GDG
GAVIN & DOHERTY
GEOSOLUTIONS

Illaunbaun Wind Farm - Environmental Impact Assessment Report

Appendix A08-06: Aquatic Ecology Baseline

This report considers the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

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The findings outlined within this report and the data we have provided are to our knowledge true and express our bona fide professional opinions. This report has been prepared and provided in accordance with the Chartered Institute of Ecology and Environmental Management (CIEEM) good practice guidelines. Where pertinent CIEEM Guidelines used in the preparation of this report include the *Guidelines for Ecological Report Writing* (CIEEM, 2017a), *Guidelines for Preliminary Ecological Appraisals* (CIEEM, 2017b) and *Guidelines for Ecological Impact Assessment in the UK and Ireland. Terrestrial, Freshwater, Coastal and Marine*, (CIEEM, 2024). CIEEM Guidelines include model formats for Preliminary Ecological Appraisal and Ecological Impact Assessment. Also, where pertinent, evaluations presented herein take cognisance of recommended Guidance from the EPA such as *Guidelines on the information to be contained in Environmental Impact Assessment Reports* (EPA, 2022), and in respect of European sites, *Managing Natura 2000 sites. The provisions of Article 6 of the 'Habitats' Directive 92/43/EEC* (European Commission, 2018).

Due cognisance has been given at all times to the provisions of the *Wildlife Act, 1976-2023,* the *European Union (Natural Habitats) Regulations*, the *European Communities (Birds and Natural Habitats) Regulations 2011-2021,* EU Regulation on Invasive Alien Species under *EU Regulation 1143/2014*, the EU Birds *Directive 2009/147/EC* and *Habitats Directive 92/43/EEC*.

No method of assessment can completely remove the possibility of obtaining partially imprecise or incomplete information. Any limitation to the methods applied or constraints however are clearly identified within the main body of this document.

Quality Assurance

Version	Date		Name	Signature
1	18/12/2023	**Report prepared by:**	Conor Daly MSc BSc ACIEEM	
1	14/03/2024	**Report checked by:**	Dr Alex Copland BSc PhD MIEnvSc MCIEEM	
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4	06/08/2025	**Report Amended by:**	Conor Daly MSc BSc ACIEEM	
Project Reference	**2216**	**Title**	Aquatic Ecology Baseline Technical Appendix	

Notice

This report was produced by INIS Environmental Consultants Ltd. (INIS) on behalf **of GDG** (hereafter known as the Developer), for the specific purpose of assessing Aquatics baseline at the EIA Development project, with all reasonable skill, care and due diligence within the terms of the contract with the client, incorporating our terms and conditions and taking account of the resources devoted to it by agreement with the client.

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1 INTRODUCTION

1.1 Purpose of Technical Appendix

Inis Environmental Consultants Ltd. (INIS) were commissioned to conduct baseline aquatic surveys to inform Environmental Impact Assessment Report (EIAR) preparation for the proposed Illaunbaun Wind Farm Project (from here on referred to as 'the Proposed Development') and the associated Zone of Influence (ZoI) relevant to aquatics receptors and supports Chapter 8 of the EIAR. The Proposed Development comprises all the land and riverine habitats under consideration at the time of surveys that falls within the "Site Layout" of the Wind Farm site and is provided in the Description of Development in the Main EIA Document.

The following report provides a baseline assessment of the aquatic ecology including fisheries and biological water quality, as well as protected aquatic species and habitats in the vicinity of the Proposed Development, located approx. 3.5 km north-east of Miltown Malbay, Co. Clare.

Undertaken on a catchment-wide scale, the baseline surveys focused on aquatic habitats in relation to fisheries potential (including both salmonid and lamprey habitat), white-clawed crayfish (*Austropotamobius pallipes*), freshwater pearl mussel (*Margaritifera margaritifera*) (eDNA only), macro-invertebrates (biological water quality), macrophytes and aquatic bryophytes, aquatic invasive species, and fish of conservation value which may use the watercourses in the vicinity of the Proposed Development (**Figure 2.1**). Aquatic surveys were undertaken in August 2022. All surveys and reporting were undertaken by Ross Macklin and Bill Brazier (Section **1.1.1**).

1.1.1 Statement of Authority

Ross Macklin B.Sc. (Hons), MIFM, HDip GIS, PDip IPM is an ecologist with over 16 years' professional experience in Ireland who conducted the aquatic surveys for this report. He specialises in freshwater fisheries ecology, biology and water quality. He has considerable experience in a wide range of ecological and environmental projects including EIAR, EcIA, AA/NIS, CEMP reporting, as well as biodiversity, water quality monitoring, invasive species and fisheries management. Ross was involved in all aquatic surveys undertaken for the Proposed Development used to inform the Biodiversity EIAR chapter. He also has expert identification skills in macrophytes, freshwater invertebrates, protected aquatic habitats and protected aquatic species including freshwater pearl mussel. His diverse project list includes work on renewable energy developments, flood relief schemes, road schemes, blueways/greenways, biodiversity projects, fisheries management projects and catchment wide water quality management. He is currently completing his Ph.D. on the ecology and impact of common carp (*Cyprinus carpio*) in Irish waters.

Bill Brazier B.Sc. (Hons) MIFM: is an aquatic ecologist with over 10 years' professional experience in Ireland who conducted the aquatic surveys and drafted this report. He specialises in freshwater fisheries ecology, biology and water quality. He has considerable experience in a wide range of ecological and environmental projects including EIAR, EcIA and AA/NIS reporting, as well as biodiversity, invasive species and fisheries management. Bill was involved in all aquatic surveys undertaken for the Proposed Development used to inform the Biodiversity EIAR chapter. His diverse project list includes work on renewal energy developments, flood relief schemes, road schemes, blueways/greenways and biodiversity projects. He is currently completing his Ph.D. on the genetics, reproductive biology and invasive potential impact of common carp in Irish waters. Additionally, Bill

runs the highly respected Off the Scale magazine, Ireland's most-read recreational angling publication and is the national coordinator for the novel Anglers National Line Recycling Scheme (ANLRS).

Dr. Alex Copland BSc PhD MIEnvSc MCIEEM reviewed this report. He is a qualified ecologist with over 25 of professional experience working in both statutory and private companies, in third-level research institutions and with environmental NGOs. He is proficient in experimental design and data analysis and has managed several large-scale, multi-disciplinary ecological projects. These have included research and targeted management work for species of conservation concern, the design and delivery of practical conservation actions with a range of stakeholders and end-users, education and interpretation on the interface between people and the environment and the development of co-ordinated, strategic plans for birds and biodiversity. This work has been delivered in Ireland, where he has worked with NGOs and industry as well as public officials, and the EU, where he has worked with EU-level NGOs as well as EU institutions (EU Commission and EU Parliament).

Alex has written numerous scientific papers, developed and contributed to evidence-based position papers, visions and strategies on birds and habitats in Ireland. He has supervised the successful completion of research theses for several post-graduate students, including doctoral candidates. He lectures to both undergraduate and post-graduate students at UCD, as well as being a collaborative researcher with both UCD and UCC. He also sits on the Editorial Panel of the scientific journal, *Irish Birds*, which publishes original ornithological research relevant to Ireland's avifauna.

Conor Daly MSc BSc (Hons.) is an Ecologist with INIS who reviewed and amended this report to update with project layout and ensured the report aligned with EIAR documents. Conor was awarded an MSc in Biodiversity and Conservation and an Honours BSc in Zoology. Conor has been conducting ornithological surveys for projects since 2021 for a variety of projects including industrial estates and wind farms (small-large). Conor has conducted habitat surveys to inform the Biodiversity EIAR chapter. Conor has experience in raptor conservation and bird of prey pressures and threats on protected species and has provided reports for EIAR and NIS while working with Inis Environmental Ltd. Conor has been a Qualifying member of CIEEM since 2022.

1.1.2 Structure of Technical Appendix

This technical appendix has been set out as follows:

- Section 2 sets out the approach and methodology used for obtaining the desk-study and survey data. The details of the data collected to inform the aquatics baseline conditions is provided in section **2.1** to **2.12** .
- Section 3 sets out the aquatic ecological baseline based on the desk study level data.
- Section 4 provides detailed description of survey results per watercourse crossing test location.
- Section 5 discusses the Important Ecological Features scoped in for Chapter 8 of the EIAR with summary statements on eDNA and waterbody features.
- Section 6 provides a list of references cited within this report.
- Annex A includes the fisheries assessment details as a separate document to this report.

- Annex B provides the macroinvertebrate and water quality survey results.
- Annex C provides the eDNA lab results based on the field survey site samples.

1.2 Description of Development

A full description of the Proposed Development is provided in the accompanying Environmental Impact Assessment Report (EIAR).

1.3 Legislation and Policies

The following legislation has been used and considered when developing the baseline for the Proposed Development:

- EU Habitats Directive (1992) Council Directive 92/43/EEC.
- Irish Wildlife Acts 1976 to 2024 (As amended) ("Wildlife Acts").
- National Biodiversity Action Plan (2017 – 2021).
- Clare County Development Plan 2023 – 2029
- Clare Biodiversity Action Plan 2017-2023
- Water Framework Directive (2000) Directive 2000/60/EC.

1.4 Guidance & Best Practice

The following guidance has been used and considered when developing the baseline for the Proposed Development:

- CEN (European Committee for Standardization) (2003). Water Quality - Sampling of Fish with Electricity. Document CEN EN 14011:2000.
- Meehan (2013). National Smooth Newt Survey 2013 Report, Irish Wildlife Trust.
- National Roads Authority (2008). 'Ecological Surveying Techniques for Protected Flora and Fauna During the Planning of National Road Schemes' were followed when carrying out surveys.
- Environment Agency (2003). River Habitat Survey in Britain and Ireland Field Survey Guidance Manual 2003'.
- O'Grady (2006). Channels and challenges: enhancing Salmonid rivers. Irish Fresh- water Fisheries Ecology and Management Series: Number 4. Central Fisheries Board, Dublin.
- Matson *et al.* (2018). Sampling Fish in Rivers 2017 – Nuenna & Arigna, Factsheet No. 14. National Research Survey Programme. Inland Fisheries Ireland
- Harvey & Cowx (2003). Monitoring the River, Sea and Brook Lamprey, *Lampetra fluviatilis, L. planeri* and *Petromyzon marinus*. Conserving Natura 2000 Rivers Monitoring Series No. 5, English Nature, Peterborough.
- APEM (2004). Assessment of sea lamprey distribution and abundance in the River Spey: Phase II. Scottish Natural Heritage Commissioned Report No. 027 (ROAME No. F01AC608).
- Niven & McCauley (2013). Lamprey Baseline Survey No2: River Faughan and Tributaries SAC. Loughs Agency, 22, Victoria Road, Derry.

- Potter & Osborne (1975). The systematics of British larval lampreys. Journal of Zoology, 176(3), 311-329.
- Gardiner (2003). Identifying lamprey. A field key for sea, river and brook lamprey. Conserving Natura 2000 Rivers, Conservation techniques No. 4. Peterborough. English Nature.
- Foster, Nelson. & O Connor (2009). Ireland Red List No. 1 – Water beetles. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.
- Kelly-Quinn & Regan (2012). Ireland Red List No. 7: Mayflies (Ephemeroptera). National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.
- Feeley *et al*. (2020). Ireland Red List No. 13: Stoneflies (Plecoptera). National Parks and Wildlife Service.
- Byrne *et al.* (2009). Ireland Red List no. 2: non-marine molluscs. National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government.
- Nelson, Ronayne & Thompson (2011). Ireland Red List No.6: Damselflies & Dragonflies (Odonata). National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin, Ireland.
- Reynolds *et al.* (2010). A technical manual for monitoring white-clawed crayfish, *Austropotambius pallipes* in Irish lakes. Irish Wildlife Manuals, Department of Arts, Heritage and Gaeltacht.
- Toner *et al.* (2005). Water quality in Ireland. Environmental Protection Agency, Co. Wexford, Ireland.

1.5 Scoping of Important Ecological Features (IEFs)

Aquatic features and species of varying ecological importance are expected to be present on within the baseline aquatic environment and within the receiving environment of the Proposed Development (proposed site boundary). Following the desk and field study efforts, ecological value was assigned to species present within the Proposed Development with consideration of their conservation and/or protected status. Reasoning and conclusions are provided in **Section 4.9** based on the details provided in **Table 1.1** for determining importance at the varying geographic levels (international, national, county, local (High) or local (Low)) as set by NRA Guidance (2009) and in consideration of the more recent CIEEM guidance for Ecological Impact Assessment (EcIA) is provided in **Table 1.1** (CIEEM, 2024).

Table 1.1: *Determination of importance set out by NRA/CIEEM Guidance.*

Resource Evaluation	NRA Criteria
	• *'European Site' including Special Area of Conservation (SAC), Site of Community Importance (SCI), Special Protection Area (SPA) or proposed Special Area of Conservation.* • *Features essential to maintaining the coherence of the Natura 2000 Network.*

International Importance	• *Site containing 'best examples' of the habitat types listed in Annex I of the Habitats Directive.* • *Resident or regularly occurring populations (assessed to be important at the national level) of the following: Species of animal and plants listed in Annex II and/or IV of the Habitats Directive.* • *World Heritage Site (Convention for the Protection of World Cultural & Natural Heritage, 1972).* • *Biosphere Reserve (UNESCO Man & The Biosphere Programme). Site hosting significant species populations under the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals, 1979).* • *Site hosting significant populations under the Berne Convention (Convention on the Conservation of European Wildlife and Natural Habitats, 1979).* • *Biogenetic Reserve under the Council of Europe. European Diploma Site under the Council of Europe.* • *Salmonid water designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988, (S.I. No. 293 of 1988).*
National Importance	• Site designated or proposed as a Natural Heritage Area (NHA). • Statutory Nature Reserve. • Refuge for Fauna and Flora protected under the Wildlife Acts. • National Park. • Undesignated site fulfilling the criteria for designation as a Natural Heritage Area (NHA); • Resident or regularly occurring populations (assessed to be important at the national level) of the following: Species protected under the Wildlife Acts; and/or Species listed on the relevant Red Data list. Site containing 'viable areas' of the habitat types listed in Annex I of the Habitats Directive.
County Importance	• Area of Special Amenity. • Area subject to a Tree Preservation Order. • Area of High Amenity, or equivalent, designated under the County Development Plan. • Resident or regularly occurring populations (assessed to be important at the County level) of the following: Species of animal and plants listed in Annex II and/or IV of the Habitats Directive; Species protected under the Wildlife Acts; and/or Species listed on the relevant Red Data list. • Site containing area or areas of the habitat types listed in Annex I of the Habitats Directive that do not fulfil the criteria for valuation as of International or National importance. • County important populations of species, viable areas of semi-natural habitats or natural heritage features identified in the National or Local BAP, if this has been prepared. • Sites containing semi-natural habitat types with high biodiversity in a county context and a high degree of naturalness, or populations of species that are uncommon within the county. • Sites containing habitats and species that are rare or are undergoing a decline in quality or extent at a national level.
	• Locally important populations of priority species or habitats or natural heritage features identified in the Local BAP, if this has been prepared;

Local Importance (Higher Value)	• Resident or regularly occurring populations (assessed to be important at the Local level) of the following: Species of animal and plants listed in Annex II and/or IV of the Habitats Directive; Species protected under the Wildlife Acts; and/or Species listed on the relevant Red Data list. • Sites containing semi natural habitat types with high biodiversity in a local context and a high degree of naturalness, or populations of species that are uncommon in the locality; • Sites or features containing common or lower value habitats, including naturalised species that are nevertheless essential in maintaining links and ecological corridors between features of higher ecological value.
Local Importance (Lower Value)	• Sites containing small areas of semi natural habitat that are of some local importance for wildlife; • Sites or features containing non-native species that is of some importance in maintaining habitat links.

2 METHODOLOGY

2.1 Selection of watercourses for assessment

All freshwater watercourses which could be affected directly or indirectly by the Proposed Development were considered as part of the current assessment. A total of 21 river and watercourse sites and one lake site was selected for detailed aquatic assessment based on WFD records of recording and worst-case scenario pathways for hydrological connectivity (see **Table 2.1, Figure 2.1**). Any evidence of invasive species spread at any of sample sites were also recorded. The nomenclature for the watercourses surveyed is as per the Environmental Protection Agency (EPA). Aquatic survey sites were located on the Derrymore River (EPA code: 28D03), Illaunbaun Stream (28I03), Fahanlunaghta Beg Stream (28F08), Glendine River (28G02), Kilcorcoran Stream (28K11), Ballinphonta River (28B03), Drumbaun River (28D20), several unnamed streams and Lough Keagh (**Table 2.1**). The 22 aquatic survey sites were located within the Inagh [Ennistymon]_SC_010 and Annagh [Clare]_SC_010 river sub-catchments. The proposed site boundary and associated infrastructure were not located within a European Site.

Please note this aquatic report should be read in conjunction with the Environmental Impact Assessment Report (EIAR) prepared for the Proposed Development. More specific aquatic methodology is outlined below and Annex A of this report.

2.2 Aquatic site surveys

Aquatic surveys of the watercourses and waterbody within the vicinity of the Proposed Development were conducted on Friday 2nd to Sunday 4th August 2022. Survey effort focused on both instream and riparian habitats at each aquatic sampling location (**Figure 2.1**). Surveys at each of these sites included a fisheries assessment (electro-fishing and/or fisheries habitat appraisal), white-clawed crayfish survey, macrophyte and aquatic bryophyte survey and (where suitable) biological water quality sampling (Q-sampling) or macro-invertebrate sweep sampling. (**Figure 2.1**).

Suitability for freshwater pearl mussel was assessed at each survey site with environmental DNA (eDNA) sampling undertaken for the species at three strategically chosen river and watercourse locations within the vicinity of the Proposed Development. These water samples were also analysed for white-clawed crayfish (*Austropotamobius pallipes*), crayfish plague (*Aphanomyces astaci*) and Atlantic salmon (*Salmo salar*). Furthermore, a composite water sample was also analysed for eDNA of brown trout (*Salmo trutta*), European eel (*Anguilla anguilla*) and smooth newt (*Lissotriton vulgaris*) at a single lake site (Lough Keagh). This holistic 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 the ecological baseline and subsequent mitigation measures necessary for the Proposed Development are explored in the main EIAR.

- In addition to the ecological characteristics of the site, a broad aquatic and riparian habitat assessment was conducted utilising elements of the methodology given in the Environment Agency's 'River Habitat Survey in Britain and Ireland Field Survey Guidance Manual 2003' (EA, 2003) and the Irish Heritage Council's 'A Guide to Habitats in Ireland' (Fossitt, 2000). This broad characterisation helped define the watercourses' conformity or departure from naturalness.

All sites were assessed in terms of: Physical watercourse/waterbody characteristics (i.e. width, depth etc.) including associated evidence of historical drainage (filled in drains, or degraded stream flows from unnatural drains etc.)

- Substrate type, listing substrate fractions in order of dominance (i.e. bedrock, boulder, cobble, gravel, sand, silt etc.)
- Flow type by proportion of riffle, glide and pool in the sampling area
- An appraisal of the macrophyte and aquatic bryophyte community at each site
- Riparian vegetation composition

Table 2.1: *Location of the 22 aquatic survey sites in the vicinity of the Proposed Development.*

Site no.	Watercourse	EPA code	Location	X (ITM)	Y (ITM)
A1	Derrymore River	28D03	Illaunbaun	510235	682012
A2	Derrymore River	28D03	Illaunbaun	510895	682359
A3	Unnamed stream	n/a	Illaunbaun	510595	681573
A4	Unnamed stream	n/a	Illaunbaun	510728	681909
A5	Illaunbaun Stream	28I03	Illaunbaun	511085	682020
A6	Illaunbaun Stream	28I03	Illaunbaun	511135	682362
A7	Fahanlunaghta Beg Stream	28F08	Illaunbaun	511482	681501
A8	Fahanlunaghta Beg Stream	28F08	Illaunbaun	511913	682328
A9	Derrymore River	28D03	White's Bridge	511766	682675
A10	Derrymore River	28D03	Derrymore Bridge	515061	681712
L1	Lough Keagh	n/a	Slievenalicka & Tooreen	510051	681168
B1	Glendine River	28G02	Tooreen	511200	680847
B2	Unnamed stream	n/a	Tooreen	509903	680034
B3	Kilcorcoran Stream	28K11	Ballynew	509568	680425
B4	Kilcorcoran Stream	28K11	Ballynew Bridge	508784	679868
B5	Glendine River	28G02	Knockloskeraun Bridge	505228	677447
C1	Ballinphonta River	28B03	Drumbaun	509271	681492
C2	Ballinphonta River	28B03	Drumbaun	508558	681320
C3	Drumbaun River	28D20	Lackamore	509328	682132
C4	Drumbaun River	28D20	Drumbaun	508136	681629
C5	Ballinphonta River	28B03	Carrowkeel Bridge	507059	680785
C6	Ballinphonta River	28B03	Cloonbony Bridge (N67)	504809	680257

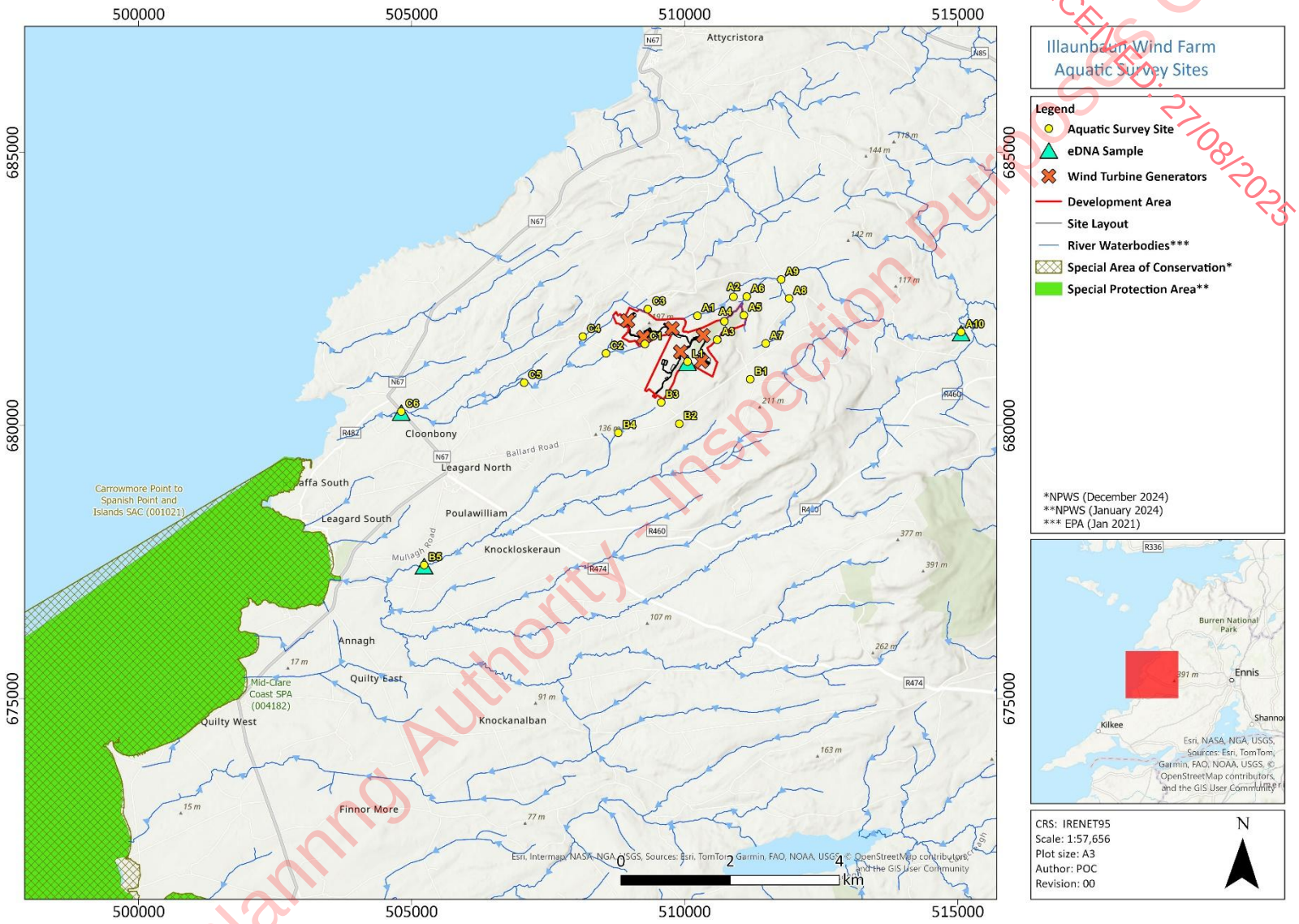

Figure 2.1: Overview of the 22 aquatic survey site locations *in the vicinity of the* **Proposed Development.**

2.3 Fish stock assessment (electro-fishing)

A single anode Smith-Root LR24 backpack (12V DC input; 300 V, 100 W DC output) was used to electro-fish sites on watercourses in the vicinity of the Proposed Development in August 2022, following notification to Inland Fisheries Ireland (IFI), under the conditions of a Department of the Environment, Climate and Communications (DECC) licence. Electro-fishing was undertaken at all river and watercourse survey sites. As such, a total of 21 sites were surveyed via electro-fishing (**Table 2.1, Figure 2.1; Annex A**). The surveys were undertaken in accordance with best practice (CEN, 2003; CFB, 2008) and Section 14 licencing requirements (Annex A).

Furthermore, a fisheries habitat appraisal of the aquatic survey sites (**Figure 2.1**) was undertaken to establish their importance for salmonid, lamprey, European eel and other fish species. The baseline assessment also considered the quality of spawning, nursery and holding habitat for salmonids and lamprey within the vicinity of the survey sites. For detailed survey methodology, please refer to the accompanying fisheries assessment report in **Annex A.**

2.4 White-clawed crayfish survey

White-clawed crayfish surveys were undertaken at the aquatic survey sites in August 2022 under a National Parks and Wildlife Service (NPWS) open licence (no. C31/2022), as prescribed by Sections 9, 23 and 34 of the Wildlife Acts, to capture and release crayfish to their site of capture, under condition no. 6 of the licence. As per IFI recommendations, the crayfish sampling started at the uppermost site(s) of the Proposed Development catchment/sub-catchments in the survey area to minimise the risk of transfer invasive propagules (including crayfish plague) in an upstream direction.

Hand-searching of instream refugia and sweep netting was undertaken according to Reynolds *et al.* (2010). An appraisal of white-clawed crayfish habitat at each site was conducted based on physical channel attributes, water chemistry and incidental records in mustelid spraint. Additionally, a desktop review of crayfish records from NPWS and NBDC within the wider survey area was also completed.

2.5 Freshwater pearl mussel survey (eDNA only)

There are no known freshwater pearl mussel records in the Inagh [Ennistymon]_SC_010 and Annagh [Clare]_SC_010 river sub-catchments based on reviews of NPWS and IFI public databases. This was based on an extensive literature review and also examination of NPWS sensitive species data in May 2025. However, following the precautionary principle and to account for any lacunae in data for the species, environmental DNA (eDNA) samples were collected from the Derrymore River, Glendine River and Ballinphonta River and analysed for freshwater pearl mussel eDNA to confirm the species' absence within the vicinity of the Proposed Development. Please refer to section 2.7 (eDNA analysis) below for further detail.

2.6 Otter signs

The presence of otter (*Lutra lutra*) at each aquatic survey site was determined through the recording of otter signs, if encountered incidentally during surveys. Notes on the age and location (ITM coordinates) were made for each otter sign (spraints, prints, slides) recorded, in addition to the quantity and visible constituents of spraints (i.e. remains of fish, molluscs etc.).

2.7 eDNA analysis

To validate site surveys and to detect potentially cryptically-low populations of freshwater pearl mussel within the study area, three composite water samples were collected from the Derrymore River (site A10), Glendine River (B5) and Ballinphonta River (C6) and analysed for freshwater pearl mussel eDNA (**Figure 2.1**). The water samples were collected on 4th August 2022, with the sites strategically chosen to maximise longitudinal (instream) coverage within the catchment (i.e. facilitating a greater likelihood of species detection). A composite water sample was also collected from Lough Keagh (site L1) and analysed for brown trout, European eel and smooth newt.

In accordance with best practice, a composite (500 ml) water sample was collected from the sampling point, maximising the geographic spread at the site (20 x 25 ml samples at each site), thus increasing the chance of detecting the target species' DNA. The composite sample was filtered on site using a sterile proprietary eDNA sampling kit. The fixed sample was stored at room temperature and sent to the laboratory for analysis within 48 hours of collection. A total of 12 qPCR replicates were analysed for the site. Given the high sensitivity of eDNA analysis, a single positive qPCR replicate is considered appropriate proof of the species' presence (termed qPCR No Threshold, or qPCR NT). This approach will yield a positive result even if only traces of a species are within the sample (Salmon carrying small pieces of pearl mussel shell to the sample site would produce a 1/12 result for Freshwater Pearl Mussel). Whilst an eDNA approach is not currently quantitative, the detection of the target species' DNA indicates the presence of the species at and/or upstream of the sampling point. Please refer to **Annex C** for full eDNA laboratory analysis methodology.

2.8 Biological water quality (Q-sampling)

The 21 no. river and watercourse survey sites were assessed for biological water quality through Q-sampling in August 2022 (**Figure 2.1**). All samples were taken with a standard kick sampling hand net (250 mm width, 500 µm mesh size) from areas of riffle/glide utilising a 2-minute kick sample, as per Environmental Protection Authority (EPA) methodology (Feeley *et al.*, 2020). Large cobbles were also washed at each site for 1-minute (where present) to collect attached macro-invertebrates (as per Feeley *et al.*, 2020). Samples were elutriated and fixed in 70% ethanol for subsequent laboratory identification. Samples were converted to Q-ratings as per Toner *et al.* (2005) and assigned to WFD status classes (**Table 2.2**). Any rare invertebrate species were identified from the NPWS Red List publications for beetles (Foster *et al.*, 2009), mayflies (Kelly-Quinn & Regan, 2012), stoneflies (Feeley *et al.*, 2020) and other relevant taxa (i.e. Byrne *et al.*, 2009; Nelson *et al.*, 2011).

Table 2.2: *Reference categories for EPA Q-ratings (Q1 to Q5)*

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

2.9 Lake macro-invertebrate communities

The lake survey site (L1) was sampled for macro-invertebrates via sweep netting. A standard pond net (250 mm width, mesh size 500 µm) was used to sweep macrophytes to capture macro-invertebrates. The net was also moved along the lakebed to collect epibenthic and epiphytic invertebrates from the substratum (as per Cheal *et al.*, 1993). A 3-minute sampling period was employed. To ensure appropriate habitat coverage, the sampling period was also divided amongst the range of meso-habitats present at the survey sites to get a representative sample for sub-habitats. Four sub-habitats were sampled. The Lake margins which was based on how these have semi-transitional habitat for invertebrates, the littoral zone which is the shore area of the lake, the paludal zone which is the habitat directly below the low tide waterline and the sloping land adjoining the lake. These covered the key mesohabitats relevant for the lake.

2.10 Macrophytes and aquatic bryophytes

Surveys of the macrophyte and aquatic bryophyte community were conducted by instream wading at each of the 21 river and watercourse and one lake survey sites, with specimens collected (by hand or via grapnel) for on-site identification. An assessment of the aquatic vegetation community helped 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').

2.11 Aquatic ecological evaluation

The evaluation of aquatic ecological receptors contained within this report uses the geographic scale and criteria defined in the 'Guidelines for Assessment of Ecological Impacts of National Road Schemes' (NRA, 2009) (Sections **1.5** & **4.9**). CIEEM (2024) guidance on assigning importance was utilised to ensure appropriate valuation of receptors was applied for EIA assessment.

2.12 Biosecurity

A strict biosecurity protocol following IFI (2010) and the Check-Clean-Dry approach was adhered to during surveys for all equipment and PPE used. Disinfection of all equipment and PPE before and after use with Virkon™ was conducted to prevent the transfer of pathogens or invasive propagules between survey sites. Surveys were undertaken at sites in a downstream order to minimise the risk of upstream propagule mobilisation. Particular cognisance was given towards preventing the spread or introduction of crayfish plague (*Aphanomyces astaci*) given the known distribution of white-clawed crayfish (*Austropotamobius pallipes*) in the wider survey area. Furthermore, staff did not undertake any work in a known crayfish plague catchment for a period of no less than 72hrs in advance of the survey. Where feasible, equipment was also thoroughly dried (through UV exposure) between survey areas. Any aquatic invasive species or pathogens recorded within or adjoining the survey areas were geo-referenced. All staff are certified in 'Good fieldwork practice: slowing the spread of invasive non-native species' by the University of Leeds.

2.13 Limitations & constraints

There are a number of limitations inherent to field-based surveying, in particular for aquatic surveys, where risks such as water hazards and unstable sediment along riverbanks are encountered more often. These also relate to availability of suitable weather conditions for completing surveys with good visibility and safe access. As such, when undertaking and completing fieldwork, careful consideration and planning is made to ensure optimal weather conditions during survey periods. Due to the nature of the survey methodology, access to all areas within the ZoI is not always possible. Where areas were inaccessible for sampling to be conducted, these areas were noted as such in the field data. All surveys were conducted in dry and safe conditions for instream survey methods. All catchment overlapping with the Proposed Development were surveyed along the rivers for at least one location.

For electro-fishing surveys, certain more minor watercourse sites or sites with limited access, it was only possible to undertake electro-fishing for a 5-minute Catch per Unit Effort (CPUE). Discrepancies in fishing effort (CPUE) between sites are accounted for in the subsequent results section (**Table 3.1 of Annex A**).

Water quality surveys encountered certain constraints where there was less than suitable sampling areas at the sample site or lower than suitable water flow, which created tentative Q-values for certain rivers and watercourses (B1 & C3) (**Section 4.6**).

eDNA surveys have limitations as it requires a certain extent of species cells in the water to yield a result. As such, the no threshold limit for PCR in order to consider even a trace to yield a positive result for presence to ensure any presence of Freshwater Pearl Mussel or other species that may be upstream or downstream of the eDNA sampling points.

Both of these constraints were accounted for in determining the ecological baseline of the aquatic features within the baseline aquatic environment for the Proposed Development.

Per the CIEEM (2019) advice note on data validity, the aquatic ecology baseline data was sampled in August 2022. This places the Aquatics baseline presented being within 18 months to 3 years age range. As such, the data provided as part of the ecological baseline for aquatic receptors may be subject to changes from the 2022 survey period.

In summary, it is considered that no significant constraints occurred during the monitoring period, and the survey data provides accurate detail on the baseline biodiversity in relation to aquatic species and features within the proposed scheme and environs.

3 RECEIVING ENVIRONMENT

3.1 Proposed Development catchment and survey area description

The Proposed Development is located in an upland area within the townlands of Drumbaun, Slievenalicka, Lackamore, Tooreen and Illaunbaun, approximately 3.5 km north-west of Miltown Malbay Co. Clare (**Figure 2.1**). The proposed site boundary is within the Shannon River Basin District and within hydrometric area 28 (Mal Bay). The aquatic survey sites were located within the Inagh [Ennistymon]_SC_010 and Annagh [Clare]_SC_010 river sub-catchments (**Figure 2.1**). The Proposed Development is drained by the Derrymore River (EPA code: 28D03), Illaunbaun Stream (28I03), Fahanlunaghta Beg Stream (28F08), Glendine River (28G02), Kilcorcoran Stream (28K11), Ballinphonta River (28B03), Drumbaun River (28D20), several unnamed streams (**Table 2.1**). Lough Keagh is located within 50 m the Proposed Development boundary.

The watercourse and aquatic survey sites in the vicinity of Proposed Development are typically small, upland eroding channels (FW1; Fossitt, 2000). Predominantly, the watercourses flow over areas of carboniferous sandstone, siltstone and mudstone (Geological Survey of Ireland data). Land use practices in the wider survey area are peat bogs (CORINE 412), transitional woodland scrub (CORINE 324), land principally occupied by agriculture with significant areas of natural vegetation (CORINE 243) and pastures (CORINE 231).

3.2 Fisheries asset of the survey area

The Glendine River, also known locally as the Annagh River, rises in the hills west of Miltown Malbay and flows for approximately 9 km before reaching the sea just south of Spanish Point. At Knockloskeraun Bridge (survey site B5), the river is known to support Atlantic salmon, brown trout and European eel (Kelly *et al.*, 2010, 2014; IFI 2020 data[1]).

Lough Keagh (site L1), also known locally as Rockmount Lake, is utilised as a recreational stocked brown trout fishery by the Miltown and District Angling Club.

IFI were unable to provide fisheries data for the other watercourses within the survey area.

3.3 Protected aquatic species[2]

A comprehensive desktop review of available data (NPWS, National Biodiversity Centre (NBDC) & Botanical Society of Britain and Ireland (BSBI) data) for 10 km grid squares containing and adjoining the Proposed Development (i.e. R07, R08 and R18) identified a low number of records for rare and/or protected aquatic species within the vicinity of the Proposed Development.

Whilst a low number of records for Annex II freshwater pearl mussel[2] (*Margaritifera margaritifera*) were available for the Annageeragh River in 10 km grid square R07, these were located in a separate sub-catchment (Annageeragh_SC_010) to the proposed site boundary, >11.5 km south-west from the Proposed Development, within the Annageeragh *Margaritifera* sensitive area (**Figure 3.1**).

[1] *Inland Fisheries Ireland data for Water Framework Directive Fish Ecological Status 2008-2021. Available at https://opendata-ifigis.hub.arcgis.com/datasets/IFIgis::water-framework-directive-fish-ecological-status-2008-2021/*

[2] *This report may not be made available to the public without redaction given the inclusion of sensitive species data*

A low number of Annex II otter (*Lutra lutra*) records were available for the relevant 10 km grid squares (NPWS & NBDC data; **Figure** 3.1 **3.1**) although none were available in the vicinity of the Proposed Development, with most records present in coastal areas.

A low number of common frog (*Rana temporaria*) records were available for the R07, R08 and R18 grid squares, including Lough Keagh (Rockmount Lake) (survey site L1) (appendix A08-07).

3.4 EPA water quality data (existing data)

The following outlines the available water quality data for the watercourses in context of the Proposed Development. Only recent water quality is summarised below (WFD 2016 - 2021). There was no contemporary EPA biological monitoring data available for the surveyed watercourses, namely the Derrymore River (EPA code: 28D03), Illaunbaun Stream (28I03), Fahanlunaghta Beg Stream (28F08), Kilcorcoran Stream (28K11), Ballinphonta River (28B03), Drumbaun River (28D20) or several unnamed streams. However, the Ballinphonta _010 and Inagh (Ennistymon)_040 river water bodies both achieved moderate status in the 2013-2018 period and were considered 'at risk' of not achieving target good status water quality (EPA, 2019a, 2019b).

Please note that biological water quality analysis (Q-sampling) was undertaken as part of this survey, with the results presented in **section 4.6** and

Annex B – Macro-invertebrates (biological water quality of this report.

3.4.1 Glendine River

Two contemporary EPA biological monitoring stations were located on the Glendine River. The river achieved **Q4 (good status)** at Knockloskeraun Bridge (station RS28G020200, survey site C6) in 2021. In the tidal reaches, the river achieved **Q3-4 (poor status)** (brackish) at station RS28A030900 in 2021 at the N67 road crossing.

The freshwater reaches of Glendine River (Glendine (Clare)_010 river waterbody) achieved poor status in the 2013-2018 period and was considered 'at risk' of not achieving target good status water quality. The primary risk to water quality within the Annagh (Clare)_SC_010 sub-catchment is siltation (from forestry) and wastewater discharge (EPA, 2019a).

3.4.2 Lough Keagh

Lough Keagh achieved moderate status in the 2013-2018 period and was considered 'at risk' of not achieving target good status water quality. The primary risk to water quality within Lough Keagh is coniferous afforestation (EPA, 2019b).

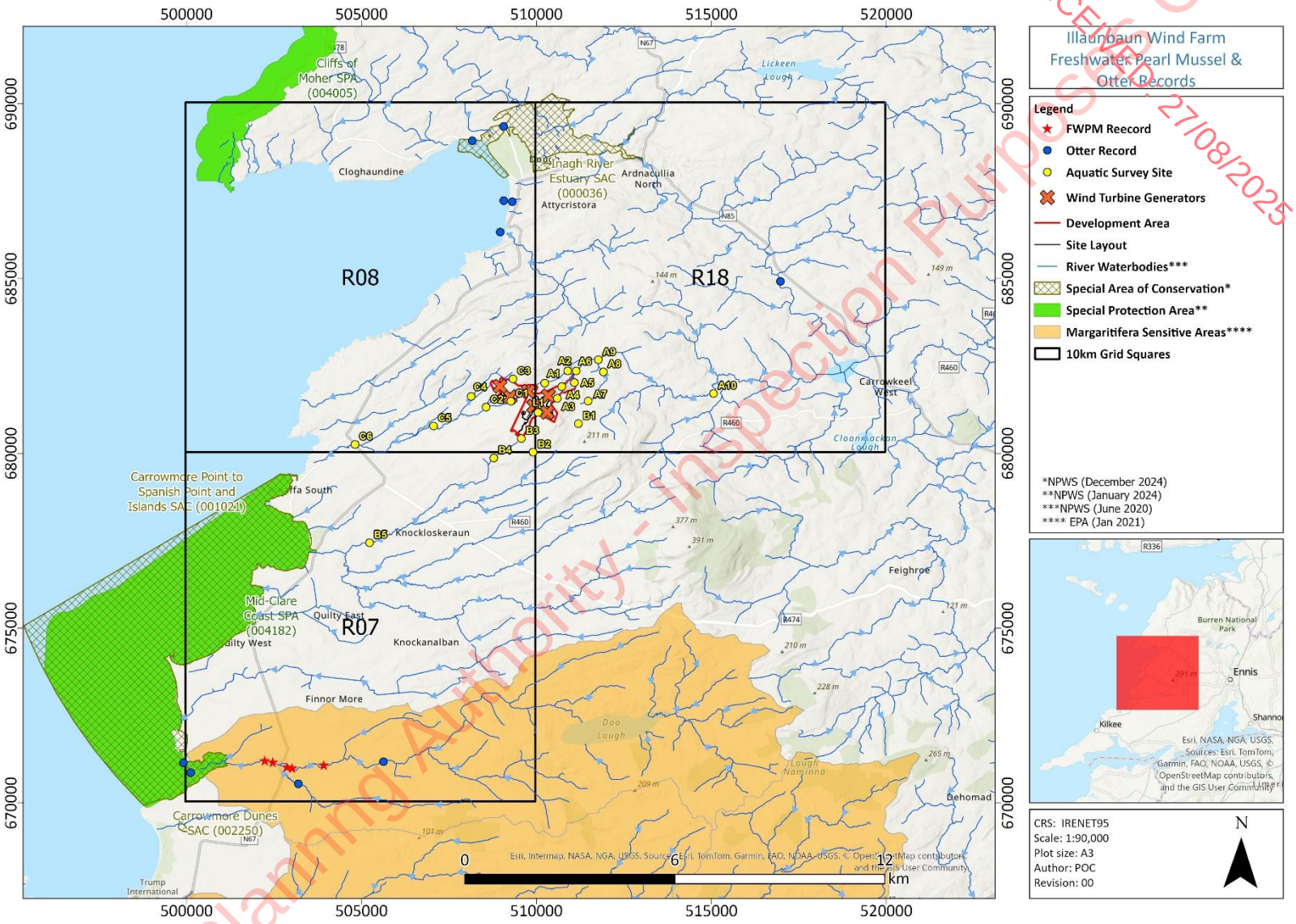

Figure 3.1: Distribution of freshwater pearl mussel and otter in the vicinity of the Proposed Development (source: NPWS & NBDC data)

4 RESULTS OF AQUATIC SURVEYS

The following section summarises each of the 22 survey sites in terms of aquatic habitats, physical characteristics and overall value for fish, white-clawed crayfish and macrophyte/aquatic bryophyte communities. Biological water quality (Q-sample) results are also summarised for each river and watercourse sampling site (21) and in

Annex B – Macro-invertebrates (biological water quality. Habitat codes are according to Fossitt (2000). Sites were surveyed in August 2022. Please refer to **Annex A** (fisheries assessment report) for more detailed fisheries results. A summary of the fish species recorded at each survey site is provided in **Table 4.2**. A summary of the aquatic species and habitats of high conservation concern recorded during the surveys is provided in **Table 4.2**. An evaluation of the aquatic ecological importance of each survey site based on these aquatic surveys is provided and summarised in **Table 4.3**.

4.1 Aquatic survey site results

4.1.1 Site A1 – Derrymore River, Illaunbaun

Site A1 was located on the uppermost reaches of the Derrymore River (28D03). The upland eroding watercourse (FW1) flowed over a moderate gradient at the survey site before falling over a steep gradient in a deeply incised V-shaped valley downstream. Whilst the river did not show signs of modification, the banks had been modified historically for the purposes of livestock retention (i.e. walls/embankments on the north bank). The small spate river at this location averaged <1 m wide and 0.2-0.3 m deep, with occasional deeper pools to 0.6 m associated with natural cascades. Scouring of the soft banks was frequent. The substrata were dominated by mixed gravels and compacted cobbles with only occasional boulders. Siltation was moderate overall, despite the high energy nature of the site. Soft sediment deposits were confined to pool and meander margins (largely derived from livestock poaching). Given high flow rates, compacted substrata, peat staining and high riparian shading, macrophytes were not recorded. Bryophytes were limited to occasional *Pellia epiphylla* liverwort on shaded banks. The river was heavily scrubbed by bramble (*Rubus fruticosus* agg.) and terrestrial vegetation, with dense willow (*Salix* sp.) and hazel (*Corylus avellana*) scrub (and tunnelling) present downstream. The site was bordered by sloping wet grassland (GS4, some improved for pasture) with coniferous afforestation (WD3) present upstream.

No fish were recorded via electro-fishing from site A1 (**Annex A**). Despite some physical suitability, site A1 was not of value to fisheries given its location in the headwaters of the river and high natural gradients, resulting in poor connectivity with downstream habitats. The uppermost reaches also likely suffer from low seasonal flows, further reducing their value to fisheries. There was no suitability for white-clawed crayfish or freshwater pearl mussel. No otter signs were recorded in the vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q2-3 (poor status)** (**Annex B**). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the absence of aquatic species or habitats of higher conservation value, in addition to poor status water quality, the aquatic ecological evaluation of site A1 was of **local importance (lower value) (Table 4.4).**

Plate 4.1: Representative image of site 1 on the upper reaches of the Derrymore River, August 2022

4.1.2 Site A2 – Derrymore River, Illaunbaun

Site A2 was located on the Derrymore River approx. 0.7 km downstream of site A1. In contrast to upstream (high gradient), the river at this location flowed over a moderate gradient in a naturally incised (spate) channel. The upland eroding watercourse (FW1) averaged 1.5 m wide and 0.1-0.2 m deep with occasional plunge pools to 0.3 m. The site featured fast, shallow riffles and glides with occasional pools associated with natural cascades. The substrata were dominated by bedrock, with only very limited angular cobbles and boulders, with occasional mixed gravels and sands along channel margins. Given high flow rates and a predominantly bedrock substrate, macrophytes were limited to only very occasional watercress (*Nasturtium officinale*) along channel margins. The moss *Rhynchostegium riparioides* was occasional on infrequent larger boulders, with rare *Chiloscyphus polyanthos*. The channel was largely open in vicinity of the survey site, with a steep roadside embankment of willow, heather (*Calluna vulgaris*), bramble and ferns along the south and wet pasture (GA1) to the north. Dense scrub and heavy tunnelling (willow, hazel, bramble) was present both upstream and downstream of the survey site.

No fish were recorded via electro-fishing from site A2 (**Annex A**). Despite some low physical suitability, site A2 was not of value to fisheries given its location in the headwaters of the river and high natural gradients which precluded upstream fish passage. Spawning habitat for salmonids was also absent given the predominance of bedrock substrata. Furthermore, the uppermost reaches also likely suffer from low seasonal flows, further reducing their value to fisheries (often 0.1 m deep even after heavy rainfall). There was no suitability for white-clawed crayfish or freshwater pearl mussel. No otter signs were recorded in the vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q3 (poor status)** (**Annex B**). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the absence of aquatic species or habitats of higher conservation value, in addition to poor status water quality, the aquatic ecological evaluation of site A2 was of **local importance (lower value) (Table 4.4).**

Plate 4.2: Representative image of site A2 on the Derrymore River, August 2022

4.1.3 Site A3 – unnamed stream, Illaunbaun

Site A3 was located on the uppermost reaches of an unnamed Derrymore River tributary. The small upland eroding watercourse (FW1) averaged <0.75 m wide and 0.2-0.4 m deep. It flowed in a deep U-shaped channel (1 m bankfull heights) with peat banks over a moderate gradient before entering a deeply incised valley downstream (near site A4). The profile comprised deep, silted glides with frequent pools associated with natural cascades over peat. Instream obstructions to flow (e.g. peat, terrestrial vegetation) were frequent. The substrata were dominated by peat with only very localised mixed gravels and boulders. Given heavy peat staining and high levels of terrestrial encroachment (shading), the narrow channel did not support macrophytes. The bryophytes *Marsupella emarginata* and *Fissidens* sp. were present on exposed peaty banks, cascades and occasional boulders. *Sphagnum cuspidatum* was present instream but rare (more common on banks), with frequent *Polytrichum* sp. and the liverwort *Pellia epiphylla*. Filamentous algae were also present (2 % cover), indicating enrichment. The site was located in an area of wet grassland (GS4) dominated by rushes (*Juncus* spp.), heather and bilberry (*Vaccinium myrtillus*) bordered by clear-fell (WS5), with coniferous afforestation (WD3) and improved (wet) pasture (GA1) upstream.

No fish were recorded via electro-fishing from site A3 (**Annex A**). Site A3 was not of value to fisheries given its location in the headwaters of the stream, high natural gradients, frequent natural barriers (cascades) and heavy siltation (from peat escapement). There was no suitability for white-clawed crayfish or freshwater pearl mussel. No otter signs were recorded in the vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q3 (poor status)** (**Annex B**). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the absence of aquatic species or habitats of higher conservation value, in addition to poor status water quality, the aquatic ecological evaluation of site A3 was of **local importance (lower value) (Table 4.4).**

Plate 4.3: Representative image of site A3 on an unnamed Derrymore River tributary, August 2022

4.1.4 Site A4 – unnamed stream, Illaunbaun

Site A4 was located on the uppermost reaches of an unnamed Derrymore River tributary, approx. 0.35 km downstream of site A3. The upland eroding watercourse (FW1) at this location flowed over a steep gradient in a deeply incised natural valley with bankfull heights of up to 6 m. The high energy (spate) stream averaged 1.5-2 m wide and 0.1-0.3 m deep. The profile comprised steep cascades over bedrock and peat with fast shallow glides and riffles between pools. The substrata were dominated by boulders and cobbles, with frequent bedrock and only localised compacted coarse gravels. Instream large woody debris was frequent. Given the spate nature of the site, macrophytes were limited to very occasional watercress along channel margins. However, the site supported a high coverage of bryophytes. *Scapania undulata* was frequent with abundant *Hyocomium armoricum* on the waterline. The liverwort species *Conocephalum conicum* and *Pellia* sp. were abundant on wet sheer banks, with occasional *Chiloscyphus polyanthos* also present along channel margins. The steep escarpments supported abundant terrestrial mosses with ferns, wild angelica (*Angelica sylvestris*), bramble and mature hazel. The site was bordered by historical clear-fell (WS5).

No fish were recorded via electro-fishing from site A4 (**Annex A**). Despite some physical suitability, site A4 was of low value to fisheries given its location in the headwaters of the stream and frequent impassable natural barriers (cascades). Furthermore, heavy siltation (peat escapement) further reduced the value to fisheries. Whilst there was some low suitability for European eel (better able to navigate significant barriers than salmonids), none were recorded. There was no suitability for white-clawed crayfish or freshwater pearl mussel. No otter signs were recorded in the vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q3 (poor status)** (**Annex B**). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the absence of aquatic species or habitats of higher conservation value, in addition to poor status water quality, the aquatic ecological evaluation of site A4 was of **local importance (low value) (Table 4.4).**

Plate 4.4: Representative image of site A4 on an unnamed Derrymore River tributary, August 2022

4.1.5 Site A5 – Illaunbaun Stream, Illaunbaun

Site A5 was located on the Illaunbaun Stream (28I03) at a forestry track crossing. The small upland eroding stream flowed over a moderate gradient and flowed under the track via a 900 mm pipe culvert. The stream averaged <1 m wide and 0.1-0.2 m deep in a deeply incised channel with 1.5-2.5 m bankfull heights. The profile comprised shallow glides and riffles with occasional plunge pools associated with cascades (to 0.4 m max.). The substrata were dominated by loose angular cobbles and boulders, with interstitial angular gravels. Siltation was moderate overall but soft sediment deposits were not present given the high energy nature of the stream. Given the narrow channel width, high flow rates and high riparian shading, macrophytes were absent. However, the bryophytes *Scapania undulata*, *Hyocomium armoricum* and *Fissidens* sp. were present on more stable boulders and steep banks. The riparian zone supported abundant heather, soft rush (*Juncus effusus*), rosebay willowherb (*Chamaenerion angustifolium*), wild angelica, foxglove (*Digitalis purpurea*), willow, downy birch (*Betula pubescens*), mosses and ferns. The upland site was bordered by coniferous afforestation (WD3) to the north and replanted clear-fell (WS2) to the south.

No fish were recorded via electro-fishing from site A5 (**Annex A**). Despite some low physical suitability, site A5 was not of value to fisheries given its location in the headwaters of the stream and frequent natural barriers (cascades). Furthermore, the uppermost reaches also likely suffer from low seasonal flows, further reducing their value to fisheries (often 0.1 m deep even after heavy rainfall). There was

no suitability for white-clawed crayfish or freshwater pearl mussel. No otter signs were recorded in the vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q3 (poor status) (Annex B**). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the absence of aquatic species or habitats of higher conservation value, in addition to poor status water quality, the aquatic ecological evaluation of site A5 was of **local importance (lower value) (Table 4.4).**

Plate 4.5: Representative image of site A5 on the upper reaches of the Illaunbaun Stream, August 2022

4.1.6 Site A6 – Illaunbaun Stream, Illaunbaun

Site A6 was located on the Illaunbaun Stream (28I03) at a local road crossing (pipe culvert), approx. 0.4 km downstream of site A5. The upland eroding watercourse (FW1) flowed over a slight gradient in a deeply incised channel with 1.5-2.5 m bankfull heights. The spate channel averaged 1-1.5 m wide and 0.1-0.2 m deep. Give the high energy nature of the site, the substrata were dominated by bedrock with localised patches of mixed gravels and cobbles, typically at the tailings of pools. The profile comprised shallow fast glides and riffles with only very occasional small pools (to 0.4 m) associated with natural cascades over bedrock. Natural scouring of the banks (undercuts) was frequent, further indicative of the spate nature of the site. Instream large woody debris was frequent. Macrophyte vegetation was not recorded, although marsh marigold (*Caltha palustris*) was present in the wet grassland adjoining the stream. The bryophytes *Jungermannia* sp. was abundant along channel margins (usually on bedrock) with occasional *Conocephalum conicum* on shaded banks. The stream was heavily shaded and often tunnelled by riparian scrub vegetation, with abundant dense willow, hazel, hawthorn (*Crataegus monoygna*) and bramble scrub. The site was bordered by a local road (and associated scrubby hedgerow) and wet grassland (GS4) / semi-improved grassland (GA1) to the north. Coniferous afforestation (WD3) was present upstream of the road crossing.

Site A6 was of low value to fisheries. A single juvenile brown trout was the only fish recorded via electro-fishing (**Annex A**). The bedrock-dominated substrata provided poor spawning opportunities for salmonids, and the shallow high energy nature of the site was of poor value as a nursery or holding habitat. Furthermore, siltation pressures and natural barriers (e.g. gradients, cascades) reduced the value for all fish species. The upland eroding spate channel was not suitable for lamprey. There was no suitability for white-clawed crayfish or freshwater pearl mussel. No otter signs were recorded in the vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q3 (poor status)** (**Annex B**). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the presence of salmonids, the aquatic ecological evaluation of site A6 was of **local importance (higher value) (Table 4.4).**

Plate 4.6: Representative image of site A6 on the Illaunbaun Stream downstream of the road culvert, August 2022

4.1.7 Site A7 – Fahanlunaghta Beg Stream, Illaunbaun

Site A7 was located on the upper reaches of the Fahanlunaghta Beg Stream (28F08) at a local road crossing (masonry box culvert). The small upland eroding watercourse (FW1) flowed over a slight gradient in a shallow trapezoidal channel with 1-1.5 m bankfull heights. The stream showed evidence of historical straightening upstream of the road culvert. The stream averaged 1-1.5 m wide and 0.05-0.1 m deep at the time of survey. Swift shallow glides and riffles dominated the profile with only occasional small pools to 0.3 m. The substrata were dominated by loose mixed gravels with occasional cobbles and infrequent small boulders. Soft sediment accumulations were present along channel margins (derived from livestock poaching). Siltation was high overall (significant plumes underfoot). Macrophytes were not recorded. Bryophyte coverage was low, with only very occasional *Chiloscyphus*

polyanthos and *Rhynchostegium riparioides* on more stable substrata. The liverwort *Pellia epiphylla* was abundant on wet muddy banks. Filamentous green algae were present on the substrata, indicating enrichment. The riparian zone supported abundant bramble and willow with common valerian (*Valeriana officinalis*) and soft rush. Downstream of the culvert, the channel was heavily bound in scrub (tunnelled) with willow vegetation. The site was bordered by wet grassland (GS4, *Juncus*-dominated) to the north and semi-improved wet pasture (GA1) to the south. Pasture and coniferous afforestation (WD3) was present upstream.

No fish were recorded via electro-fishing from site A7 (**Annex A**). Despite some physical suitability, site A7 was of low value to fisheries given its location in the headwaters of the stream, siltation pressures and frequent barriers within the catchment. Furthermore, the shallow nature of the site and likely low seasonal flows further reduced the value to fisheries. Whilst there was some low suitability for European eel, none were recorded. There was no suitability for white-clawed crayfish or freshwater pearl mussel. No otter signs were recorded in the vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q3 (poor status)** (**Annex B**). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the absence of aquatic species or habitats of higher conservation value, in addition to poor status water quality, the aquatic ecological evaluation of site A7 was of **local importance (lower value) (Table 4.4).**

Plate 4.7: Representative image of site A7 on the Fahanlunaghta Beg Stream, August 2022 (upstream of road culvert)

4.1.8 Site A8 – Fahanlunaghta Beg Stream, Illaunbaun

Site A8 was located on the Fahanlunaghta Beg Stream (28F08) at a local road crossing approx. 1 km downstream of site A7. The upland eroding watercourse (FW1) flowed under the road via a twin bore pipe culvert with a fall of 2.5 m on the downstream side that presented an impassable barrier to fish

(**Plate 4.8**). The stream had been straightened locally downstream of the road crossing (spoil heaps on banks) but some good instream recovery was evident. The spate channel flowed in a semi-natural, deeply incised channel with steep banks of up 2-3 m in height. The stream averaged 0.1-0.2 m deep, with locally deeper plunge pool associated with cascades of up to 0.5 m. A large plunge pool of 1.6 m depth was located at the road culvert. The profile was typified by riffles and shallow glides with occasional natural cascades over boulders and/or bedrock. The substrata were dominated by cobbles and coarse gravels, though boulders and bedrock were also frequent. Finer gravels and sands were present in pools. Soft sediment deposits were not present. Siltation was moderate overall, despite high flow rates. Given the spate nature and typically heavy shading, macrophytes were limited to only very occasional watercress. Bryophyte coverage was moderate, with *Chiloscyphus polyanthos* dominating. The moss *Rhynchostegium riparioides* was occasional, with *Conocephalum conicum* liverwort also frequent. The stream was heavily scrubbed with dense willow and bramble scrub, with few open areas of channel. The riparian zone also supported hawthorn, ash (*Fraxinus excelsior*) and occasional sycamore (*Acer psuedoplatanus*) in an intermittent treeline. The invasive Himalayan balsam (*Impatiens glandulifera*) was recorded at the site and was abundant along the roadside to the south-west of the site. The site was bordered by semi-improved grassland (GA1), with coniferous afforestation (WD3) present downstream.

Brown trout was the only fish species recorded via electro-fishing at site A8 (**Annex A**). The site was of moderate value for salmonids and supported a small population of mixed-cohort brown trout. The spate nature and predominance of larger substrata reduced the stream's value as a spawning habitat at this location, although some moderate quality areas were present. The site was a moderate quality nursery. Holding habitat was typically poor (shallow, spate stream) although some good quality holding pools were present in association with natural and artificial cascades. The road culvert presented an impassable barrier to upstream fish migration given the fall of c.2.5 m. Despite some low suitability, no European eel were present. The upland eroding stream was unsuitable for lamprey and none were recorded. There was no suitability for white-clawed crayfish or freshwater pearl mussel. No otter signs were recorded in the vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q3-4 (moderate status)** (**Annex B**). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the presence of salmonids, the aquatic ecological evaluation of site A8 was of **local importance (higher value) (Table 4.4).**

Plate 4.8: Representative image of site A8 on the Fahanlunaghta Beg Stream, August 2022 (downstream of fish-impassable road culvert)

4.1.9 Site A9 – Derrymore River, White's Bridge

Site A9 was located on the Derrymore River (28D03) at White's Bridge, approx. 1 km downstream of site A2. The river flowed via a masonry box culvert under a local road before flowing under the single arch bridge. The upland eroding watercourse (FW1) had likely been straightened at this location historically but showed good instream recovery. The river averaged 2 m wide and 0.2-0.4 m deep in a largely open channel (some locally heavy scrub/tunnelled downstream). The profile was of frequent riffles and shallow glides with occasional pools (to 0.6 m). The substrata were dominated by relatively loose mixed gravels and cobbles with occasional small boulders. Finer gravels and sand were present locally, adjoining pools slacks. Soft sediment deposits were absent given the spate nature of the channel. Siltation was moderate overall (primarily from peat escapement). With the exception of very occasional water starwort (*Callitriche* sp.) and watercress, macrophytes were absent. Iris (*Iris psuedacorus*) was present upstream of the box culvert. Bryophyte coverage was low given the mobile nature of the substrata. However, *Rhynchostegium riparioides* and *Chiloscyphus polyanthos* were present on larger boulders and instream debris. The liverwort *Conocephalum conicum* was abundant on the bridge apron and muddy banks (on waterline). The riparian zone supported herbaceous vegetation with treelines of mature willow. Dense willow and bramble scrub tunnelled the channel downstream of the bridge. The site was bordered by a local road and semi-improved grassland (GA1), with coniferous afforestation (WD3) present upstream and downstream.

Brown trout was the only fish species recorded via electro-fishing at site A9 (**Annex A**). The site was a good quality salmonid habitat, supporting a small population of mixed-cohort brown trout. The relatively mobile cobbles and mixed gravels provided some good spawning habitat, although the value was reduced by siltation pressures. The site was evidently a good quality nursery with ample refugia by way of bank scours and cobbles/boulders. Holding habitat, whilst present and shallow, was localised, e.g. under the bridge arch and box culvert. Despite some suitability for European eel, none were recorded. The spate channel was unsuitable for lamprey at this location. There was no suitability

for white-clawed crayfish or freshwater pearl mussel. A regular otter sprait site (mixed age) was recorded on marginal gravels under the road bridge (ITM 511761, 682670).

Biological water quality, based on Q-sampling, was calculated as **Q3 (poor status)** (**Annex B**). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the presence of salmonids, the aquatic ecological evaluation of site A9 was of **local importance (higher value) (Table 4.4).**

Plate 4.9: Representative image of site A9 on the Derrymore River, August 2022 (facing upstream from bridge)

4.1.10 Site A10 – Derrymore River, Derrymore Bridge

Site A10 was located on the Derrymore River (28D03) at Derrymore Bridge, approx. 4.5 km downstream of site A9. The upland eroding watercourse (FW1) averaged 2.5-3 m wide and 0.2-0.3 m deep, with occasional deeper pools to 0.7 m. Whilst modified in the vicinity of a twin bore box culvert (revetment etc.), the river was natural elsewhere. The meandering profile comprised swift glides with frequent riffles and pools, with frequent scouring of the banks of meanders indicative of the spate nature. The substrata were dominated by loose mixed gravels and cobbles, with only occasional boulders. Finer gravels and sands were deposited along the margins (typically exposed under normal flows). Soft sediment accumulations were present but clay- and/or sand-dominated and invariably in the inundation zone (i.e. only covered during spate). However, some soft sands were present adjoining a large pool upstream of the bridge. Natural scouring had led to slumping of clay into the river on several meanders. Given the spate nature of the channel, macrophytes were limited although water horsetail (*Equisetum fluviatile*), brooklime (*Veronica beccabunga*) and water starwort (*Callitriche* sp.) were all occasional. Exposed gravel bars supported purple loosestrife (*Lythrum salicaria*) and the invasive Himalayan balsam. Bryophyte coverage was low given mobile substrata. *Chiloscyphus polyanthos and Rhynchostegium riparioides* were both occasional. Stands of iris were present but localised. The liverwort species *Pellia* and *Marchantia polymorpha* were abundant on exposed banks

(along the waterline). The well-developed riparian zone supported abundant bramble, nettle (*Urtica dioica*), angelica and hedge bindweed (*Calystegia sepium*), frequent common valerian and purple loosestrife and occasional Himalayan balsam, in addition to abundant grey willow (*Salix cinerea*). The site was bordered by scrub (WS1), dry meadows, grassy verges (GS2) and wet grassland (GS4).

Brown trout, European eel and three-spined stickleback (*Gasterosteus aculeatus*) were recorded via electro-fishing at site A10 (**Annex A**). The site was considered a very good salmonid habitat, supporting a population of mixed-cohort brown trout. The predominance of uncompacted mixed gravels provided good quality spawning habitat. The site's value as a nursery was moderate owing to a general paucity of instream refugia. Although localised, some excellent quality holding habitat for adults was present, including deep pools and scoured banks. No Atlantic salmon were recorded via electro-fishing, despite some suitability. However, environmental DNA analysis at the site produced a positive, albeit weak result, for Atlantic salmon, signifying the presence of the species at or upstream of the site (see **section 4.4**). Despite some good suitability for European eel, only a low density was recorded. Whilst some suitable soft sediment areas for lamprey ammocoetes were present adjoining pool areas, these were typically located in very shallow water and sand-clay-dominated (i.e. sub-optimal). The spate nature of the site reduced the suitability for lamprey and none were recorded. There was no suitability for white-clawed crayfish. Despite some low suitability, eDNA analysis did not detect freshwater pearl mussel DNA at or upstream of the site (**section 4.4**). Despite good foraging suitability, no otter signs were recorded in the vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q3-4 (moderate status)** (**Annex B**). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the presence of salmonids and Red-listed European eel, the aquatic ecological evaluation of site A10 was of **local importance (higher value) (Table 4.4).**

Plate 4.10: Representative image of site A10 on the Derrymore River at Derrymore Bridge, August 2022 (facing downstream to bridge)

4.1.11 Site L1 – Lough Keagh

Lough Keagh, also known locally as Rockmount Lake, was an upland lake covering approx. 7 ha. The lake averaged 5-12 m deep with a maximum depth[3] of 14.8 m. The lake was heavily peat stained at the time of survey.

The lake margins featured compacted cobble and boulder substrata with a light deposition of peat given the surrounding blanket bog which sloped on all sides to the lake.

The littorals supported frequent water horsetail and occasional common clubrush (*Schoenoplectus lacustris*), with more occasional floating bur-reed (*Sparganium angustifolium*) and stonewort (*Chara* sp.). The moss species *Fontinalis antipyretica* was occasional on larger marginal boulder.

The paludal zone (inundated at the time of survey) supported abundant spike rush (*Eleocharis lacustris*), marsh pennywort (*Hydrocotyle vulgaris*), *Sphagnum cuspidatum* and marsh cinquefoil (*Comarum palustre*), with occasional bog bean (*Menyanthes trifoliata*). Marsh ragwort (*Jacobaea aquatica*) was also occasional.

The sloping land adjoining the lake supported wet grassland (GS4) and mosaics of wet heath (HH3) with abundant soft rush, purple moor grass (*Molinia caerulea*), bracken (*Pteridium aquilinum*), heather, cross-leaved heath (*Erica tetralix*), common valerian and wild angelica to the west, coniferous afforestation (WD3) to the north and blanket bog to the east and south.

Lough Keagh is known to support a recreationally valuable stock of wild brown trout, with supplemental stocking also undertaken by the local angling club. Wave-washed gravels and cobbles (windward shoreline) likely provide some limited spawning habitat for salmonids, given the absence of a suitable inflowing channel. The lake had high suitability for European eel and likely supports three-spined stickleback. Environmental DNA analysis confirmed the presence of brown trout and European eel, in addition to smooth newt (see **section 4.4**). No white-clawed crayfish were recorded via hand-searching and there are no records for the species in the lake. Despite some suitability, no otter signs were recorded in the vicinity of the lake.

The lake site was not suitable for biological water quality assessment via Q-sampling. However, a composite sweep sample was taken to gain a representation of the macro-invertebrate community. No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded (**Annex B**).

Given the presence of salmonids, Red-listed European eel and smooth newt (protected by the Irish Wildlife Acts 1976-2023), the aquatic ecological evaluation of site L1 was of **local importance (higher value) (Table 4.4).**

[3] *Bathymetry map available at https://www.gpsnauticalcharts.com/main/ii_ie_28_64_keagh-keagh-lough-nautical-chart.html*

Plate 4.14: Representative image of Lough Keagh from the south-western shoreline, August 2022

4.1.12 Site B1 – Glendine River, Tooreen

Site B1 was located at the headwaters of the Glendine River (28G02). At this location the river represented a drainage channel that averaged 1-1.5 m wide and 0.1-0.2 m deep. The channel was not flowing at the time of survey (seepage area) and showed signs of being ephemeral (only holding significant water after rainfall). The channel featured a bed of silt/mud and did not support macrophytes apart from very occasional water mint and abundant *Sphagnum cuspidatum* (the latter characteristic of wet heath/bog habitat). The channel featured heavy terrestrial encroachment from grey willow, purple moor grass, tormentil (*Potentilla erecta*), cross-leaved heath, bog myrtle, bramble and scattered sitka spruce (*Picea sitchensis*). The site was bordered by blanket bog supporting abundant rushes (*Juncus* spp.), bog cotton (*Eriophorum angustifolium*) and *Sphagnum* spp. mosses.

No fish were recorded via electro-fishing from site B1 (**Annex A**). The river at this location was not of value to fisheries given its ephemeral nature and location in the uppermost reaches of the catchment. There was no suitability for white-clawed crayfish or freshwater pearl mussel. No otter signs were recorded in the vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q3 (poor status)** (**Annex B**). However, it should be noted that this is a tentative rating given poor flows and lack of suitable riffle areas for sampling (as per Toner *et al.*, 2005). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the absence of aquatic species or habitats of higher conservation value, in addition to poor status water quality, the aquatic ecological evaluation of site B1 was of **local importance (lower value) (Table 4.4).**

Plate 4.11: Representative image of site B1 at the headwaters of the Glendine River, August 2022

4.1.13 Site B2 – unnamed stream, Tooreen

Site B2 was located on an unnamed, unmapped (by the EPA) Glendine River tributary at a farm track crossing. At this location, the small upland eroding watercourse (FW1) had been straightened and deepened in the recent past. The channel averaged <1 m wide and 0.05-0.1 m deep (following rainfall) in a steep trapezoidal channel with 1.5-2 m bankfull heights. The river was swift flowing following recent rainfall but was considered to likely suffer from very low seasonal flows in its upper reaches. The substrata comprised recently excavated/exposed angular cobbles and boulders with mixed gravels which were soft and heavily silted. The profile comprised very shallow riffles and glides with no pools in the vicinity of the track crossing. With the exception of very localised watercress, macrophytes were absent. The only bryophytes recorded were the moss *Rhynchostegium riparioides* and the liverwort *Chiloscyphus polyanthos* which were occasional on rare larger cobbles and small boulders. The riparian zone was heavily scrubbed with abundant bramble, *Cotoneaster* sp., bracken, purple loosestrife, wild angelica and meadowsweet (*Filipendula ulmaria*). The site was bordered by improved pasture (mostly wet) (GA1).

Cotoneaster species are a medium impact invasive non-native species posing risk to vegetation and biodiversity.

No fish were recorded via electro-fishing from site B2 (**Annex A**). The stream at this location was not of value to fisheries given its ephemeral nature and location in the uppermost reaches of the catchment. There was no suitability for white-clawed crayfish or freshwater pearl mussel. No otter signs were recorded in the vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q3 (poor status)** (**Annex B**). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the absence of aquatic species or habitats of higher conservation value, in addition to poor status water quality, the aquatic ecological evaluation of site B2 was of **local importance (lower value) (Table 4.4).**

Plate 4.12: Representative image of site B2 on an unnamed Glendine River tributary, August 2022

4.1.14 Site B3 – Kilcorcoran Stream, Ballynew

Site B3 was located on the headwaters of the Kilcorcoran Stream (28K11) at a local road crossing. The upland eroding watercourse (FW1) had been straightened and deepened historically but showed some recovery instream, with steep banks of 2-2.5 m. The stream flowed under a box culvert with significant barriers present upstream by way of a number of pipe culverts and an old headwall. The stream averaged 0.5-1 m wide and <0.1 m deep. The profile was of very shallow riffles and glides with very occasional shallow pools (max of 0.3 m). The substrata were dominated by mixed gravels with occasional bedrock and infrequent boulders and cobbles. Siltation was moderate overall given typically low flow rates. Soft sediment deposits were not present. Peat staining was moderate at the time of survey (site draining upland bog). The very narrow stream was heavily shaded and tunnelled and did not support macrophytes. However, the bryophytes *Chiloscyphus polyanthos* and *Pellia epiphylla* were present on wet muddy banks and small boulders. The stream was very heavily tunnelled with dense scrub vegetation dominated by willow, gorse (*Ulex europaeus*) and bramble. The site was bordered by wet improved grassland (GA1).

No fish were recorded via electro-fishing from site B3 (**Annex A**). The stream at this location was not of value to fisheries given its very shallow nature and location in the uppermost reaches of the catchment. There was no suitability for white-clawed crayfish or freshwater pearl mussel. No otter signs were recorded in the vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q2-3 (poor status)** (**Annex B**). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the absence of aquatic species or habitats of higher conservation value, in addition to poor status water quality, the aquatic ecological evaluation of site B3 was of **local importance (lower value) (Table 4.4).**

Plate 4.13: Representative image of site B3 on the upper reaches of the Kilcorcoran Stream, August 2022 (downstream of box culvert)

4.1.15 Site B4 – Kilcorcoran Stream, Ballynew Bridge

Site B4 was located on the Kilcorcoran Stream (28K11) Ballynew Bridge approx. 0.9 km downstream of site B3. The upland eroding watercourse (FW1) flowed under the local road via a masonry box culvert (revetment present near bridge but good instream recovery). The stream flowed over a moderate gradient in a deeply incised valley with bankfull heights of 5-6 m and steep sloping banks. The upland stream averaged 2 m wide (in a 3 m wide channel) and 0.1-0.15 m deep. The profile comprised very shallow glides and riffles with only localised small pools associated with cascades (0.3 m max depth). The substrata were dominated by angular cobbles and mixed gravels with occasional boulders. Bedrock was also present locally. These were both compacted and very heavily silted, with significant plumes under foot. Soft sediment accumulations were not present. Large woody debris was frequent instream and formed frequent barrier to flow. Extensive, long-term fly-tipping of household refuse was observed at the site (including instream). Given very heavy shading (tunnelling), macrophytes were not present. Bryophyte coverage was low with only very occasional *Rhynchostegium riparioides*. The liverwort *Conocephalum conicum* was present on muddy banks. The stream was heavily tunnelled by dense hazel, fuchsia (*Fuchsia magellanica*), willow, ivy, fern and honeysuckle (*Lonicera periclymenum*) with a well-developed terrestrial moss community on valley escarpments. Extensive stands of the invasive Himalayan knotweed (*Persicaria wallichii*) were present upstream of the road crossing (where the channel was also very heavily tunnelled). The site was bordered by dense scrub, with adjoining improved pasture (GA1).

No fish were recorded via electro-fishing from site B4 (**Annex A**). Despite some (low) physical suitability, site B4 was not of value to fisheries given its location in the headwaters of the stream,

frequent natural barriers and evident water quality issues (e.g. heavy siltation). Furthermore, the uppermost reaches also likely suffer from low seasonal flows, further reducing their value to fisheries (often 0.1 m deep even after heavy rainfall). There was no suitability for white-clawed crayfish or freshwater pearl mussel. No otter signs were recorded in the vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q3-4 (moderate status)** (**Annex B**). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the absence of aquatic species or habitats of higher conservation value, in addition to moderate status water quality, the aquatic ecological evaluation of site B4 was of **local importance (lower value) (Table 4.4).**

Plate 4.15: Representative image of site B4 on the Kilcorcoran Stream, August 2022 (downstream of road culvert)

4.1.16 Site B5 – Glendine River, Knockloskeraun Bridge

Site B5 was located on the Glendine River at Knockloskeraun Bridge, approx. 5 km downstream of site B4. The natural upland eroding river (FW1) averaged 4-6 m wide and 0.2-0.4 m deep. The profile comprised shallow glides and riffles with occasional pools (deeper upstream than downstream). Natural scouring of the soft, 1-1.5 m high banks was frequent. The substrata were dominated by loose cobbles and mixed gravels. Boulders were occasional. Finer gravels and sands were present along channel margins and adjoining pool areas. Shallow soft sediment (c.5 cm depth) was present but localised (e.g. adjoining the bridge abutment on the upstream side, north bank). Siltation was moderate overall (considerable plumes underfoot). Livestock poaching was evident in the vicinity of the bridge. Bedrock dominated downstream of the bridge for >100 m with no gravel, cobbles or boulders. Whilst open in the vicinity of the bridge, the river was highly shaded elsewhere (often tunnelled). As a result, macrophyte growth was sparse with occasional watercress and brooklime along channel margins. Hemlock water dropwort (*Oenanthe crocata*) was present but rare on exposed gravel bars and margins. In terms of bryophytes, *Rhynchostegium riparioides* was present but rare

given a paucity of stable boulders. The liverwort species *Pellia epiphylla* and *Lunularia cruciata* were frequent on shaded muddy banks. The river was lined by mature and scrubby willow, blackthorn and gorse with non-native montbretia (*Crocosmia x crocosmiiflora*) also scattered throughout. The site was bordered by treelines, bracken scrub (HH3) and improved pasture (GA1).

Brown trout and European eel were the only fish species recorded via electro-fishing at site B5 (**Annex A**). The site was of high value for both salmonids, with a mixed-cohort population of brown trout present. Good quality salmonid spawning habitat was present in vicinity of the bridge, though the value was reduced due to siltation pressures. Good quality nursery habitat was also present, though was considered sub-optimal due to a paucity of instream refugia. Whilst localised, good quality holding habitat for migratory adults was also present. Despite good suitability and proximity to the sea (c.2 km downstream), Atlantic salmon were not recorded, which may reflect the presence of downstream barriers. Whilst Atlantic salmon are known from the site (Kelly *et al.*, 2010, 2014), eDNA analysis at the site produced a negative result for Atlantic salmon, indicating the absence of the species at or upstream of the site (see **section 4.4**). The site was also of high value for European eel with a moderate density of primarily adults recorded. The twin arch masonry bridge featured frequent crevices which provided highly suitable refugia for eel. Despite some suitability in terms of both spawning and soft sediment (ammocoete) habitat, no lamprey were recorded during targeted electro-fishing. There was no suitability for white-clawed crayfish. Environmental DNA analysis did not detect freshwater pearl mussel DNA at or upstream of the site (**section 4.4**). No otter signs were recorded in the vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q3-4 (moderate status)** (**Annex B**). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the presence of salmonids and Red-listed European eel, the aquatic ecological evaluation of site B5 was of **local importance (higher value) (Table 4.4).**

Plate 4.16: Representative image of site B5 on the Glendine River at Knockloskeraun Bridge, August 2022 (facing upstream from bridge)

4.1.17 Site C1 – Ballinphonta River, Drumbaun

Site C1 was located on the upper reaches of the Ballinphonta River (28B03) (also known as the Carrowkeel River) at a livestock access point. The upland eroding stream (FW1) had been historically modified and straightened, with a culvert (and revetment) evident. The stream flowed over a slight gradient (on a hill top) before entering a deeply incised, high gradient valley downstream of the survey site. The small river channel averaged 1.5 m wide and 0.1-0.2 m deep. Swift glides and riffles predominated with occasional cascades over boulders and bedrock (increasing, moving downstream). Angular cobbles and boulders predominated the substrata with mixed gravels present interstitially. Siltation was high although no soft sediment accumulations were present given the spate nature of the watercourse. High shading and high flow rates inhibited macrophyte growth, which were limited to very occasional watercress and water starwort (*Callitriche* sp.) in pool slacks and along channel margins. In term of bryophytes, *Fontinalis antipyretica* was frequent on larger boulders, with occasional *Chiloscyphus polyanthos* and *Racomitrium aciculare* (above water line) and rare *Scapania undulata* and *Rhynchostegium riparioides*. The liverwort *Pellia epiphylla* was present on muddy banks and exposed rock. With the exception of a small area at the survey site (livestock access point), the stream was very heavily tunnelled (inaccessible) throughout the valley by dense bramble and willow scrub, with occasional fuchsia and frequent gorse. The site was bordered by improved pasture (GA1) and wet grassland (GS4).

European eel was the only fish species recorded via electro-fishing at site C1 (**Annex A**). Despite some physical suitability, site C1 was of low value to fisheries given its location in the headwaters of the river, significant siltation pressures (primarily from livestock poaching) and high natural gradients which evidently inhibited fish passage. Furthermore, the shallow nature of the site and likely low seasonal flows further reduced the value to fisheries. Whilst there was some low suitability for European eel (able to navigate high gradients better than salmonids), only a single juvenile was recorded. There was no suitability for white-clawed crayfish or freshwater pearl mussel. No otter signs were recorded in the vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q3 (poor status)** (**Annex B**). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the presence of salmonids, the aquatic ecological evaluation of site C1 was of **local importance (higher value) (Table 4.4).**

Plate 4.17: Representative image of site C1 on the uppermost reaches of the Ballinphonta River, August 2022

4.1.18 Site C2 – Ballinphonta River, Drumbaun

Site C2 was located on the Ballinphonta River (28B03) approx. 0.8 km downstream of site C1. The small upland eroding watercourse (FW1) flowed over a slight gradient and had been straightened and deepened historically for a c.50 m section in wet pasture downstream of a farm access track crossing. The swift flowing river averaged 1.5 m wide and 0.1-0.15 m deep, with bankfull heights from 0.5 m (trampled via livestock access) to 1.5 m. The profile comprised very shallow glides and riffles with very localised pools to a maximum depth of 0.25 m. The river had been over-widened in places due to livestock poaching (**Plate 4.18**). The substrata were dominated by angular cobbles and boulders, with frequent mixed gravels. Sands were present along channel margins. Soft sediment accumulations originating from livestock poaching were also present along the channel margins. Siltation was high overall (significant plumes underfoot). Macrophyte growth was sparse with only occasional brooklime, water forget-me-not (*Myosotis scorpioides*) and water starwort (*Callitriche* sp.) along river margins. Aquatic bryophyte growth was also limited, with only very rare *Chiloscyphus polyanthos*. The site was located in an area of sloping wet grassland (GS4) dominated by soft rush, with scattered willow, gorse and bramble scrub along channel margins. Tunnelling by scrub vegetation was high upstream and downstream of the survey area.

Brown trout and European eel were the only fish species recorded via electro-fishing at site C2 (**Annex A**). The site was of moderate value to salmonids, with only a small population of juvenile brown trout present. Significant siltation pressures (various sources) reduced the quality of spawning and nursery habitat. Holding habitat by way of deeper pool and glide were absent and thus the holding habitat was of poor quality. Several instream barriers to migration were also present by way of natural and anthropogenic cascades and blockages. The site was of moderate value to European eel (plentiful refugia) with a very low density recorded. Whilst some organic-rich soft sediment accumulations were present, no lamprey ammocoetes were recorded via targeted electro-fishing – the upland nature of

the site may preclude the species. There was no suitability for white-clawed crayfish or freshwater pearl mussel. No otter signs were recorded in the vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q3 (poor status)** (**Annex B**). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the presence of salmonids and Red-listed European eel, the aquatic ecological evaluation of site C2 was of **local importance (higher value) (Table 4.4).**

Plate 4.18: Representative image of site C2 on the upper reaches of the Ballinphonta River, August 2022

4.1.19 Site C3 – Drumbaun River, Lackamore

Site C3 was located at the headwaters of the Drumbaun River (28D20). The small upland eroding watercourse (FW1) emanated from a small seepage area of wet grassland (GS4) exposed to livestock (cattle) poaching pressures. The diminutive stream averaged 0.5 m wide and <0.05 m deep and flow over a moderate gradient in a deeply incised peaty channel with bankfull heights of 1-1.5 m. The profile comprised very shallow riffles and glides with occasional pools associated with natural cascades. The substrata were dominated by angular cobbles and mixed gravels which were very heavily silted due to siltation pressures. The small stream was heavily tunnelled (with scoured banks) and did not support macrophytes. Aquatic bryophytes were also absent, with *Fissidens* sp. moss and *Pellia* sp. liverwort on muddy, heavily shaded banks. The site was situated in an area of wet sloping grassland (GS4) and was adjoined (up-slope) by coniferous afforestation (WD3) and downstream by semi-improved pasture (GA1).

No fish were recorded via electro-fishing from site C3 (**Annex A**). The diminutive site was not of value to fisheries given its location at the headwaters of the stream, high natural gradients, frequent natural barriers (cascades) and heavy siltation (livestock poaching & afforestation). There was no suitability for white-clawed crayfish or freshwater pearl mussel. No otter signs were recorded in the vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q2 (bad status)** (**Annex B**). However, it should be noted that this is a tentative rating given poor flows and lack of suitable riffle areas for sampling (as per Toner *et al.*, 2005). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the absence of aquatic species or habitats of higher conservation value, in addition to poor status water quality, the aquatic ecological evaluation of site C3 was of **local importance (lower value) (Table 4.4).**

Plate 4.19: Representative image of site C3 on the upper reaches of the Drumbaun River, August 2022

4.1.20 Site C4 – Drumbaun River, Kilfarboy Church

Site C4 was located on the Drumbaun River (28D20) at a local road crossing at Kilfarboy Church, approx. 1.5 km downstream of site C3. The small upland eroding watercourse (FW1) flowed over a slight gradient and under the local road via a twin bore pipe culvert. This culvert featured a rendered apron with a 0.5 m fall on the downstream side. Aside from these modifications, the stream was natural in profile elsewhere. The stream averaged 1 m wide and 0.1-0.2 m deep, with only very limited deeper pool to 0.4 m. Bank scouring was frequent, indicating the spate nature of the river. The profile comprised riffles and very shallow glides, with very limited pool habitat (especially upstream of the culvert). The substrata were dominated by compacted cobbles and looser mixed gravels. Boulders were rare. Soft sediment accumulations were not present but siltation was moderate overall (plumes underfoot). Given swift flows and high shading, macrophyte growth was limited to only very occasional watercress and water starwort (*Callitriche* sp.). Aquatic bryophyte coverage was low, with rare *Rhynchostegium riparioides* and *Chiloscyphus polyanthos* present on infrequent boulders. *Fissidens* sp. moss and the liverwort *Conocephalum conicum* was present on undercut, shaded banks. The riparian zone supported a well-developed herbaceous community with abundant purple loosestrife, great willowherb, meadowsweet, hedge bindweed and ferns. Non-native montbretia was also abundant throughout the site. Very dense willow-dominated vegetation, causing heavy tunnelling

of the river, was present upstream and downstream of the survey site. The site was bordered by scrub (WS1), improved grassland (GA1) and amenity grassland (GA2).

Brown trout and European eel were the only fish species recorded via electro-fishing at site C4 (**Annex A**). The site was of moderate value only for salmonids, supporting a very small mixed-cohort population of brown trout. This reflected poor spawning opportunities (compacted & silted substrata) and relatively poor nursery conditions. Whilst holding habitat was present in association with the rendered culvert apron, deeper areas for migratory adults was largely absent elsewhere. The river likely suffers from low seasonal flows at this location, further reducing its value to fisheries. The culvert apron was considered a barrier to fish at low flows. European eel habitat was moderate, with a low density recorded via electro-fishing. There was no suitability for white-clawed crayfish or freshwater pearl mussel. No otter signs were recorded in the vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q3-4 (moderate status)** (**Annex B**). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the presence of salmonids and Red-listed European eel, the aquatic ecological evaluation of site C4 was of **local importance (higher value) (Table 4.4).**

Plate 4.20: Representative image of site C4 on the Drumbaun River at Kilfarboy Church, August 2022 (facing downstream from bridge)

4.1.21 Site C5 – Ballinphonta River, Carrowkeel Bridge

Site C5 was located on the Ballinphonta River (28B03) at Carrowkeel Bridge (single arch bridge), approx. 1.8 km downstream of site C2. The upland eroding watercourse (FW1) had been deepened but not straightened in the vicinity of the bridge, with historical spoil (boulders) evident on the west bank. The river mostly flowed in a U-shaped channel with bankfull heights of 2 m (deeper and more trapezoidal near the bridge). The river averaged 3-4 m wide and 0.1-0.3 m deep, with locally deeper pools to 0.6 m. The profile was of glides and frequent small pools with occasional riffles. Large woody

debris was frequent instream and created numerous pool areas. Bank scouring was evident throughout, indicative of the spate nature of the channel. The substrata were dominated by compacted angular boulders and cobbles (including flagstone), with interstitial mixed gravels and occasional bedrock. Finer gravels and sands were present at the tailings and margins of larger pools. Siltation was moderate despite high flow rates (indicating upstream pressures). Soft sediment accumulations were not present given high flow rates. Given the compacted substrata and high riparian shading, macrophyte growth was sparse with only occasional hemlock water dropwort and rare watercress and water horsetail. In terms of aquatic bryophytes, coverage was low with only occasional *Rhynchostegium riparioides* and rare *Hygroamblystegium* sp. and *Scapania undulata*. The foliose lichen *Xanthoparmelia conspersa* was abundant on the tops of instream boulders. Filamentous algae were present (1 %) indicating enrichment. The river was heavily shaded with mature willow-dominated treelines along both banks, in addition to ash, gorse, bramble and non-native montbretia. The site was bordered by improved agricultural grassland (GA1) with mosaics of wet grassland (GS4).

Brown trout and European eel were the only fish species recorded via electro-fishing at site C5 (**Annex A**). The site was of moderate value to salmonids, with a small population of mixed-cohort brown trout present. Salmonid spawning habitat was of moderate quality given compaction and siltation of the bed. Nursery habitat was also of moderate quality, with abundant boulders and cobbles generally not accessible as refugia (due to compaction/bedding). Some good quality holding habitat was present but highly localised (e.g. under bridge). The site was of moderate value for European eel, with instream refugia present but compromised by compaction. The high energy site was unsuitable for lamprey and none were recorded. There was no suitability for white-clawed crayfish and low suitability for freshwater pearl mussel. Despite some suitability, no otter signs were recorded in the vicinity of the survey site.

Biological water quality, based on Q-sampling, was calculated as **Q3 (poor status)** (**Annex B**). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the presence of salmonids and Red-listed European eel, the aquatic ecological evaluation of site C5 was of **local importance (higher value) (Table 4.4).**

Plate 4.21: Representative image of site C5 on the Ballinphonta River, August 2022 (downstream of road crossing)

4.1.22 Site C6 - Ballinphonta River, Cloonbony Bridge

Site C6 was located on the Ballinphonta River (28B03) at Cloonbony Bridge on the N67 road, approx. 2.6 km downstream of site C5. The upland eroding watercourse (FW1) had been straightened and deepened in vicinity of the bridge, with historical bank clearance and modifications (revetment) also evident. The trapezoidal channel featured steep banks of 2-3 m high. The river averaged 4 m wide and 0.2-0.3 m deep. The profile was typified by shallow glides and riffles with only very occasional pools (largely confined to the bridge). The substrata were dominated by highly compacted cobbles with interstitial mixed gravels and only very infrequent small boulders. Underneath the bridge, sand and silt deposits were present along the channel margins although these are likely exposed for much of the year. Siltation was moderate overall. Macrophyte growth was sparse although hemlock water dropwort, watercress and water starwort (*Callitriche* sp.) were all present and occasional. Ivy-leaved crowfoot (*Ranunculus hederaceus*) was present in the littoral mud near the pipe inflow at the bridge (an evident source of enrichment). In terms of aquatic bryophytes, *Fontinalis antipyretica* and *Rhynchostegium riparioides* was frequent, with rare *Chiloscyphus polyanthos*. The riparian zone supported abundant montbretia, purple loosestrife, great willowherb and bramble, with angelica, ragwort and nettle. Trees (and therefore riparian shading) were absent (historically cleared). The site was bordered by improved agricultural grassland (GA1).

Brown trout and European eel were the only fish species recorded via electro-fishing at site C6 (**Annex A**). The site was of moderate value to salmonids, with a population of mixed-cohort brown trout present. Salmonid spawning habitat was of moderate quality given compaction of the bed. Nursery habitat was also of moderate quality, with abundant boulder and cobble generally not accessible as refugia (due to compaction/bedding). Some good quality holding habitat was present in the vicinity of the bridge (and underneath) but absent elsewhere. No Atlantic salmon were recorded via electro-fishing, despite some suitability. However, eDNA analysis at the site produced a positive, albeit weak result, for Atlantic salmon, signifying the presence of the species at or upstream of the site (see **section**

4.4). The site was evidently of high value as a European eel nursery, with a relatively high density of juveniles recorded. However, the value of the site was reduced due to substrata sedding. Despite the presence of some localised soft sediment underneath the bridge, no lamprey ammocoetes were recorded (**Annex A**). There was no suitability for white-clawed crayfish. Environmental DNA analysis did not detect freshwater pearl mussel DNA at or upstream of the site (**section 4.4**). Fresh otter prints were recorded on the muddy bridge ledge (ITM 504815, 680262).

Biological water quality, based on Q-sampling, was calculated as **Q3 (poor status)** (**Annex B**). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the presence of salmonids and Red-listed European eel, in addition to utilisation by Annex II otter, the aquatic ecological evaluation of site C6 was of **local importance (higher value) (Table 4.4).**

Plate 4.22: Representative image of site C5 on the Ballinphonta River at Cloonbony Bridge, August 2022 (facing upstream towards bridge)

4.2 White-clawed crayfish

No white-clawed crayfish were recorded via hand-searching or sweep netting of instream refugia during the survey. Furthermore, environmental DNA analysis of samples collected from the Derrymore River (site A10), Glendine River (B5) and Ballinphonta River (C6) failed to detect white-clawed crayfish DNA (see **section 4.4**). This result was considered as evidence of the species' absence from the wider survey area and corroborated the known distribution of the species in Co. Clare (i.e. no records within the R07, R08 or R18 10 km grid squares; **section 3.3**).

4.3 Otter signs

Whilst a full otter survey was beyond the scope of this survey, signs were recorded, where encountered. Despite some good suitability at numerous survey locations, otter signs were only recorded at a total of two locations during the course of aquatic surveys undertaken in August 2022.

A regular otter spraint site was recorded on marginal gravels under White's Bridge on the Derrymore River (site A9) (ITM 511761, 682670).

Fresh otter prints were recorded on littoral mud on the bridge ledge at Cloonboony Bridge on the Ballinphonta River (site C6) (ITM 504815, 680262).

No breeding (holts) or resting (couch) areas were identified in the vicinity of the survey sites in August 2022.

4.4 eDNA analysis

Composite water samples collected from the Derrymore River (FK616), Glendine River (FK617) and Ballinphonta River (FK629) returned a negative result for freshwater pearl mussel and white-clawed crayfish eDNA, i.e. freshwater pearl mussel and white-clawed crayfish eDNA not present or was present below the limit of detection in a series of 12 qPCR replicates (0 positive replicates out of 12, respectively) (**Table 4.1**; **Annex C**). These results were considered as evidence of the species' absence at and/or upstream of the sampling locations.

Crayfish plague DNA was detected in the Derrymore River (2 positive replicates out of 12) (**Table 4.1**; **Annex C).**

In light of an absence of Atlantic salmon during electro-fishing surveys, composite water samples from the Derrymore River (site A10), Glendine River (B5) and Ballinphonta River (C6) were analysed for Atlantic salmon DNA. The Derrymore River and Ballinphonta River samples produced a positive result for the species (i.e. 1 and 2 positive replicates out of 12, respectively) (**Table 4.1**; **Annex C**). Atlantic salmon eDNA was not detected in the Glendine River sample, despite the known historical presence of the species in the river (Kelly *et al.*, 2010; 2014).

The Lough Keagh sample (FK621) tested positive for brown trout, European eel and smooth newt eDNA (12, 1, and 12 of 12 qPCR replicates, respectively) (**Table 4.1**). These results were considered as evidence of the species' presence within the lake.

Table 4.1: eDNA results in the vicinity of the Proposed Development, Co. Clare (positive qPCR replicates out of 12 in parentheses)

Sample	Watercourse	Freshwater pearl mussel	White-clawed crayfish	Crayfish plague	Atlantic salmon	Brown trout	European eel	Smooth newt
FK616	Derrymore River (site A10)	Negative (0/12)	Negative (0/12)	**Positive (2/12)**	**Positive (1/12)**	n/a	n/a	n/a
FK617	Glendine River (site B5)	Negative (0/12)	Negative (0/12)	Negative (0/12)	Negative (0/12)	n/a	n/a	n/a
FK629	Ballinphonta River (site C6)	Negative (0/12)	Negative (0/12)	Negative (0/12)	**Positive (2/12)**	n/a	n/a	n/a
FK621	Lough Keagh (L1)	n/a	n/a	n/a	n/a	**Positive (12/12)**	**Positive (1/12)**	**Positive (12/12)**

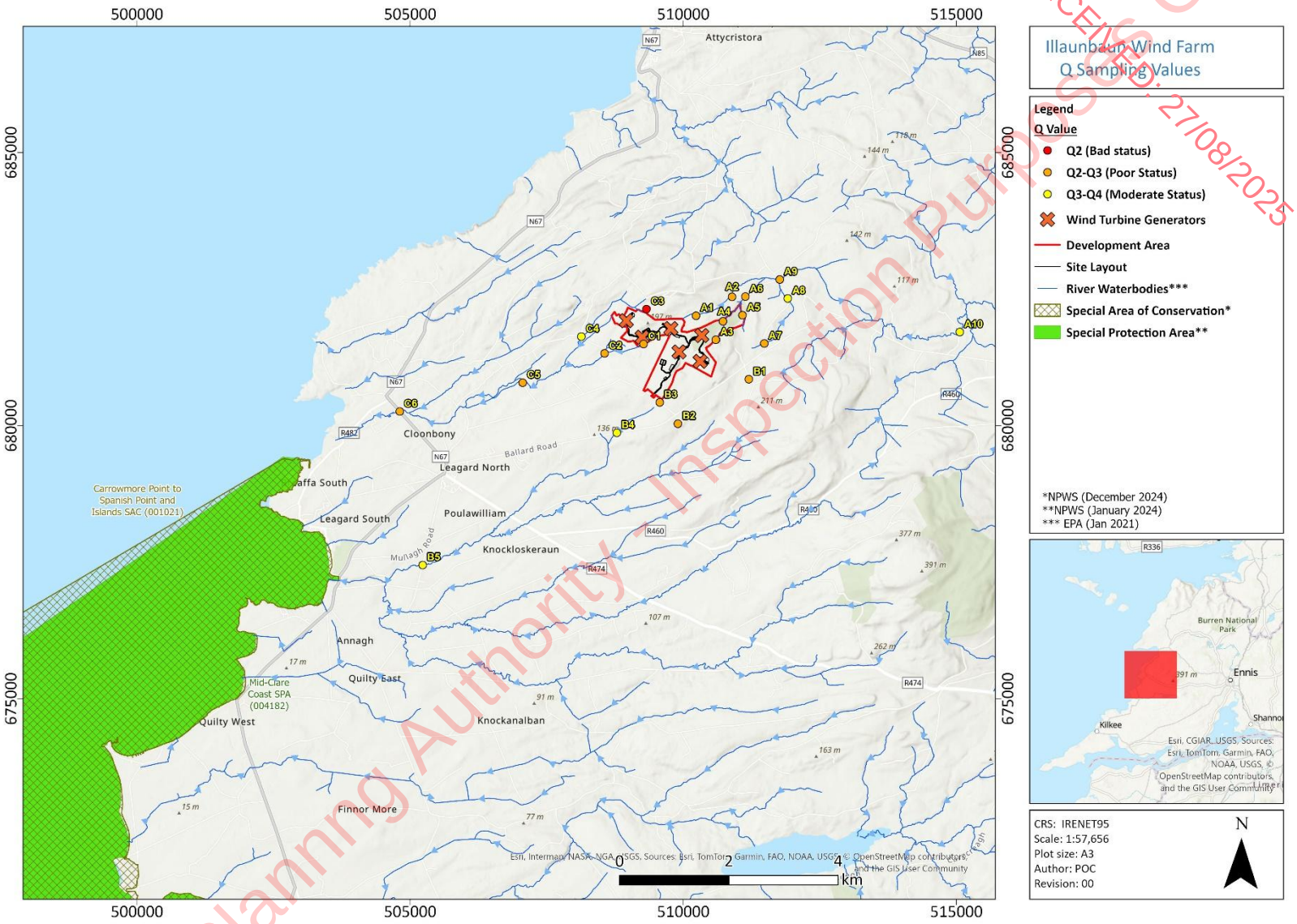

Figure 4.1: Overview of the biological water quality status in the vicinity of the Proposed Development August 2022

4.5 Invasive aquatic species

No aquatic invasive species were recorded during the survey of a total of 21 rivers and watercourses sites or Lough Keagh in August 2021.

However, the invasive terrestrial plant Himalayan knotweed (*Persicaria wallichii*) was abundant along the roadside and riparian zone immediately upstream of survey site B4 on the Kilcorcoran Stream. Himalayan balsam was also recorded at A8 along the Illaunbaun. Both plants are listed on the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations 2011-2021 (S.I. 477/2011) and the first schedule of the IAS of national concern in the European Union (Invasive Alien Species) Regulations 2024 (S.I. No. 374 of 2024). Both are considered a high-impact species in Ireland.

The non-native terrestrial plant montbretia (Crocosmia x crocosmiiflora) was recorded from sites B5 on the Glendine River and site C4 on the Drumbaun River and sites C5 and C6 on the Ballinphonta River.

Cotoneaster sp. was also observed at B2 along an unnamed stream.

4.6 Biological water quality (macro-invertebrates)

No rare or protected macro-invertebrate species (according to national red lists) were recorded in the biological water quality samples taken from 21 river and watercourse sites and a single lake site in August 2022 (**Annex B**).

None of the survey sites achieved target good status (≥Q4) requirements of the European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2019 and the Water Framework Directive (2000/60/EC) (Figure 4.1above).

Sites A8 (Fahanlunaghta Beg Stream), A10 (Derrymore River), B4 (Kilcorcoran Stream), B5 (Glendine River) and C4 (Drumbaun River) achieved **Q3-4 (moderate status)** water quality. This was given the low numbers (<5 %) of group A species such as flattened mayflies (Heptageniidae), a low number of group B species such as *Leuctra hippopus* and *Sericostoma personatum*, and a dominance of group C species such as the mayfly *Baetis rhodani*, freshwater shrimp (*Gammarus duebeni*) and the non-native mollusc *Potamopyrgus antipodarum* (**Annex B**). Site B4 was the only site to support the group A stonefly species *Nemoura cinerea*.

With the exception of site C3 (see below), the remaining sites (i.e. A1, A2, A3, A4, A5, A6, A7, A9, B1, B2, B3, C1, C2, C5 & C6) all achieved **Q2-3 or Q3 (poor status)** based on an absence of group A species, low numbers of group B species such as the cased caddis *Potamophylax cingulatus* and stonefly *Leuctra hippopus*, and a dominance of group C species, particularly *Baetis rhodani*, *Gammarus duebeni* and *Potamopyrgus antipodarum* (**Annex B**). It should be noted that due to poor flows and an absence of suitable riffle areas for sampling, the Q-rating for sites B1 on the Glendine River (Q2-3) is tentative.

Site C3 in the headwaters of the Drumbaun River achieved **Q2 (bad status)**. This was given a dominance of highly pollution tolerant group D and E species, namely Sphaeriidae (pea mussels) and *Chironomus* spp. However, the rating for this site is tentative due to poor flows at the time of survey.

4.7 Lake macro-invertebrates

No rare or protected macro-invertebrate species were recorded in the sweep samples taken Lough Keagh (site L1) (**Annex B**).

The sample supported low numbers of the mayfly species Purple dun (*Paraleptophlebia cincta*), a typically river-dwelling species which favours aquatic vegetation and is sensitive to eutrophication (Kelly-Quinn & Regan, 2011). Low numbers of caseless caddis species such as *Mystacides longicornis* and *Polycentropus flavomaculatus* were also present (**Annex B**). Two dragonfly species, *Aeshna* sp. and *Sympetrum* sp. were recorded in the sample in addition to two damselflies, namely *Coenagrion* sp. and the emerald damselfly (*Lestes sponsa*). Other invertebrates recorded included the whirligig beetle *Gyrinus substriatus*, water cricket (*Velia caprai*), water scorpion (*Nepa cinerea*) and biting midge larvae (non-*Chironomus* spp.).

4.8 Macrophytes and aquatic bryophytes

No rare or protected macrophytes or aquatic bryophytes were recorded at the 22 survey sites. Similarly, no examples of Annex I aquatic vegetation habitats were recorded during the surveys in August 2022.

4.9 Aquatic ecological evaluation

An aquatic ecological evaluation of each survey site was based on the results of desktop reviews (i.e., presence of fish of conservation value), fisheries habitat assessments, the presence of protected or rare invertebrates (e.g. white-clawed crayfish, freshwater pearl mussel), environmental DNA analysis, the presence of rare macrophytes and aquatic bryophytes and/or associated representations of Annex I habitats. Furthermore, biological water quality status also informed the aquatic evaluation (**Table 4.2**).

None of the 22 no. aquatic survey sites were evaluated as greater than **local importance (higher value)**. The higher value sites were present on the Illaunbaun Stream (site A6), Derrymore River (A9 & A10), Lough Keagh (L1), Glendine River (B5), Drumbaun River (C4) and the Ballinphonta River (C1, C2, C5 & C6). This evaluation was due to the presence of salmonids, Red-listed European eel and/or other aquatic species or habitats of conservation value, such as Annex II otter.

The remaining sites 12 no. sites on the Derrymore River (A1, A2), unnamed streams (A3, A4, A5 & B2), Fahanlunaghta Beg Stream (A7 & A8), Glendine River (B1), Kilcorcoran Stream (B3 & B4) and Drumbaun River (C3) were evaluated as **local importance (lower value)** in terms of their aquatic ecology given an absence of aquatic species or habitats of high conservation value.

Table 4.2: Summary of fish species of higher conservation value recorded via electro-fishing per survey site in the vicinity of the Proposed Development, August 2022

Site	Watercourse	Atlantic salmon	Brown trout	European eel	Other species
A1	Derrymore River	No fish recorded			
A2	Derrymore River	No fish recorded			
A3	Unnamed stream	No fish recorded			
A4	Unnamed stream	No fish recorded			
A5	Illaunbaun Stream	No fish recorded			
A6	Illaunbaun Stream	None	✓	None	
A7	Fahanlunaghta Beg Stream	No fish recorded			
A8	Fahanlunaghta Beg Stream	None	✓	None	
A9	Derrymore River	None	✓	None	
A10	Derrymore River	None	✓	✓	Three-spined stickleback
B1	Glendine River	No fish recorded			
B2	Unnamed stream	No fish recorded			
B3	Kilcorcoran Stream	No fish recorded			
B4	Kilcorcoran Stream	No fish recorded			
B5	Glendine River	None	✓	✓	
C1	Ballinphonta River	None	None	✓	
C2	Ballinphonta River	None	✓	✓	
C3	Drumbaun River	No fish recorded			
C4	Drumbaun River	None	✓	✓	
C5	Ballinphonta River	None	✓	✓	
C6	Ballinphonta River	None	✓	✓	

*** Conservation value:** Atlantic salmon (*Salmo salar*), sea lamprey (*Petromyzon marinus*), brook lamprey (L*ampetra planeri*) and river lamprey (*Lampetra fluviatilis*) are listed under Annex II of the Habitats Directive [92/42/EEC]. Atlantic salmon and river lamprey are also listed under Annex V of the Habitats Directive [92/42/EEC]. European eel are 'critically endangered' according to most recent ICUN red list (Pike *et al.*, 2020) and listed as 'critically engendered' in Ireland (King *et al.*, 2011). With the exception of the Fisheries Acts 1959 to 2019, brown trout and coarse fish species have no legal protection in Ireland.

Table 4.3: Summary of aquatic species (excluding fish) and habitats of higher conservation value recorded in the vicinity of the Proposed Development, August 2022

Site	Watercourse	White-clawed crayfish	Freshwater pearl mussel	Otter signs4	Annex I aquatic habitats	Rare or protected macrophytes/ aquatic bryophytes	Rare or protected macro-invertebrates	Other species/habitats of high conservation value
A1	Derrymore River	None recorded			Not present	None recorded	None recorded	
A2	Derrymore River	None recorded			Not present	None recorded	None recorded	
A3	Unnamed stream	None recorded			Not present	None recorded	None recorded	
A4	Unnamed stream	None recorded			Not present	None recorded	None recorded	
A5	Illaunbaun Stream	None recorded			Not present	None recorded	None recorded	
A6	Illaunbaun Stream	None recorded			Not present	None recorded	None recorded	
A7	Fahanlunaghta Beg Stream	None recorded			Not present	None recorded	None recorded	
A8	Fahanlunaghta Beg Stream	None recorded			Not present	None recorded	None recorded	
A9	Derrymore River	None recorded		Spraint site	Not present	None recorded	None recorded	
A10	Derrymore River	None recorded; negative eDNA result at site	Negative eDNA result at site, no records in catchment		Not present	None recorded	None recorded	
L1	Lough Keagh	None recorded			Not present	None recorded	None recorded	Smooth newt (detected via eDNA)
B1	Glendine River	None recorded			Not present	None recorded	None recorded	
B2	Unnamed stream	None recorded			Not present	None recorded	None recorded	
B3	Kilcorcoran Stream	None recorded			Not present	None recorded	None recorded	
B4	Kilcorcoran Stream	None recorded			Not present	None recorded	None recorded	

Site	Watercourse	White-clawed crayfish	Freshwater pearl mussel	Otter signs4	Annex I aquatic habitats	Rare or protected macrophytes/ aquatic bryophytes	Rare or protected macro-invertebrates	Other species/habitats of high conservation value
B5	Glendine River	None recorded; negative eDNA result at site	Negative eDNA result at site, no records in catchment		Not present	None recorded	None recorded	
C1	Ballinphonta River	None recorded			Not present	None recorded	None recorded	
C2	Ballinphonta River	None recorded			Not present	None recorded	None recorded	
C3	Drumbaun River	None recorded			Not present	None recorded	None recorded	
C4	Drumbaun River	None recorded			Not present	None recorded	None recorded	
C5	Ballinphonta River	None recorded			Not present	None recorded	None recorded	
C6	Ballinphonta River	None recorded; negative eDNA result at site	Negative eDNA result at site, no records in catchment	Prints	Not present	None recorded	None recorded	

*** Conservation value:** White-clawed crayfish (*Austropotamobius pallipes*), freshwater pearl mussel (*Margaritifera margaritifera*) and Eurasian otter (*Lutra lutra*) are listed under Annex II and Annex V of the Directive on the Conservation of Natural Habitats of Wild Fauna and Flora (92/43/EEC) ('EU Habitats Directive') and all are protected under the Irish Wildlife Acts 1976-2023. White-clawed crayfish (Füreder *et al.*, 2010) and freshwater pearl mussel (Moorkens *et al.*, 2017) are also both listed as 'Endangered' according to the IUCN Red List. The European Union (Invasive Alien Species) (Freshwater Crayfish) Regulations 2018 (SI 354/2018) affords further protection to native white-clawed crayfish by prohibiting the introduction and spread of five no. invasive 'Union concern' crayfish species listed under EU Regulation 1143/2014. Common frog (*Rana temporaria*) and smooth newt (*Lissotriton vulgaris*) are protected under the Irish Wildlife Acts 1976-2023. Common frog are also afforded protection under Annex V of the Habitats Directive [92/42/EEC].

[4] Otter signs within 150 m of the survey site

Table 4.4: Aquatic ecological evaluation summary of the Proposed Development survey sites identified as IEFs

Site no.	Watercourse	EPA code	Evaluation of importance	Rationale summary
A1	Derrymore River	28D03	Local importance (lower value)	Uppermost, high gradient reaches of upland watercourse with low fisheries & aquatic value; no fish recorded via electro-fishing; Q2-3 (poor status) water quality; no aquatic species or habitats of high conservation value
A2	Derrymore River	28D03	Local importance (lower value)	Uppermost reaches of high gradient upland watercourse with low fisheries & aquatic value; no fish recorded via electro-fishing despite some physical suitability (likely reflecting downstream barriers); Q3 (poor status) water quality; no aquatic species or habitats of high conservation value
A3	Unnamed stream	n/a	Local importance (lower value)	Uppermost reaches of narrow, heavily silted upland watercourse with low fisheries & aquatic value; no fish recorded via electro-fishing; Q3 (poor status) water quality; no aquatic species or habitats of high conservation value
A4	Unnamed stream	n/a	Local importance (lower value)	Uppermost reaches of high gradient upland watercourse with low fisheries & aquatic value; no fish recorded via electro-fishing despite some physical suitability (likely reflecting downstream barriers); Q3 (poor status) water quality; no aquatic species or habitats of high conservation value
A5	Illaunbaun Stream	28I03	Local importance (lower value)	Uppermost reaches of narrow upland watercourse with low fisheries & aquatic value; no fish recorded via electro-fishing; Q3 (poor status) water quality; no aquatic species or habitats of high conservation value
A6	Illaunbaun Stream	28I03	Local importance (higher value)	Upper reaches of upland watercourse; brown trout recorded via electro-fishing but poor-quality fisheries habitat present; Q3 (poor status) water quality
A7	Fahanlunaghta Beg Stream	28F08	Local importance (lower value)	Upper reaches of heavily silted upland watercourse with low fisheries & aquatic value; no fish recorded via electro-fishing despite some physical suitability (likely reflecting downstream barriers); Q3 (poor status) water quality; no aquatic species or habitats of high conservation value
A8	Fahanlunaghta Beg Stream	28F08	Local importance (lower value)	Small, historically modified upland watercourse; brown trout recorded via electro-fishing; moderate quality salmonid spawning & nursery habitat; Q3-4 (moderate status) water quality
A9	Derrymore River	28D03	Local importance (higher value)	Small, historically modified upland watercourse; brown trout recorded via electro-fishing; good quality salmonid spawning, nursery & holding habitat; regular Annex II otter spraint site recorded under bridge; Q3 (poor status) water quality

Site no.	Watercourse	EPA code	Evaluation of importance	Rationale summary
A10	Derrymore River	28D03	Local importance (higher value)	Medium-sized upland watercourse with high value for salmonids; brown trout, Red-listed European eel & three-spined stickleback recorded via electro-fishing; good quality salmonid spawning & holding habitat with moderate quality nursery habitat; good quality eel habitat; good otter suitability but no signs recorded; Q3 (poor status) water quality
L1	Lough Keagh	n/a	Local importance (higher value)	7 ha upland lake with high suitability for brown trout (known to be present); and Red-listed European eel (detected via eDNA); smooth newt eDNA detected
B1	Glendine River	28G02	Local importance (lower value)	Uppermost, ephemeral reaches of upland watercourse with no value to fisheries & poor aquatic value; no fish recorded via electro-fishing; Q3 (poor status) water quality (tentative Q-rating); no aquatic species or habitats of high conservation value
B2	Unnamed stream	n/a	Local importance (lower value)	Upper reaches of modified, heavily silted & ephemeral upland watercourse with low fisheries & aquatic value; no fish recorded via electro-fishing; Q3 (poor status) water quality; no aquatic species or habitats of high conservation value
B3	Kilcorcoran Stream	28K11	Local importance (lower value)	Uppermost reaches of narrow, modified upland watercourse with low fisheries & aquatic value; no fish recorded via electro-fishing; Q2-3 (poor status) water quality; no aquatic species or habitats of high conservation value
B4	Kilcorcoran Stream	28K11	Local importance (lower value)	Upper reaches of heavily-silted upland watercourse with low fisheries & aquatic value; no fish recorded via electro-fishing; Q3-4 (moderate status) water quality; no aquatic species or habitats of high conservation value
B5	Glendine River	28G02	Local importance (higher value)	Medium-sized upland watercourse with high value for salmonids; brown trout & Red-listed European eel recorded via electro-fishing; Atlantic salmon known from the river (Kelly *et al.*, 2010, 2014) but not recorded in August 2022; good quality salmonid spawning, nursery & holding habitat; good quality eel habitat (primarily for adults); good otter suitability but no signs recorded; Q3-4 (moderate status) water quality
C1	Ballinphonta River	28B03	Local importance (higher value)	Upper reaches of heavily silted, high gradient, modified upland watercourse; Red-listed European eel recorded via electro-fishing; no salmonids recorded (likely reflecting natural downstream barriers); Q3 (poor status) water quality
C2	Ballinphonta River	28B03	Local importance (higher value)	Upper reaches of heavily silted upland watercourse; brown trout & Red-listed European eel recorded via electro-fishing; moderate quality salmonid & eel habitat; Q3 (poor status) water quality

Site no.	Watercourse	EPA code	Evaluation of importance	Rationale summary
C3	Drumbaun River	28D20	Local importance (lower value)	Headwaters of high gradient, heavily-silted upland watercourse with no value to fisheries & poor-quality aquatic habitats; no fish recorded via electro-fishing; Q2 (bad status) water quality (tentative Q-rating); no aquatic species or habitats of high conservation value
C4	Drumbaun River	28D20	Local importance (higher value)	Narrow, shallow, modified upland watercourse; brown trout & Red-listed European eel recorded via electro-fishing; moderate quality salmonid & eel habitat; Q3-4 (moderate status) water quality
C5	Ballinphonta River	28B03	Local importance (higher value)	Medium-sized, semi-natural upland watercourse; brown trout & Red-listed European eel recorded via electro-fishing; moderate quality salmonid & eel habitat; Q3 (poor status) water quality
C6	Ballinphonta River	28B03	Local importance (higher value)	Lower reaches of upland watercourse; brown trout & Red-listed European eel recorded via electro-fishing; Atlantic salmon not recorded in August 2022 but detected via eDNA; moderate quality salmonid habitat; site of high value as European eel nursery; fresh Annex II otter prints recorded under bridge; Q3 (poor status) water quality

Conservation value: Atlantic salmon (*Salmo salar*), sea lamprey (*Petromyzon marinus*), brook lamprey (L*ampetra planeri*), river lamprey (*Lampetra fluviatilis*), white-clawed crayfish (*Austropotamobius pallipes*) and otter (*Lutra lutra*) are listed under Annex II of the Habitats Directive [92/42/EEC]. Atlantic salmon, river lamprey, freshwater pearl mussel, white-clawed crayfish and otter are also listed under Annex V of the Habitats Directive [92/42/EEC]. Freshwater pearl mussel and otters (along with their breeding and resting places) are also protected under provisions of the Irish Wildlife Acts 1976 to 2023. European eel are 'critically endangered' according to most recent ICUN red list (Pike *et al.*, 2020) and listed as 'critically engendered' in Ireland (King *et al.*, 2011). With the exception of the Fisheries Acts 1959 to 2019, brown trout have no legal protection in Ireland.

5 DISCUSSION

5.1 Most valuable areas for aquatic ecology

None of the 22 no. aquatic survey sites were evaluated as greater than **local importance (higher value)**. The higher value sites were present on the Illaunbaun Stream (site A6), Derrymore River (A9 & A10), Lough Keagh (L1), Glendine River (B5), Drumbaun River (C4) and the Ballinphonta River (C1, C2, C5 & C6) (**Table 4.4**). This evaluation was due to the presence of salmonids, Red-listed European eel and/or other aquatic species or habitats of conservation value, such as Annex II otter.

Over half of the survey sites (i.e. A1, A2, A3, A4, A5, A7, B1, B2, B3, B4 & C3) did not support fish at the time of survey. These sites provided poor quality habitat for salmonids, European eel or other fish species given their diminutive nature, historical modifications, siltation pressures, low or intermittent flows and/or high natural gradients (instream barriers) which precluded resident fish from the upper reaches of some watercourses (e.g. Derrymore River).

With the exception of site C1, all of the **local importance (higher value)** sites supported salmonids. However, these were brown trout populations only, with no Annex II Atlantic salmon recorded during the survey (see section 5.2 below). As would be expected for higher-gradient, spate systems (O'Grady, 2006; Amiro, 1993), higher fish biomass and better-quality salmonid habitat was largely confined to the lower reaches of watercourses such as the Derrymore River, Glendine River and Ballinphonta River. These sites also supported higher salmonid densities (**Annex A**).

These **local importance (higher value)** sites supported also supported European eel, with the exception of sites on the Illaunbaun Stream (A6) and Derrymore River (A9). European eel are Red-listed in Ireland (King *et al.*, 2011) and are classed as 'critically endangered' on a global scale (Pike *et al.*, 2020). Eel were typically recorded in very low numbers via electro-fishing although sites B5 and C6 on the lower reaches of the Glendine River and Ballinphonta River, respectively, supported significantly higher numbers of eel and were valuable eel nursery habitats. This spatial abundance pattern is typically seen in European eel (Degerman *et al.*, 2019; Moriarty, 2003).

No Annex II lamprey were recorded during the electro-fishing survey and habitat suitability was poor or absent throughout. This reflected the upland, higher-energy, spate nature of the survey watercourses which are inimical for lamprey population establishment and persistence, in addition to natural and artificial instream barriers for anadromous lamprey species (**Annex A**).

Despite good suitability elsewhere, otter signs were only recorded at sites A9 on the Derrymore River (spraint) and C6 on the lower Ballinphonta River (prints). This paucity of signs was considered to reflect the upland, higher-gradient, higher-energy nature of the survey watercourses which generally provide more restricted, stochastic prey resources and reduced foraging opportunities for otter (Sittenthaler *et al.*, 2019; Scorpio *et al.*, 2016; Remonti *et al.*, 2009).

Lough Keagh (site L1) was particularly suitable for smooth newt given heavily vegetated margins and adjoining wet heath/peatland areas. A high amount of smooth newt eDNA was detected from the lake (12 positive qPCR replicates out of 12; **Table 4.1**). Suitability for common frog was widespread throughout the survey area. Both species are protected under the Irish Wildlife Acts 1976-2023, with common frog also afforded protection under Annex V of the Directive on the Conservation of Natural Habitats of Wild Fauna and Flora (92/43/EEC) ('EU Habitats Directive').

No rare or protected macro-invertebrate species (according to national red lists) were recorded in the biological water quality samples taken from 21 river and watercourse sites and a single lake site in August 2022 (**Annex B**). None of the survey sites achieved target good status (≥Q4) requirements of the European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2019 and the Water Framework Directive (2000/60/EC). The majority of survey sites achieved **≤Q3 (poor status)** in August 2022 (**Annex B**). Eutrophication originating from coniferous afforestation (EPA 2019a, 2019b) and siltation (via peat escapement) are known to be the major pressures within the survey area and this was supported by observations made during the aquatic surveys.

No examples of Annex I habitats were recorded during the aquatic surveys undertaken in August 2022.

5.2 eDNA analysis

Despite some good habitat suitability in the Derrymore River and Ballinphonta River, and known distribution in the Glendine River (Kelly *et al.*, 2010, 2014; IFI 2020 data), no Annex II Atlantic salmon were recorded during the electro-fishing survey. However, water samples collected and analysed in August 2022 detected low levels of Atlantic salmon eDNA in both the Derrymore River (site A10) and Ballinphonta River (C6) (**Table 4.1**). Whilst Atlantic salmon are known from the Glendine River at site B5 (Knockloskeraun Bridge), eDNA analysis at the site produced a negative result for Atlantic salmon. This indicated the absence of the species at or upstream of the site during the survey period, or the presence of salmon DNA concentrations below the limit of detection via qPCR methodology. Our results suggest that Atlantic salmon populations within the Derrymore, Ballinphonta and Glendine Rivers may be small and stochastic.

No freshwater pearl mussel or white-clawed crayfish eDNA was detected in the Derrymore, Ballinphonta or Glendine River samples collected in August 2022, in keeping with the known distribution of these species in the west Clare area. However, low levels of crayfish plague (*Aphanomyces astaci*) eDNA was detected in the Derrymore River (A10) (previously unrecorded in the catchment).

5.3 Aquatic ecology summary

The surveyed watercourses in the vicinity of the Proposed Development were typically small, higher-gradient, upland spate channels draining areas of peatland and afforestation. They supported a low diversity of fish and macro-invertebrate species, generally low fish abundances and biological water quality of **≤Q3-4 (moderate status)**. Over half of the survey sites were evaluated as **local importance (lower value)** in terms of their aquatic ecology.

However, sites on the Illaunbaun Stream (site A6), Derrymore River (A9 & A10), Glendine River (B5), Drumbaun River (C4), Ballinphonta River (C1, C2, C5 & C6) and Lough Keagh (L1) were evaluated as **local importance (higher value)** given they supported salmonids, European eel and/or otter populations.

6 REFERENCES

Amiro, P.G. (1993). *Habitat measurement and population estimation of juvenile Atlantic salmon*. In R.J. Gibson and R.E. Cutting [ed.]. Production of juvenile Atlantic salmon in natural waters. Can. Spec. Publ. Fish. Aquat. Sci. 118. P 81-97.

APEM (2004). *Assessment of sea lamprey distribution and abundance in the River Spey: Phase II*. Scottish Natural Heritage Commissioned Report No. 027 (ROAME No. F01AC608)

Aronsuu, K. & Virkkala, P. (2014). *Substrate selection by subyearling European river lampreys (Lampetra fluviatilis) and older larvae (Lampetra spp.)*. Ecology of Freshwater Fish, 23: 644–655

Byrne, A. W., Moorkens, E. A., Anderson, R., Killeen, I. J., & Regan, E. (2009). *Ireland Red List no. 2: Non-marine molluscs*. National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government.

CEN (2003) *Water Quality – Sampling of Fish with Electricity.* European Standard. Document CEN EN 14011:2000

CFB (2008). *Methods for the Water Framework Directive. Electric Fishing in Wadeable Reaches*. Central Fisheries Board. Unpublished report.

Central Fisheries Board (2008) *Methods for the Water Framework Directive, Electric Fishing in Wadeable Reaches.* Central Fisheries Board, Unpublished report.

Cheal, F., Davis, J. A., Growns, J. E., Bradley, J. S., & Whittles, F. H. (1993). *The influence of sampling method on the classification of wetland macroinvertebrate communities.* Hydrobiologia, 257(1), 47-56.

CIEEM (2017a). *Guidelines For Ecological Report Writing*. Chartered Institute of Ecology and Environmental Management.

CIEEM (2017b). *Guidelines for Preliminary Ecological Appraisal: Vol. 2nd ed.* Chartered Institute of Ecology and Environmental Management.

CIEEM (2019) *Advice Note on the lifespan of ecological reports & surveys*. Chartered Institute of Ecology and Environmental Management.

CIEEM (2024) *Guidelines For Ecological Impact Assessment In The UK and Ireland Terrestrial, Freshwater, Coastal and Marine.* Chartered Institute of Ecology and Environmental Management.

Degerman, E., Tamario, C., Watz, J., Nilsson, P. A., & Calles, O. (2019). *Occurrence and habitat use of European eel (Anguilla anguilla) in running waters: lessons for improved monitoring, habitat restoration and stocking.* Aquatic ecology, 53(4), 639-650.

EA (2003). *River Habitat Survey in Britain and Ireland Field Survey Guidance Manual 2003.* Environment Agency, UK.

EPA (2019a). *WFD Cycle 2 - Catchment Mal Bay Subcatchment Annagh (Clare)_SC_010.* Available at: https://catchments.ie/wpcontent/files/subcatchmentassessments/28_5%20Annagh[Clare]_SC_010%20Subcatchment%20Assessment%20WFD%20Cycle%202.pdf

EPA (2019b). *WFD Cycle 2 - Catchment Mal Bay Subcatchment Inagh [Ennistymon]_SC_010. Available at:* https://catchments.ie/wpcontent/files/subcatchmentassessments/28_1%20Inagh[Ennistymon]_SC_010%20Subcatchment%20Assessment%20WFD%20Cycle%202.pdf

Gardiner, R. (2003). *Identifying lamprey. A field key for sea, river and brook lamprey.* Conserving Natura 2000 Rivers, Conservation techniques No. 4. Peterborough. English Nature.

Goodwin, C.E., Dick, J.T.A. & Elwood, R.W. (2008). *A preliminary assessment of the distribution of the sea lamprey (Petromyzon marinus L), river lamprey (Lampetra fluviatilis (L.)) and brook lamprey (Lampetra planeri (Bloch)) in Northern Ireland.* Biology and Environment: Proceedings of the Royal Irish Academy 109B, 47-52.

Feeley, H. B., Baars, J. R., Kelly-Quinn, M., & Nelson, B. (2020). *Ireland Red List No. 13: Stoneflies (Plecoptera).* National Parks and Wildlife Service.

Fossitt, J. (2000) A Guide to Habitats in Ireland. The Heritage Council, Ireland.

Foster, G. N., Nelson, B. H. & O Connor, Á. (2009). *Ireland Red List No. 1 – Water beetles.* National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.

Füreder, L., Gherardi, F., Holdich, D., Reynolds, J., Sibley, P. & Souty-Grosset, C. (2010). *Austropotamobius pallipes*. *The IUCN Red List of Threatened Species 2010*: e.T2430A9438817. https://dx.doi.org/10.2305/IUCN.UK.2010-3.RLTS.T2430A9438817.en. Accessed on 02 October 2022.

Harvey & Cowx (2003). *Monitoring the River, Sea and Brook Lamprey, Lampetra fluviatilis, L. planeri and Petromyzon marinus.* Conserving Natura 2000 Rivers Monitoring Series No. 5, English Nature, Peterborough.

IFI (2010). *Biosecurity Protocol for Field Survey Work.* Available at http://www.fisheriesireland.ie/Invasive-Species/biosecurity-protocol-for-field-survey-work.html

Kelly, F.L., Harrison, A., Connor, L., Wightman, G., Matson, R., Hanna, G., Feeney, R., Morrissey, E., O'Callaghan, R., Wogerbauer, C., Rocks, K., Hayden, B. & Stafford, T. (2010). *Sampling Fish for the Water Framework Directive – Rivers 2009.* Shannon International River Bason District Rivers. Central and Regional Fisheries Boards.

Kelly, F.L., Matson, R., Connor, L., Feeney, R., Morrissey, E., Coyne, J. & Rocks, K. (2014). *Water Framework Directive Fish Stock Survey of Rivers in the Shannon International River Basin District.* Inland Fisheries Ireland, 3044 Lake Drive, Citywest Business Campus, Dublin 24, Ireland.

Kelly-Quinn, M. & Regan, E.C. (2012). *Ireland Red List No. 7: Mayflies (Ephemeroptera).* National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

Matson, R., Delanty, K., Shephard, S., Coghlan, B., & Kelly, F. (2018). *Moving from multiple pass depletion to single pass timed electrofishing for fish community assessment in wadeable streams.* Fisheries Research, 198, 99-108.

Meehan (2013). *National Smooth Newt Survey 2013 Report*, Irish Wildlife Trust.

Moriarty, C. (2003). *The yellow eel. In Eel Biology*, pp. 89-105). Springer, Tokyo.

Moorkens, E., Cordeiro, J., Seddon, M.B., von Proschwitz, T. & Woolnough, D. (2017). *Margaritifera margaritifera* (*errata version published in 2018). The IUCN Red List of Threatened Species 2017*: e.T12799A128686456. https://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T12799A508865.en. Accessed on 02 October 2022.

Nelson, B., Ronayne, C. & Thompson, R. (2011). *Ireland Red List No.6: Damselflies & Dragonflies (Odonata).* National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin, Ireland.

Niven & McCauley (2013). *Lamprey Baseline Survey No2: River Faughan and Tributaries SAC.* Loughs Agency, 22, Victoria Road, Derry.

NRA (2009). *Guidelines for Assessment of Ecological Impacts of National Road Schemes.* Revision 2, 1st June 2009. National Roads Authority, Dublin.

O'Flynn, C. Kelly, J. & Lysaght, L. (2014). *Ireland's invasive and non-native species - trends in introductions.* National Biodiversity Data Centre Series No. 2 Ireland.

O'Grady, M.F. (2006). *Channels and challenges: enhancing Salmonid rivers.* Irish Fresh- water Fisheries Ecology and Management Series: Number 4. Central Fisheries Board, Dublin.

Pike, C., Crook, V. & Gollock, M. (2020). Anguilla anguilla. *The IUCN Red List of Threatened Species 2020*: e.T60344A152845178. https://dx.doi.org/10.2305/IUCN.UK.2020-2.RLTS.T60344A152845178.en.

Potter & Osborne (1975). *The systematics of British larval lampreys*. Journal of Zoology, 176(3), 311-329.

Remonti, L., Balestrieri, A., & Prigioni, C. (2009). *Altitudinal gradient of Eurasian otter (Lutra lutra) food niche in Mediterranean habitats*. Canadian Journal of Zoology, 87(4), 285-291.

Reynolds *et al.* (2010). *A technical manual for monitoring white-clawed crayfish, Austropotambius pallipes in Irish lakes*. Irish Wildlife Manuals, Department of Arts, Heritage and Gaeltacht.

Scorpio, V., Loy, A., Di Febbraro, M., Rizzo, A., Aucelli, P. (2016). *Hydromorphology meets mammal ecology: river morphological quality, recent channel adjustments and otter resilience*. River Res. Appl. 32, 267–279.

Sittenthaler, M., Koskoff, L., Pinter, K., Nopp-Mayr, U., Parz-Gollner, R., & Hackländer, K. (2019). *Fish size selection and diet composition of Eurasian otters (Lutra lutra) in salmonid streams: Picky gourmets rather than opportunists?* Knowledge & Management of Aquatic Ecosystems, (420), 29.

Toner, P., Bowman, J., Clabby, K., Lucey, J., McGarrigle, M., Concannon, C., ... & MacGarthaigh, M. (2005). *Water quality in Ireland*. Environmental Protection Agency, Co. Wexford, Ireland.

Wood, J. and Budy, P. (2009) The role of environmental factors in determining early survival and invasion success of exotic brown trout. *Transactions of the American Fisheries Society*, *138*(4), pp.756-767.

Wyse Jackson, M., FitzPatrick, Ú., Cole, E., Jebb, M., McFerran, D., Sheehy Skeffington, M., & Wright, M. (2016). *Ireland red list no. 10: Vascular plants*. National Parks and Wildlife Service, Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs, Dublin, Ireland.

ANNEX A – FISHERIES ASSESSMENT REPORT

Please see accompanying fisheries assessment report

ANNEX B – MACRO-INVERTEBRATES (BIOLOGICAL WATER QUALITY)

Table B.1: Macro-invertebrate Q-sampling results for sites A1-A10, August 2022

Group	Family	Species	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10			EPA class
Ephemeroptera	Heptageniidae	*Rhithrogena semicolorata*								2		1			A
Ephemeroptera	Baetidae	*Alainites muticus*										1			B
Trichoptera	Glossosomatidae	*Agapetus fuscipes*		4								2			B
Trichoptera	Glossosomatidae	Unidentified species							1						B
Trichoptera	Goeridae	*Silo pallipes*							3	1					B
Trichoptera	Limnephilidae	*Halesus radiatus*				2									B
Trichoptera	Limnephilidae	*Potamophylax cingulatus*					5	2	2		3	1			B
Trichoptera	Sericostomatidae	*Sericostoma personatum*						3		2		11			B
Ephemeroptera	Baetidae	*Baetis rhodani*	11	32	5		34	13	16	12	45	53			C
Ephemeroptera	Ephemerellidae	*Serratella ignita*								1		8			C
Trichoptera	Polycentropodidae	*Plectrocnemia conspersa*			1	7	2	3				1			C
Trichoptera	Rhyacophilidae	*Rhyacophila dorsalis*									1	1			C
Mollusca	Tateidae	*Potamopyrgus antipodarum*		2			11		16	6		7			C
Mollusca	Planorbidae	*Ancylus fluviatilis*		9				8	7		6	1			C
Crustacea	Gammaridae	*Gammarus duebeni*	48	61	8	7	42	59	62	12	44	57			C
Coleoptera	Dytiscidae	*Oreodytes sanmarkii*										1			C
Coleoptera	Elmidae	*Elmis aenea*		2						1	1	1			C
Coleoptera	Elmidae	*Limnius volckmari*			2						7	14			C

Group	Family	Species	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10			EPA class
Coleoptera	Hydraenidae	*Hydraena gracilis*									1	4			C
Coleoptera	Hydrophilidae	*Anacaena globulus*					1								C
Coleoptera	Scirtidae	*Scirtidae larva*		2						1	3				C
Diptera	Chironomidae	non-*Chironomus* spp.	1							1		13			C
Diptera	Pediciidae	*Dicranota* sp.					2	2	1	5	2	2			C
Diptera	Psychodidae	Unidentified species				1									C
Diptera	Simuliidae	Unidentified species	7	11			10		1		14				C
Diptera	Thaumaleidea	Unidentified species			1										C
Hemiptera	Corixidae	Corixidae nymph	1												C
Hemiptera	Veliidae	Veliidae nymph			1	2									C
Hemiptera	Veliidae	*Velia caprai*				1									C
Mollusca	Sphaeriidae	Unidentified species		2											D
Hirudinidae	Glossiphoniidae	Unidentified species	1								1				D
Diptera	Chironomidae	*Chironomus* spp.	36		2				1		3	2			E
Annelidae	Oligochaeta	Unidentified species		1						1		1			n/a
Abundance			105	126	20	20	107	90	110	45	131	182			
Q-rating			Q2-3	Q3	Q3	Q3	Q3	Q3	Q3	Q3-4	Q3	Q3-4			
WFD status			Poor	Poor	Poor	Poor	Poor	Poor	Poor	Mod	Poor	Mod			

Table B.2: Macro-invertebrate Q-sampling results for sites B1-B5 and C1-C6, August 2022

Group	Family	Species	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	C6	EPA class
Ephemeroptera	Heptageniidae	*Ecdyonurus insignis*					3							A
Ephemeroptera	Heptageniidae	*Ecdyonurus dispar*									4			A
Plecoptera	Nemouridae	*Nemoura cinerea*				1								A
Ephemeroptera	Baetidae	*Alainites muticus*							2		3			B
Ephemeroptera	Baetidae	*Cloeon dipterum*				1								B
Plecoptera	Leuctridae	*Leuctra hippopus*					8				11	7	1	B
Trichoptera	Beraeidae	*Beraea pullata*			2									B
Trichoptera	Glossosomatidae	Unidentified species					4							B
Trichoptera	Leptoceridae	Unidentified species									1			B
Trichoptera	Limnephilidae	*Halesus radiatus*										6	4	B
Trichoptera	Limnephilidae	*Potamophylax cingulatus*		1					3					B
Trichoptera	Limnephilidae	Unidentified species		1	7			2						B
Trichoptera	Sericostomatidae	*Sericostoma personatum*									4	9	2	B
Ephemeroptera	Baetidae	*Baetis rhodani*		8		1	31	39	32		25	29	27	C
Ephemeroptera	Ephemerellidae	*Serratella ignita*					5		4			6	1	C
Trichoptera	Hydropsychidae	*Diplectrona felix*							3					C
Trichoptera	Hydropsychidae	*Hydropsyche instabilis*										1		C
Trichoptera	Hydropsychidae	*Hydropsyche siltalai*										1		C
Trichoptera	Polycentropodidae	*Plectrocnemia conspersa*			4	5		2	2		1	1		C
Trichoptera	Polycentropodidae	*Polycentropus kingi*										6		C

Group	Family	Species	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	C6	EPA class
Trichoptera	Rhyacophilidae	*Rhyacophila dorsalis*									1	1		C
Mollusca	Tateidae	*Potamopyrgus antipodarum*	47	27	33	13	56	2	45		33	28	28	C
Mollusca	Planorbidae	*Ancylus fluviatilis*					1	9	16		9	14		C
Crustacea	Gammaridae	*Gammarus duebeni*		22	1	2	39	31	2		1	2		C
Coleoptera	Dytiscidae	*Dytiscidae larva*	1	1										C
Coleoptera	Dytiscidae	*Hydroporus tessellatus*									2			C
Coleoptera	Dytiscidae	*Ilybius fuliginosus*									1			C
Coleoptera	Elmidae	*Elmis aenea*			3		7				3	2		C
Coleoptera	Elmidae	*Limnius volckmari*	3								1	3		C
Coleoptera	Halipliidae	*Haliplus lineatocollis*										1		C
Coleoptera	Hydraenidae	*Hydraena gracilis*			1		2				1			C
Coleoptera	Hydraenidae	*Limnebius truncatellus*		1										C
Coleoptera	Hydrophilidae	*Anacaena globulus*	4											C
Coleoptera	Hydrophilidae	*Laccobius bipunctatus*		1										C
Diptera	Chironomidae	non-*Chironomus* spp.	4			1		1	1		3	6		C
Diptera	Culicidae	Unidentified species											2	C
Diptera	Limoniidae/Pediciidae	Unidentified species			1		1							C
Diptera	Pediciidae	*Dicranota* sp.									2			C
Diptera	Simuliidae	Unidentified species		2	1		12	4	3		12	1	1	C
Hemiptera	Gerridae	Gerridae nymph											1	C

Group	Family	Species	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	C6	EPA class
Arachnida	Hydrachnidiae	Unidentified species			1		2							C
Crustacea	Asellidae	*Asellus aquaticus*											2	D
Mollusca	Lymnaeidae	*Ampullacaena balthica*											13	D
Mollusca	Sphaeriidae	Unidentified species	1		48					4				D
Hirudinidae	Glossiphoniidae	Unidentified species		1				1			1		5	D
Diptera	Chironomidae	*Chironomus* spp.	10						1			2		E
Annelidae	Oligochaeta	Unidentified species		1	1					9	6			n/a
Abundance			70	66	103	24	171	91	114	13	124	126	88	
Q-rating			Poor	Poor	Poor	Mod	Mod	Poor	Poor	Bad	Mod	Poor	Poor	
WFD status			Q2-3	Q3	Q2-3	Q3-4	Q3-4	Q3	Q3	Q2	Q3-4	Q3	Q3	

Table B.3: Macro-invertebrate results for Lough Keagh (site L1), August 2022

Group	Family	Species	L1	EPA class
Ephemeroptera	Leptophlebiidae	*Paraleptophlebia cincta*	8	B
Trichoptera	Leptoceridae	*Mystacides longicornis*	5	B
Trichoptera	Limnephilidae	*Limnephilus* sp.	1	B
Trichoptera	Polycentropodidae	*Polycentropus flavomaculatus*	2	B
Odonata	Aeshnidae	*Aeshna* sp.	3	B
Odonata	Coenagrionidae	*Coenagrion* sp.	8	B
Odonata	Lestidae	*Lestes sponsa*	6	B
Odonata	Libellulidae	*Sympetrum* sp.	2	B
Ephemeroptera	Baetidae	*Baetis rhodani*	2	C
Coleoptera	Gyrinidae	*Gyrinidae larva*	1	C
Coleoptera	Gyrinidae	*Gyrinus substriatus*	1	C
Diptera	Chironomidae	non-*Chironomus* spp.	2	C
Hemiptera	Veliidae	*Velia caprai*	1	C
Hemiptera	Corixidae	Corixidae nymph	8	C
Hemiptera	Corixidae	*Siagara* sp.	5	C
Hemiptera	Nepidae	*Nepa cinerea*	1	C

ANNEX C – eDNA ANALYSIS LAB REPORT

SureScreen Scientifics

Folio No: E15284
Report No: 1
Client: Triturus Environmental Ltd
Contact: Bill Brazier

TECHNICAL REPORT

ANALYSIS OF ENVIRONMENTAL DNA IN WATER FOR AQUATIC SPECIES DETECTION

SUMMARY

When aquatic organisms inhabit a waterbody such as a pond, lake or river they continuously release small amounts of their DNA into the environment. By collecting and analysing water samples, we can detect these small traces of environmental DNA (eDNA) to confirm the presence or absence of the target species within the waterbody.

RESULTS

Date sample received in laboratory: 19/08/2022
Date results reported: 01/09/2022
Matters affecting result: None

TARGET SPECIES: Atlantic salmon *(Salmo salar)*

Lab ID	Site Name	OS Reference	SIC	DC	IC	Result	Positive Replicates
FK616	A10 Derrymore River	-	Pass	Pass	Pass	Positive	1/12
FK617	B5 Glendine River	-	Pass	Pass	Pass	Negative	0/12
FK629	C6 Drumbaun River	-	Pass	Pass	Pass	Positive	2/12

Forensic Scientists and Consultant Engineers
SureScreen Scientifics Division Ltd, Morley Retreat, Church Lane, Morley, Derbyshire, DE7 6DE, UK
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Company Registration No. 08950940

SureScreen Scientifics

TARGET SPECIES: Brown (Sea) Trout *(Salmo trutta)*

Lab ID	Site Name	OS Reference	SIC	DC	IC	Result	Positive Replicates
FK621	L1 Lough Keagh	-	Pass	Pass	Pass	Positive	12/12

TARGET SPECIES: Crayfish plague *(Aphanomyces astaci)*

Lab ID	Site Name	OS Reference	SIC	DC	IC	Result	Positive Replicates
FK616	A10 Derrymore River	-	Pass	Pass	Pass	Positive	2/12
FK617	B5 Glendine River	-	Pass	Pass	Pass	Negative	0/12
FK629	C6 Drumbaun River	-	Pass	Pass	Pass	Negative	0/12

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TARGET SPECIES: European eel *(Anguilla anguilla)*

Lab ID	Site Name	OS Reference	SIC	DC	IC	Result	Positive Replicates
FK621	L1 Lough Keagh	-	Pass	Pass	Pass	Positive	1/12

TARGET SPECIES: Freshwater pearl mussel *(Margaritifera margaritifera)*

Lab ID	Site Name	OS Reference	SIC	DC	IC	Result	Positive Replicates
FK616	A10 Derrymore River	-	Pass	Pass	Pass	Negative	0/12
FK617	B5 Glendine River	-	Pass	Pass	Pass	Negative	0/12
FK629	C6 Drumbaun River	-	Pass	Pass	Pass	Negative	0/12

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TARGET SPECIES: Smooth Newt *(Lissotriton vulgaris)*

Lab ID	Site Name	OS Reference	SIC	DC	IC	Result	Positive Replicates
FK621	L1 Lough Keagh	-	Pass	Pass	Pass	Positive	12/12

TARGET SPECIES: White-clawed crayfish *(Austropotamobius pallipes)*

Lab ID	Site Name	OS Reference	SIC	DC	IC	Result	Positive Replicates
FK616	A10 Derrymore River	-	Pass	Pass	Pass	Negative	0/12
FK617	B5 Glendine River	-	Pass	Pass	Pass	Negative	0/12
FK629	C6 Drumbaun River	-	Pass	Pass	Pass	Negative	0/12

If you have any questions regarding results, please contact us: ForensicEcology@surescreen.com

Reported by: **Chelsea Warner** Approved by: **Jennifer Higginbottom**

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METHODOLOGY

The samples detailed above have been analysed for the presence of target species eDNA following scientifically published eDNA assays and protocols which have been thoroughly tested, developed and verified for use by SureScreen Scientifics.

The analysis is conducted in two phases. The sample first goes through an extraction process where the filter is incubated in order to obtain any DNA within the sample. The extracted sample is then tested via real time PCR (also called q-PCR) for each of the selected target species. This process uses species-specific molecular markers (known as primers) to amplify a select part of the DNA, allowing it to be detected and measured in 'real time' as the analytical process develops. qPCR combines amplification and detection of target DNA into a single step. With qPCR, fluorescent dyes specific to the target sequence are used to label targeted PCR products during thermal cycling. The accumulation of fluorescent signals during this reaction is measured for fast and objective data analysis. The primers used in this process are specific to a part of mitochondrial DNA only found in each individual species. Separate primers are used for each of the species, ensuring no DNA from any other species present in the water is amplified.

If target species DNA is present, the DNA is amplified up to a detectable level, resulting in positive species detection. If target species DNA is not present then amplification does not occur, and a negative result is recorded.

Analysis of eDNA requires scrupulous attention to detail to prevent risk of contamination. True positive controls, negative controls and spiked synthetic DNA are included in every analysis and these have to be correct before any result is declared and reported. Stages of the DNA analysis are also conducted in different buildings at our premises for added security.

SureScreen Scientifics Ltd is ISO9001 accredited and participate in Natural England's proficiency testing scheme for GCN eDNA testing. We also carry out regular inter-laboratory checks on accuracy of results as part of our quality control procedures.