* sp. and patches of *Ranunculus* sp. were present upstream of the bridge. A kick sample at WQ05 recovered three salmonid fry measuring ca. 5–6 cm in length, suggesting the presence of potential salmonid nursery habitat within the recorded mixed juvenile areas.

Overall, the Black River at FH02 provides a good mix of aquatic habitats, favoured by a range of fish and invertebrate species, with potential salmonid nursery habitat being observed on the reach surveyed. Although the surveyed area included substrate types and flow conditions potentially suitable for lamprey, no definitive lamprey ammocoete habitat was observed during the walkover. Fine, silt-laden or soft sediment areas suitable for ammocoete burrowing were absent or limited.

Site FH03

The section surveyed (**Figure 4**, **Plate 12-13**) was ca. 145 m in length and ca. 1.5 m in width, with a low flow. This stream reach exhibited a poor diversity of fish habitats, with only riffle, glide and standing water habitats recorded. The substrate was primarily composed of gravel, with cobble and silt also present. Macrophyte growth was evident, dominated by fool's watercress, particularly in upstream areas where standing water had developed due to dense macrophyte growth within the channel.

Overall, the Shancloon Stream at FH03 provides a limited range of aquatic habitats and is considered unsuitable for supporting salmonid and lamprey species.

6. White-clawed Crayfish Survey

6.1. Methods

Prior to carrying out field surveys of WCC (*Austropotamobius pallipes*), a review for previous records within the catchment was carried out (refer to **Section 2.1**). Licences for WCC surveys were secured from NPWS prior to commencement of the survey (Licence No. C112/2023).

Two WCC surveys were carried out in accordance with the standard methodology used by Peay (2003), Reynolds *et al.* (2010) and Gammell *et al.* (2021). Surveys were conducted on 15 August 2023. Weather conditions were overcast and dry, with a slight breeze, 60% cloud cover, and an air temperature of 17°C. The river flow at this time was considered close to base flow. On arrival, channel conditions were assessed, and a 100 m stretch of suitable river was chosen for survey within the 500 m survey stretch (**Plate 14-15**). Hand-searching of 50 potential refuges within 5 patches was carried out in this chosen 100 m stretch. Potential refuges were defined as any suitable substrate (e.g. gravel, cobble, woody debris) that would be resistant to high flows and capable of providing cover for WCC. Refuges were searched facing upstream to minimise the disturbance of the soft substrate. Where possible, refuges were replaced after searching. Habitat features for each patch were recorded.

6.2. Results

WCC have been recorded throughout the Lough Corrib catchment (Department of Culture, Heritage and the Gaeltacht, 2019) but have not been recorded on the Black River. Crayfish plague, caused by the water mould *Aphanomyces astaci,* is present in the catchment, with the most recent records from the National Crayfish Plague Surveillance Programme during 2020/2021 (NPWS, 2022) and updates from Fish Health Unit at the Marine Institute[8].

No crayfish were found during surveys at WCC01 and WCC02. However extensive areas of suitable habitat were found throughout the sites in the form of large cobble and boulders within the glide/run sections as well as along river margins with overhanging vegetation (**Plate 14-15**).

It is possible, therefore, that crayfish plague is now found as far as the Black River at Rooaunalaghta, accounting for the absence of the species in the reach surveyed.

[8] Update on Crayfish Plague in Ireland | Fish Health Unit (Website accessed 07 May 2025)

7. Freshwater Pearl Mussel Surveys

7.1. Methods

Prior to survey work commencing, licence C64/2024 was granted by NPWS, for qualified ecologists to survey for FPM in the specified locations. One location was chosen on the Black River for a FPM stage 1 survey (**Figure 1**).

Stage 1 surveys were carried out on 24 April 2024. Survey methods followed *Margaritifera margaritifera* Stage 1 and Stage 2 Survey Guidelines (NPWS, 2004). In brief, initial survey sections (1 km) within the footprint of the proposed wind farm development were selected for Stage 1 survey (**Figure 1**). Starting at the most downstream end of the section, a (minimum) 300 m section of riverbed was systematically searched for living mussels or mussel shells, giving particular attention to the immediate vicinity of boulders and under overhanging trees in suitable marginal areas. In areas where water was less than 75 cm deep, surveyors waded in an upstream direction using a bathyscope to search for adult FPM. A 'bank manager' always remained on the bank, monitoring the safety of surveyors and recording data. In areas deeper than 75 cm, Stage 1 surveys were completed using snorkelling survey methods, usually carried out in a downstream direction. In smaller, slower flowing watercourses, where sediment would be disturbed by snorkelling, snorkel surveys were carried out in an upstream direction. All information on mussel numbers (including absence of mussels) and habitat was recorded using a detailed data sheet.

Weather conditions were overcast and dry, with a slight breeze, 60% cloud cover, and an air temperature of 12°C. The river flow at this time was considered normal to low and therefore substrate was clearly visible during surveys.

7.2. Results

One stage 1 FPM survey was carried out along a ca. 300 m section of the Black River at site FPM01 (**Figure 1**). No live mussels were encountered, and there was no evidence of dead FPM shells. A stage 2 FPM survey was therefore not required as no FPM was recorded during the Stage 1 surveys.

Site FPM01

The section surveyed (**Figure 1**, **Plate 16–17**) was ca. 300 m long, ca. 8 m wide and fast flowing ca. 50 cm/s. It was characterised mainly by glide and run with occasional riffle and pool habitat. The substrate was composed of cobble and boulder covered with a layer of filamentous algae and bryophyte growth, with areas of gravels present throughout the channel. Salmonid fry and parr were observed during the survey. Undercut banks and tunnelled vegetation were also present in areas along the water course, tunnel vegetation mainly consisted of a canopy of broadleaved trees and hawthorn.

Overall, the Black River provides a good mix of aquatic habitats, with suitable habitat for FPM being present.

8. Discussion

8.1. Ecological quality of the Black River

Water chemistry results for the Black River indicate good quality with generally low nutrient concentrations. This is supported by macroinvertebrate survey results, with the majority sites on the Black River achieving Q4 status (WQ03, WQ04 and WQ05), indicating good ecological quality and the absence of significant pollution. The Q3 result recorded at the upstream site on the Black River (WQ02) is likely influenced by physical habitat constraints—specifically, high flow velocities exceeding 50 cm/s—rather than degraded water quality. However, the extensive growth of macrophytes (e.g. *Fontinalis* and *Cladophora*) and occasional filamentous algae suggests that localised conditions, such as high light availability, stable flow regimes, or episodic nutrient inputs, may be supporting elevated primary productivity. In contrast, elevated nitrate concentrations were recorded at WQ01 on the Rooaunalaghta tributary, which may reflect nutrient inputs associated with the intensive agricultural activity, including dairy farming observed within the catchment. The Q-value of Q3 recorded on this tributary reflects slight to moderate ecological impact, indicating existing pressure on water quality.

While some *Ranunculus* growth was identified at site FH02, there was no evidence for extensive growth of water crowfoot (*Ranunculus fluitans*) or other macrophyte species that would indicate the presence of the Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation [3260] habitat that is a qualifying feature of the SAC.

The distance covered during the fish habitat surveys was extensive and considered appropriate to understand the range of fish habitats in these parts of the river. The Black River provides good fish habitat throughout, although spawning and nursery habitat is considered mostly suboptimal owing to siltation and filamentous algae growth. Salmonid and mixed juvenile habitat was prevalent. Adult salmonid passageway (fast moving glides and runs) and resting and holding areas (deep runs and glides) were also found along the reach. Salmonids were observed feeding in glide habitat and three salmonid fry were observed in samples taken at site FH02. Likewise, lamprey spp. have been recorded within the wider Black River catchment and, together with those species listed as Qualifying Interests of Lough Corrib SAC, can be assumed to be present at or downstream of the proposed works and need to be considered in the design of any mitigation. The Shancloon Stream provides a limited range of aquatic habitats and is considered unsuitable for supporting salmonid and lamprey species.

The absence of any records of WCC, or of evidence such as partial remains from predation, despite an intensive search in two reaches with suitable habitat, suggests that the species is likely to be absent from the Black River . While WCC were not recorded during the surveys, there is good habitat present, and the sites surveyed have the potential to support future reintroduction ov WCC, subject to confirmation that crayfish plague is not present in the catchment. WCC require a varied habitat to support all stages of its life cycle. This includes riparian shrubs and trees, and the extension of their roots into the water, gravel or macrophytes to provide shelter for juveniles, and larger cobbles and boulders to act as refuges for adults, or suitable undercut banks in which they can burrow. Typically, 0.75 – 1.25 m depth with hard, mineral rich water and good water quality (Demers *et al.* 2003, Gallagher *et al.* 2006, Smith *et al.* 1996). All are present in the river.

Although suitable habitat was present, applying the results of the stage 1 survey to the NPWS method, FPM can be deemed to be absent from the section surveyed of the Black River (NPWS, 2004). A survey of this type, based on a single site visit, always has the risk of missing presence of the species elsewhere in the area to be affected, However the complete absence of records when following a survey method designed to enable a comprehensive assessment in a single site visit, would suggest genuine absence. Notwithstanding the probable absence of FPM its listing as an interest feature for

the Lough Corrib SAC [000297] SAC, of which the Black River is part, means that consideration of this species is required going forward, particularly with respect to habitat restoration following the works.

8.2. Limitations

During the collection of water samples carried out for sites WQ01 – WQ04 on 23 May 2023, in situ measurements such as temperature (°C), pH, DO (% and mg/L), conductivity (µs/cm) and turbidity (NTU) could not be taken *in situ*, due to a fault with the multimeter probe. Water quality assessment at these locations therefore relied on laboratory analysis of collected water samples. While this represents a limitation of the dataset, the laboratory analysis included the principal physico-chemical parameters relevant to the assessment of baseline water quality and is therefore considered adequate to characterise baseline conditions.

Water quality can be variable, and will change under different flow and runoff conditions, so a single sample or set of readings can only give an indication of conditions at that point of time. There may also be seasonal differences as a consequence of biological changes or land use activities. It is advisable, therefore, to take repeat water quality readings before drawing definitive conclusions about water quality.

The macroinvertebrate survey partially overcomes this issue by recording a biological feature that will react to the full range of physicochemical conditions experienced in the river over a period of several months. The macroinvertebrate dataset is from a single year and while it will integrate environmental conditions over the several months coved by the life cycles of the taxa recorded, it cannot give an indication of interannual variation. Where possible, therefore, it is always advisable to take repeat samples in multiple years.

The use of historical fish survey data and the SAC designation, along with a detailed walkover habitat survey, reduces the limitations in determining species present.

A WCC survey of this type, based on a single site visit, always has the risk of missing presence of the species elsewhere in the area to be affected, However the complete absence of records would suggest either genuine absence or very low and localised populations. Notwithstanding the probable absence of WCC its listing as an interest feature for the SAC means that consideration of this species is required going forward, particularly with respect to habitat restoration following the works.

The area chosen for the FPM stage 1 survey was accessible, though there were some obstacles which restricted coverage. This included fallen trees/woody debris, and/or vegetative cover and strong flows. However, a minimum of 300 m survey reach was achievable.

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Plates



Plate 1. Water quality and macroinvertebrate sampling Site WQ01



Plate 2. Water quality and macroinvertebrate sampling Site WQ02



Plate 3. Water quality and macroinvertebrate sampling Site WQ03



Plate 4. Water quality and macroinvertebrate sampling Site WQ04



Plate 5. Water quality (in situ) and macroinvertebrate sampling Site WQ05



Plate 6. Water quality (in situ) and macroinvertebrate sampling Site WQ06



Plate 7. Fish Habitat Survey at Site FH01 showing tunnel vegetation and glide habitat observed during survey



Plate 8. Fish Habitat Survey at Site FH01 showing run habitat observed during survey



Plate 9. Fish Habitat Survey at Site FH01 showing potential silted spawning habitat observed during survey



Plate 10. Fish Habitat Survey at Site FH01 showing growth of Cladophora and Fontinalis observed during survey



Plate 11. Fish Habitat Survey at Site FH02 showing glide habitat with abundant shading observed during survey



Plate 12. Fish Habitat Survey at Site FH03 showing shallow glide habitat observed during survey



Plate 13. Fish Habitat Survey at Site FH03 showing dense macrophyte growth in standing water habitat observed during survey



Plate 14. White-Clawed crayfish survey Site WCC01



Plate 15. White-Clawed crayfish survey Site WCC02



Plate 16. FPM stage 1 survey Site FPM01



Plate 17. FPM stage 1 survey Site FPM01

Figures

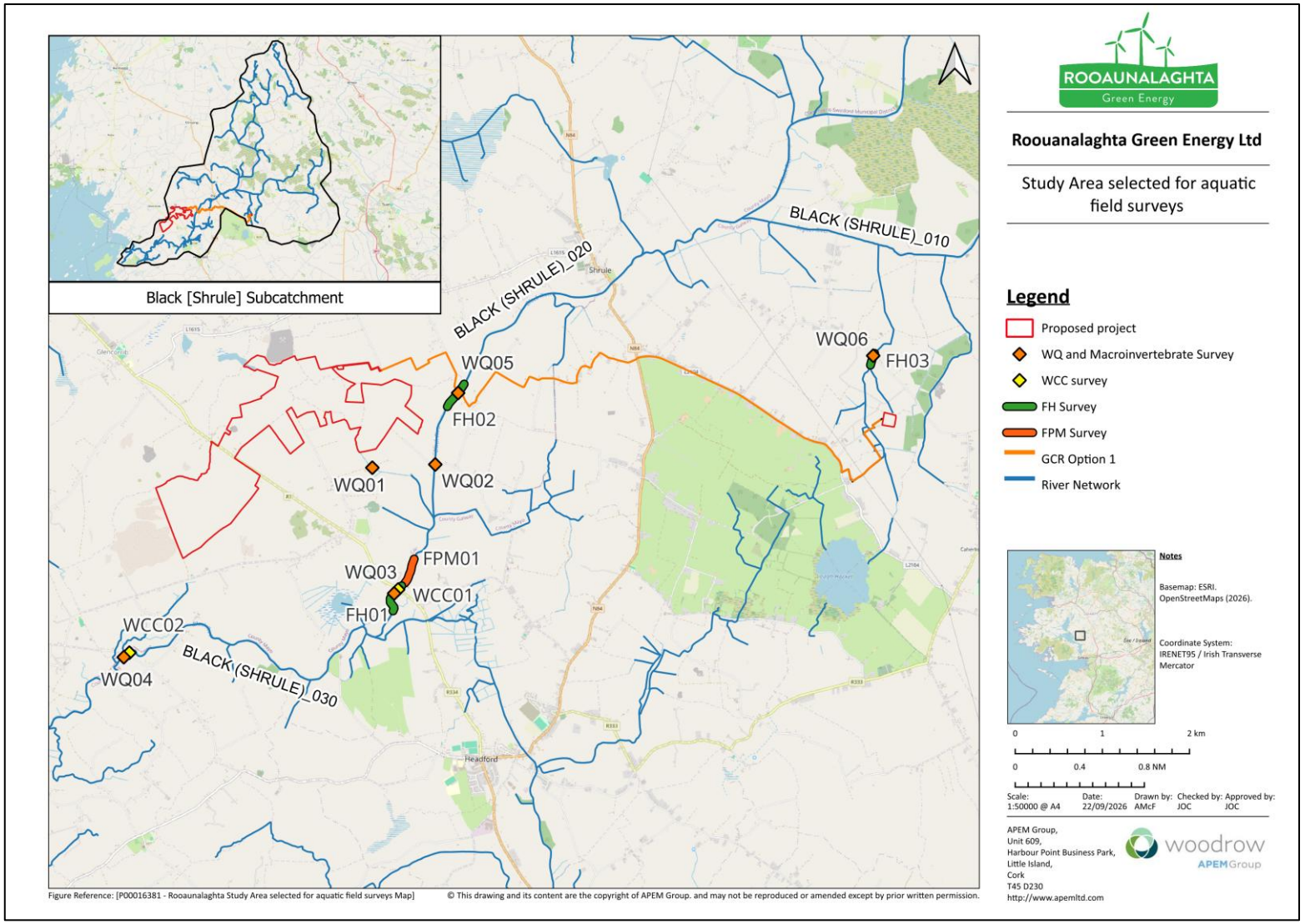


Figure 1. Site location and aquatic survey sampling sites

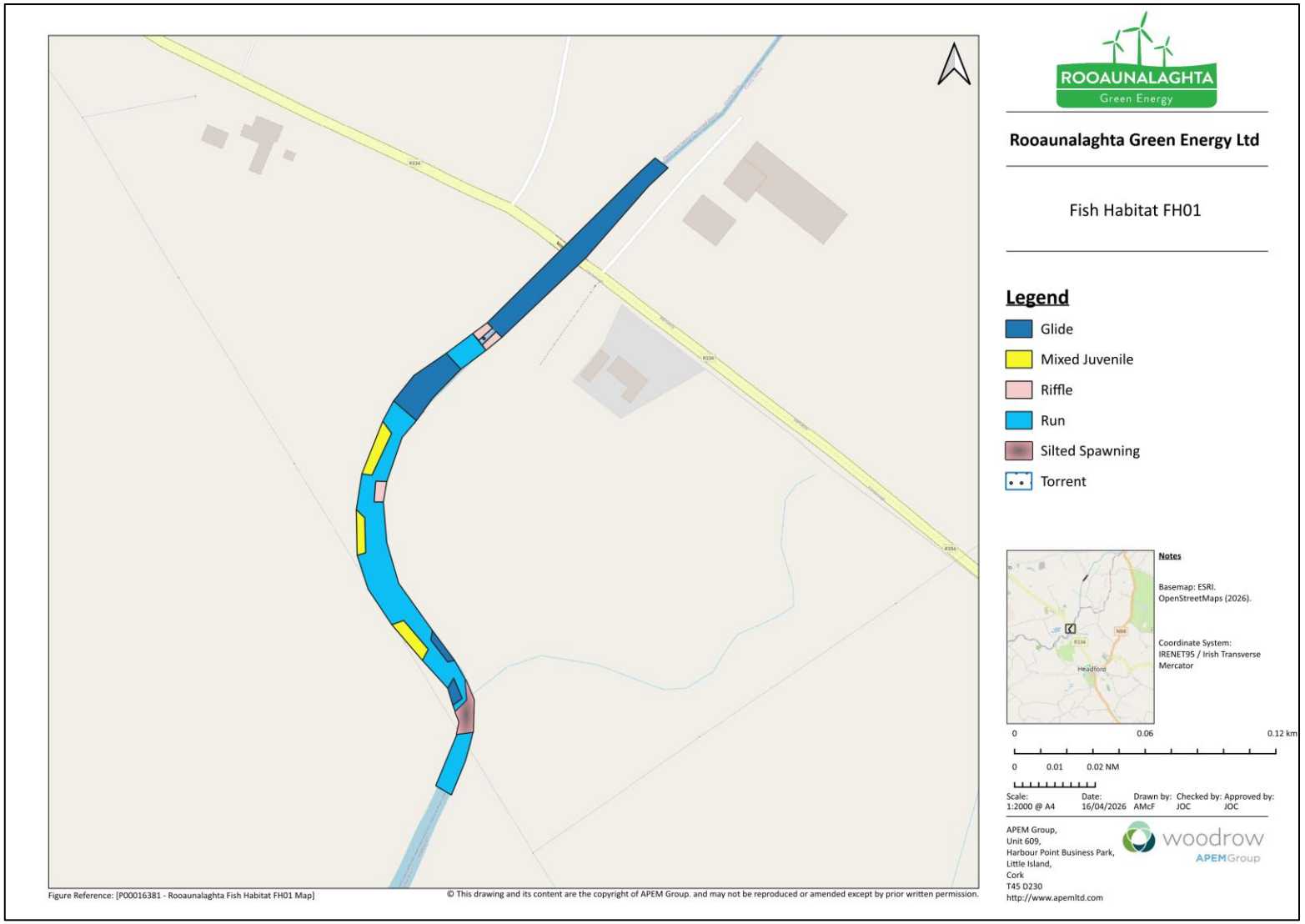


Figure 2. Fish habitat survey Site FH01

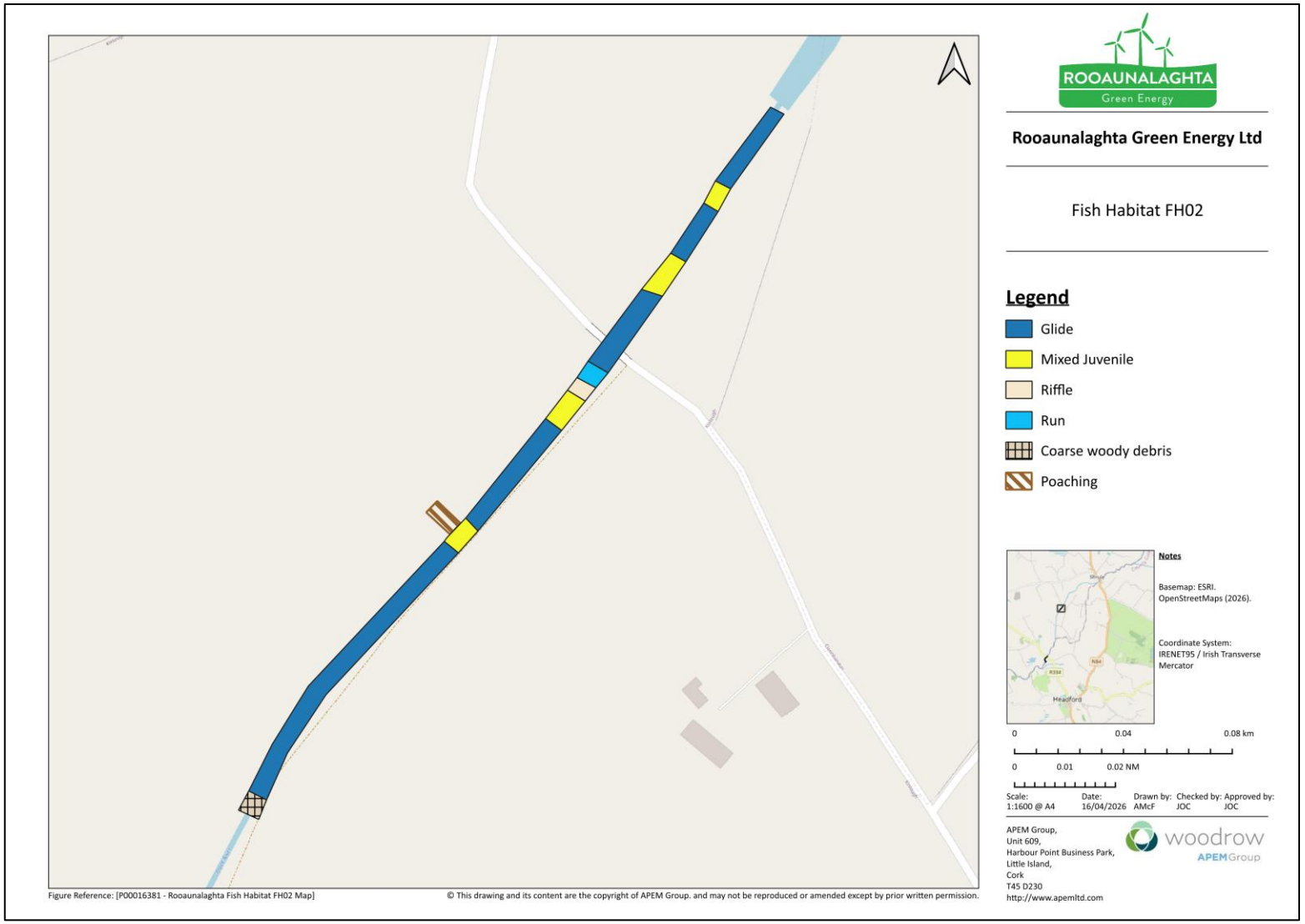


Figure 3. Fish habitat survey Site FH02

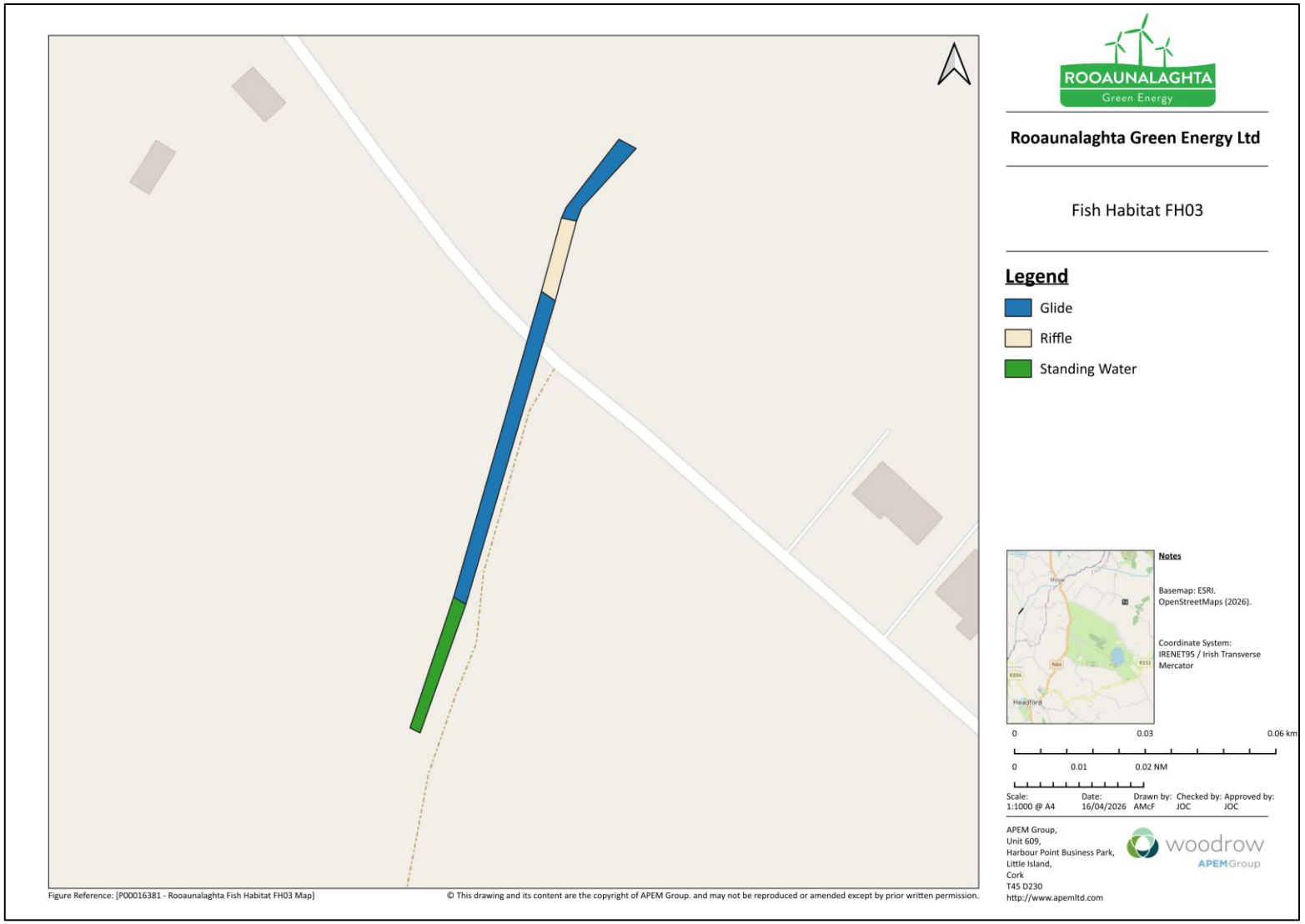


Figure 4. Fish habitat survey Site FH03

Appendix A. Description of Q Value Assessment and Taxa List

Q Value Assessment

The EPA Q-value classification is assigned based on the assessment of the macroinvertebrate sample, which involves recording the taxa present at a suitable and attainable taxonomic resolution (under field conditions) and their categorical relative abundance determined using approximate counts (as described in Feeley *et al*. 2020)). From this, the number of taxa present and categorical relative abundance of sensitive (Group A), less sensitive (Group B), tolerant (Group C), very tolerant (Group D) and most tolerant (Group E) taxa to organic pollution is examined. Additional Qualifying Criteria are also considered, consisting of recording the abundance of *Cladophora* sp, Macrophytes, and slime growths / sewage fungus, as well as the Dissolved Oxygen Saturation % and the level of substratum siltation. Then, based on the combination of number and relative abundance of the sensitive or tolerant groups present, a Q-value is assigned. Details on the assignment of the scores can be found in Toner *et al*. (2005).

In Ireland, macroinvertebrates are the main Biological Quality Element (BQE) determining the ecological status in rivers (required by the WFD) and are based on the Q-value. The WFD requires BQE scores to be expressed as an Ecological Quality Ratio (EQR) to standardize and provide a common scale of ecological quality across participatory Member States using differing national methods. Intercalibration of the Q-value with the EQR and the corresponding ecological status are described in **Table 6**.

Table 6. EPA water quality status summary

Comparing the Q-value, EQR, corresponding WFD status and pollution gradient resulting from anthropogenic pressures (Feeley *et al*., 2020).

Q value Score	EQR	Pollution Gradient	WFD Ecological Status
Q5	1.0	Unpolluted	High
Q4-5	0.9	Unpolluted	High
Q4	0.8	Unpolluted	Good
Q3-4	0.7	Slightly Polluted	Moderate
Q3	0.6	Moderately Polluted	Poor
Q2-3	0.5	Moderately Polluted	Poor
Q2	0.4	Seriously Polluted	Bad
Q1-2	0.3	Seriously Polluted	Bad
Q1	0.2	Seriously Polluted	Bad

Macroinvertebrate taxa and proportional abundance recorded.

Table 7. List of macroinvertebrate taxa and proportional abundance (%) recorded at each site

Taxon	Group	Site WQ01	Site WQ02	Site WQ03	Site WQ04	Site WQ05	Site WQ06
Ecdyonurus sp.	A			1.9	*	7.2	
Ephemera danica	A				2.0	2.4	
Heptagenia sp.	A		*	1.0	*	16.7	
Isoperla grammatica	A			2.9	4.5		
Nemoura sp.	A						1.7
Plecoptera other (early instar)						1.0	
Goeridae	B					*	
Hydroptilidae	B				1.0		
Lepidostomatidae	B				21.2		
Leuctra sp.	B		*			*	
Limnephilidae	B				2.0		2.8
Sericostomatidae	B	2.4			3.0	1.0	
Baetis rhodani/atlanticus	C		4.2	16.5	10.1	14.4	
Caenis sp.	C		4.2	1.9			
Chironomidae	C	14.1	29.2	50.0	5.6		
Dicranota	C	2.4					
Dryopidae	C				*		
Dytiscidae	C	2.4					
Elmidae	C	3.5	8.2			38.3	11.4

Taxon	Group	Site WQ01	Site WQ02	Site WQ03	Site WQ04	Site WQ05	Site WQ06
Gammarus sp.	C	51.8	45.8	18.0	33.3	14.4	51.3
Haliplidae	C			1.5			
Hydropsyche sp.	C				4.0	2.9	
Limoniidae	C				1.0		
Lumbriculidae	C				*		5.7
Pedicidae	C						5.7
Planorbidae	C	3.5					
Polycentropodidae	C						0.9
Potamopyrgus antipodarum	C	7.1					
Rhyacophila sp.	C		*	1.5	2.0		
Serratella ignita	C		4.2	3.9	4.0		
Simuliidae	C				6.1		2.8
Valvata sp.	C			1.0			
Asellus aquaticus	D	2.4	4.2				17.1
Glossiphoniidae	D	7.1					*
Sialidae	D						*
Sphaeriidae	D	*					
Naididae	D	3.5					
Chironomus sp.	E					*	
Tubificidae	E					*	
Total Number of individuals		85	48	206	198	209	351

Taxon	Group	Site WQ01	Site WQ02	Site WQ03	Site WQ04	Site WQ05	Site WQ06
Number of Taxa		12	10	11	18	13	11

*Where one individual present, this individual is ignored for the purposes of the Q value, but recorded nonetheless

Appendix B. Fish habitat surveys

1. Salmonid habitat assessment

The principal instream physical habitat variables that determine suitability for juvenile salmonids are water depth, water velocity, streambed substratum and cover (Heggenes 1990). The habitat types and their descriptions are outlined in Table **8** 8 and were recorded, where present, during the survey.

Table 8. Habitat classification system for salmonids

Habitat type	Description
Spawning Gravel	Ideally stable but not compacted, with a mean grain size 25 mm or less for trout, but up to 80 mm for salmon. 'Fines' (< 2 mm grain size) to be less than 20% by weight.
Fry (0+) habitat	Shallow, < 20 cm deep, fast flowing (> 30 cm/s), with surface turbulence and a gravel and cobble substrate
Parr (>1+) habitat	20 - 30 cm deep, fast flowing (>30 cm/s), surface turbulent, with gravel / cobble / boulder substrate.
Riffles	Shallow (< 30 cm deep), fast-flowing (> 50 cm/s), surface turbulent, gravel / cobble / boulder substrate.
Glides	= or > 30 cm deep, moderate velocity in range 10-30 cm/sec, surface smooth and unbroken, relatively even substrate of cobbles with finer material
Pools	= or > 40 cm deep, slow flowing (< 10 cm/s), surface unbroken, substrate with a high proportion of sand and silt.

In addition to the habitats listed in Table 8, other features within the study site are noted including:

- The existence of physical barriers to fish migration which are graded 1-3 (G1 being impassable at Q90 flow conditions and G3 passable under Q90 flow conditions)
- Areas of excessive erosion which could cause siltation of spawning habitat- e.g., areas where cattle enter the river
- Anthropogenic alterations to the channel which could affect fish migration
- Areas which could cause difficulties for migrating or spawning individuals during periods of low water levels (e.g., shallow areas near weirs, spawning gravels etc.).
- Locations where branches cross the entire channel giving rise to tunnel vegetation.

2. Lamprey habitat assessment

The guidance published in JNCC (2015) was applied to lamprey habitat assessments. Our approach followed Natura 2000 guidance for the monitoring of river, brook and sea lamprey (*Lampetra fluviatilis, Lampetra planeri* and *Petromyzon marinus*; Harvey and Cowx 2003) and included assessment of habitats using visual mapping of substrates suitable for adult and Juvenile lamprey (Maitland 2003). The habitats suitable for lamprey spawning and larval lamprey (ammocoetes) are outlined in Table 9 and were recorded, where present, during the survey.

Table 9. Definitions of ecologically functional habitat types for lamprey
(based on Maitland 2003; Harvey & Cowx 2003; Teague *et al*. 2012)

Species / Life stage	Habitat Description
Lampetra spp. spawning	Areas of small stones and gravel in flowing water
Petromyzon marinus spawning	Flowing shallow water amid gravel
Lampetra spp. ammocoetes	Stable fine sediment or sand > 15 cm deep, low water velocity and the presence of organic detritus
Petromyson marinus ammocoetes	Non-marginal (open channel) sites of >1.5 m depth featuring fine sand and silt accumulations; lower velocity areas of pools and glide habitat