APPENDIX 3

AQUATIC BASELINE REPORT

APPENDIX 6-3

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Aquatic baseline report for Laurclavagh Renewable Energy Development, Co. Galway

Prepared by Triturus Environmental Ltd. for MKO

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1. Introduction

1.1 Background

Triturus Environmental Ltd. were commissioned by MKO to conduct baseline aquatic surveys to inform EIAR preparation for the Proposed Project. 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 Project, located approximately 9km south-west of Tuam, Co. Galway.

Undertaken on a catchment-wide scale, the baseline surveys focused on the detection of freshwater habitats and species of high conservation value. These included surveys for white-clawed crayfish (*Austropotamobius pallipes*), otter (*Lutra lutra*), macro-invertebrates (biological water quality) and fish of high conservation value, inclusive of supporting nursery and spawning habitat. The surveys also documented macrophyte and aquatic bryophyte communities including Annex I habitat associations in the vicinity of the Proposed Project (**Figure 2.1**). Aquatic surveys were undertaken in July 2022.

1.2 Project description

A full description of the Proposed Project is provided in Chapter 4 of the Environmental Impact Assessment Report (EIAR).

2. Methodology

2.1 Selection of watercourses for assessment

All freshwater watercourses which could be affected directly or indirectly by the Proposed Project were considered as part of the current baseline. Whilst no surface water pathways drained the Proposed Wind Farm site a small number of watercourses are crossed by the Proposed Grid Connection underground cable route. A total of 15 no. sites (14. no riverine & 1 no. pond) were selected for detailed aquatic assessment (see **Table 2.1, Figure 2.1** below). The nomenclature for the watercourses surveyed is as per the Environmental Protection Agency (EPA). Aquatic survey sites were present on the Glennafosha River (EPA code: 30G69) and unnamed inline pond, Clare River (3C01) and unnamed tributary, Killeenlaun River (20K46), Cregg River (30C03), Ballinduff River (30B05) and an unnamed tributary and the Kilroe Stream (30K23) (**Table 2.1**).

The aquatic survey sites were located within the Clare[Galway]_SC_020, Clare[Galway]_SC_040 and Clare[Galway]_SC_060 river sub-catchments. The EIAR Site Boundary does not overlap with any European sites, apart from where the Proposed Grid Connection underground cabling route passes over the River Clare within the existing road crossing (Lough Corrib SAC (000297)). There is potential downstream hydrological connectivity between the Proposed Project and Lough Corrib SAC (000297), a site designated for a range of aquatic qualifying interests (NPWS, 2017).

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

2.2 Aquatic site surveys

Aquatic surveys of the watercourses within the vicinity of the Proposed Project were conducted on Tuesday 12th to Thursday 14th July 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, otter survey (within 150m of the survey site), macrophyte and aquatic bryophyte survey and (where suitable) biological water quality sampling (Q-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 3 no. strategically chosen riverine locations within the vicinity of the Proposed Project. These water samples were also analysed for white-clawed crayfish and crayfish plague (*Aphanomyces astaci*). This holistic approach informed the overall aquatic ecological evaluation of each site in context of the Proposed Project and ensured that any habitats and species of high conservation value would be detected to best inform mitigation for the Site.

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
- 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 *n*=15 aquatic survey sites in the vicinity of the Site (* indicates eDNA sampling)

Site no.	Watercourse	EPA code	Location	X (ITM)	Y (ITM)
A1	Unnamed pond	30G69	Rusheens North	540587	748080
A2	Glennafosha River	30G69	Claretuam Bridge, N83	540067	749581
A3	Clare River	30C01	Cloonmore Bridge, N83	540922	749751
A4	Killeelaun River	30K46	L6141 crossing, Cloontooa	541952	749972
A5	Unnamed stream	n/a	L6141 crossing, Cloontooa	543287	749509
A6	Clare River	30C01	Corrofin Bridge	542607	743416
A7*	Clare River	30C01	Lackagh Bridge, R354	541826	736425
B1	Cregg River	30C03	Aucloggeen	535883	738508
B2	Cregg River	30C03	L2119 road crossing, Aucloggeen	535336	737856
B3*	Cregg River	30C03	Addergoole Bridge, N84	532279	735004
C1	Unnamed channel	n/a	Cluidrevagh	533289	744115
C2	Unnamed channel	n/a	Bunatober	532180	742882
C3	Ballinduff Stream	30B05	Knockereen	531982	742840
C4	Kilroe Stream	30K23	Balrobuck Beg	532576	742092
C5*	Ballinduff Stream	30B05	N84 road crossing	531634	741344

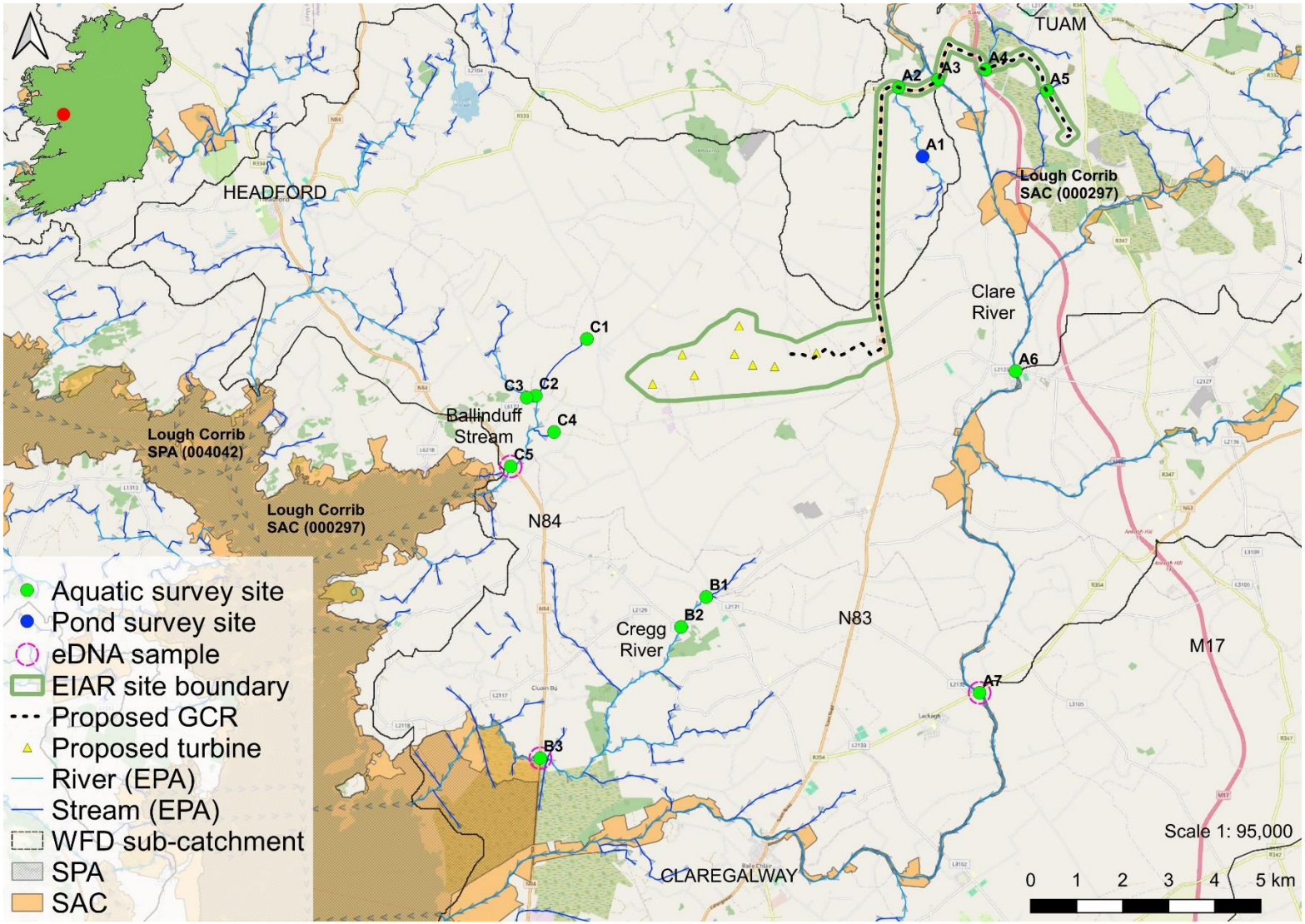

Figure 2.1 Overview of the *n*=15 aquatic survey site locations in vicinity of the Site, July 2022

2.3 Fish stock assessment (electro-fishing)

A single anode Smith-Root LR24 backpack (12V DC input; 300V, 100W DC output) was used to electro-fish sites on riverine watercourses in the vicinity of the Proposed Project in July 2022 (**Table 2.1, Figure 2.1; Appendix A**), following notification to Inland Fisheries Ireland, under the conditions of a Department of the Environment, Climate and Communications (DECC) licence. The survey was undertaken in accordance with best practice (CFB, 2008; CEN, 2003) and Section 14 licencing requirements.

Furthermore, a fisheries habitat appraisal of all aquatic survey sites (**Table 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 accompanying fisheries assessment report in **Appendix A.**

2.4 White-clawed crayfish survey

White-clawed crayfish surveys were undertaken at the aquatic survey sites in July 2022 under a National Parks and Wildlife (NPWS) open licence (no. C31/2022), as prescribed by Sections 9, 23 and 34 of the Wildlife Act (1976-2021), to capture and release crayfish to their site of capture, under condition no. 6 of the licence. As per Inland Fisheries Ireland recommendations, the crayfish sampling started at the uppermost site(s) of the wind farm catchment/sub-catchments in the survey area to minimise the risk of transferring 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 within the wider survey area was completed.

2.5 eDNA analysis (including freshwater pearl mussel)

To validate site surveys and to detect potentially cryptically low populations within the study area, 3 no. composite water samples were collected from the Clare River (A7), Cregg River (B3) and Ballinduff Stream (C5) and analysed for freshwater pearl mussel, white-clawed crayfish and crayfish plague eDNA (**Figure 2.1**). The water samples were collected on 14th July 2022, with the sites strategically chosen to maximise longitudinal (instream) coverage within the catchment (i.e. facilitating a greater likelihood of species detection).

In accordance with best practice, a composite (500ml) water sample was collected from the sampling point, maximising the geographic spread at the site (20 x 25ml 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 *n*=12 qPCR replicates were analysed for the site. Given the high sensitivity of eDNA analysis, a single positive qPCR replicate is considered as proof of the species' presence (termed qPCR No Threshold, or qPCR NT). 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 **Appendix C** for full eDNA laboratory analysis methodology.

2.6 Biological water quality (Q-sampling)

The 14 no. riverine survey sites were assessed for biological water quality through Q-sampling in July 2022 (**Figure 2.1).** All samples were taken with a standard kick sampling hand net (250mm width, 500µm 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 cobble was 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

2.7 Lacustrine macro-invertebrate communities

The small unnamed pond at site A1 was sampled for macro-invertebrates via sweep netting. A standard pond net (250mm width, mesh size 500µm) was used to sweep macrophytes to capture macro-invertebrates. The net was also moved along the lake/pond bed 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 site to get a representative sample for sub-habitats.

2.8 Macrophytes and aquatic bryophytes

Surveys of the macrophyte and aquatic bryophyte community were conducted by instream wading at each of the wetted aquatic survey sites, with specimens collected (by hand, sweep nets 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').

2.9 Otter signs

The presence of otter (*Lutra lutra*) at each aquatic survey site was determined through the recording of otter signs within 150m of each survey site. Notes on the age and location (ITM coordinates) were made for each otter sign recorded, in addition to the quantity and visible constituents of spraint (i.e. remains of fish, crustaceans, molluscs etc.).

2.10 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).

2.11 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. Specific consideration was given to highly virulent crayfish plague (*Aphanomyces astaci*) given known historical outbreaks in the connecting downstream catchment. Surveys were undertaken at sites in a downstream order to minimise the risk of upstream propagule mobilisation of pathogens and invasive species. 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 Triturus staff are certified in 'Good fieldwork practice: slowing the spread of invasive non-native species' by the University of Leeds.

3. Receiving environment

3.1 Laurclavagh Renewable Energy Development catchment and survey area description

The Proposed Project is located in a lowland karstic area approximately 9km south-west of Tuam, Co. Galway (**Figure 2.1**). The Proposed Project site is within the Western River Basin District and within hydrometric area 30 (Corrib). The aquatic survey sites were located within the Clare[Galway]_SC_020, Clare[Galway]_SC_040 and Clare[Galway]_SC_060 river sub-catchments. The Proposed Project site is not drained directly by any surface water pathways (**Figure 2.1**). The watercourses and aquatic surveys sites in the vicinity of the Site are typically small, historically modified lowland depositing channels (FW2; Fossitt, 2000) which flow over areas of karstic Visean limestone and calcareous shale (Geological Survey of Ireland data). Land use practices in the wider survey area are comprised exclusively of pastures (CORINE 231).

3.2 Fisheries asset of the survey area

The Clare River (93km in length) rises near Ballyhaunis in Co. Mayo as the Dalgan River and continues in a southerly direction passing Tuam and Claregalway before joining Lough Corrib. The river was extensively straightened and deepened as part of arterial drainage works in the 1950s and 1960s (Kelly et al., 2011). The river is known to support Atlantic salmon (*Salmo salar*), brown trout (*Salmo trutta*), European eel (*Anguilla anguilla*), lamprey (*Lampetra* sp.), perch (*Perca fluviatilis*), pike (*Esox lucius*), three-spined stickleback (*Gasterosteus aculeatus*), ten-spined stickleback (*Pungitius pungitius*), stone loach (*Barbatula barbatula*) in addition to non-native roach (*Rutilus rutilus*) (O'Briain et al., 2019; Kelly et al., 2015, 2011; Rooney et al., 2014; O'Connor, 2007). Brown trout growth in the river has been noted as 'very fast' based on the criteria of Kennedy and Fitzmaurice (1971) (Kelly et al., 2011). From a genetic perspective, the Clare River and its tributaries rivers contribute significantly to the adult brown trout population of Lough Corrib (Delanty et al., 2021; Massa-Gallucci et al., 2010). The Clare River catchment lies within an extensive area of karstic limestone and, as such, the Clare River has been described as not being a 'natural river' but more like an 'aqueduct' linking a series of pre-existing lakes, turloughs and reaches of stream (Delanty et al., 2021).

The Cregg River, a short 11km-long tributary of Lough Corrib, is known to support Atlantic salmon and brown trout (O'Reilly, 2009) in addition to a range of coarse fish species in its lower reaches including perch, pike, bream (*Abramis brama*) and roach (pers. obs.). No L*ampetra* sp. were recorded from the Cregg River during targeted surveys undertaken in 2006 (O'Connor, 2007) or 2013 (Rooney et al., 2014).

Fisheries data for the other watercourses surveyed was not available at the time of survey.

3.3 Protected and rare aquatic species

A sensitive species data request was submitted to the National Parks and Wildlife Service for the 10km grid squares containing and adjoining the Proposed Project (i.e. M23, M24, M33, M34, M43, M44 & M45). Furthermore, additional data held by the EPA and NBDC was also reviewed for these grid squares. Records for a low number of rare or protected aquatic species were available although none overlapped directly with the Proposed Project.

A relatively high number of records (>50) were available for white-clawed crayfish (*Austropotamobius pallipes*) in the respective grid squares. However, the majority of these were historical only (i.e. pre-1989). Most of the more contemporary records (2005 onwards) were available for the Abbert River, a tributary of the Clare River, as well as Lough Corrib (**Figure 3.1**). No contemporary records were available for the Clare River although the species has been detected via environmental DNA (eDNA) sampling in recent years (White et al., 2019; Swords & Griffin, 2022).

A relatively high number (c.40) of contemporary otter (*Lutra lutra*) records (2005-20218) were available for the respective 10km grid squares including on the Clare River, Cregg River and Ballinduff Stream (**Figure 3.1**). Otter signs were also recorded as part of the current survey (see section 4.1 & 4.4).

3.4 EPA Water Quality Data (Existing Data)

The following outlines the available water quality data for the watercourses in context of the Proposed Project. Only recent water quality is summarised below. Contemporary EPA biological monitoring data was available for the Clare River and Cregg River only. Please note that biological water quality analysis was undertaken as part of this study, with the results presented in the **Section 4** and **Appendix B** of this report.

3.4.1 Clare River

There were 4 no. contemporary EPA biological monitoring stations present on the Clare River (30C01 in the downstream vicinity of the Proposed Project. At Cloonmore Bridge (station RS30C010700, survey site A3) the river achieved **Q4 (good status)** in 2018. At Corrofin Bridge (station RS30C010800, survey site A6) this fell to **Q3-4 (moderate status)** in the same year. At Lackagh Bridge (station RS30C011000, survey site A7) the river also achieved **Q4 (good status)** in 2018. The lowermost sampling site at Cregmore Bridge (station RS30C011100) achieved **Q3-4 (moderate status)** in 2018.

In vicinity of the Proposed Project, the Clare (Galway)_060 and _070 river waterbodies were of poor status and good status, respectively, in the 2016-2021 periods. Whilst the Clare (Galway)_060 was considered 'at risk' of not achieving good status (WFD Risk 3rd cycle), the Clare (Galway)_070 was not considered at risk. Hydromorphology (resulting from arterial drainage) is considered the primary pressure to water quality in these waterbodies (EPA, 2019).

3.4.2 Cregg River

There were 2 no. contemporary EPA biological monitoring stations present on the Cregg River (30C03). At stations RS30C030100 (survey site B2) and RS30C030150 the river achieved **Q4 (good status)** and **Q3-4 (moderate status)** water quality in 2018, respectively.

The Cregg_010 river waterbody (encompassing the upper reaches of the Cregg River) was of poor status in the 2016-2021 period and considered 'at risk' of not achieving good status (WFD Risk 3rd cycle). The Cregg_020 river waterbody was of moderate status in the same period with the WFD risk currently under review. Hydromorphology (resulting from arterial drainage) is considered the primary pressure to water quality in these waterbodies (EPA, 2019).

3.4.3 Ballinduff Stream

There were no contemporary EPA biological monitoring stations present on the Ballinduff Stream (30B05) (i.e. one historical station only, from 1993, pre-WFD).

The Ballinduff Stream_010 river waterbody (encompassing the Ballinduff Stream and tributaries) was of good status in the 2016-2021 period and considered 'not at risk' of failing to achieve good status (WFD Risk 3rd cycle).

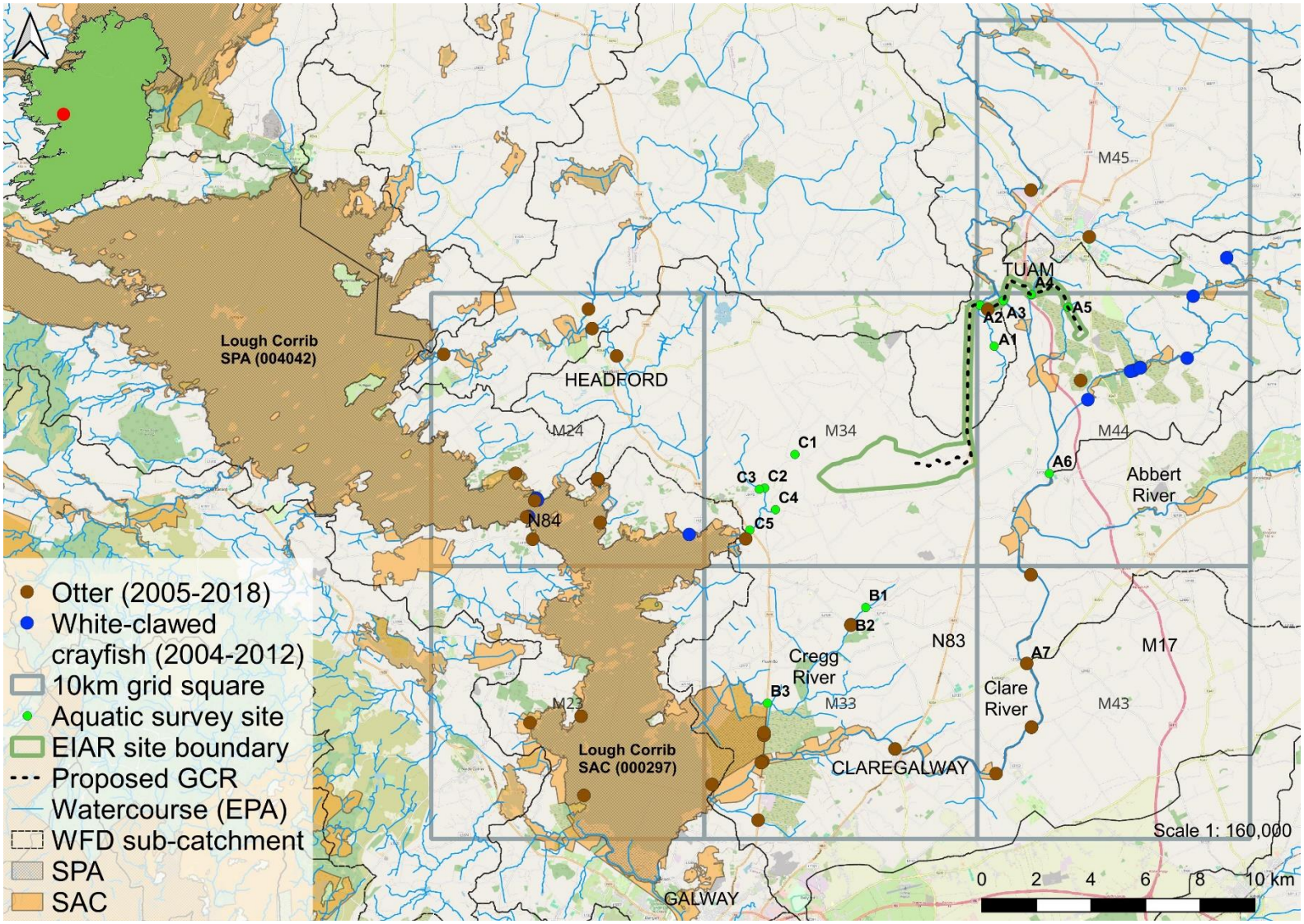

Figure 3.1 Selected protected aquatic species records in the vicinity of the Site (source: NPWS, EPA & NBDC data, 2004-2018)

4. Results of aquatic surveys

The following section summarises each of the 15 no. 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) and sweep sample results are also summarised for each riverine and lacustrine sampling site, respectively and in **Appendix B**. Habitat codes are according to Fossitt (2000). Scientific names are provided at first mention only. Sites were surveyed in July 2022. Please refer to **Appendix A** (fisheries assessment report) for more detailed fisheries results. A summary of the fish species recorded at each survey site is provided in **Table 4.1**. A summary of the aquatic species and habitats of high conservation concern recorded during the surveys is provided in **Table 4.3**. An evaluation of the aquatic ecological importance of each survey site based on these aquatic surveys is provided and summarised in **Table 4.4**.

4.1 Aquatic survey site results

4.1.1 Site A1 – Unnamed pond, Rusheens North

Site A1 was located at an inline pond (part of a series of 6 no. ponds) on the upper reaches of the Glennafosha River (EPA code: 30G69). The ponds likely joined at higher water levels but were hydrologically separated during the survey (i.e. dry river channel). The small mesotrophic pond covered 0.05ha surface area with water depths between 0.6m to 2.4m in the centre. The pond supported yellow water lily (*Nuphar lutea*) and bog bean (*Menyanthes trifoliata*) in the littorals with shining pondweed (*Potamogeton lucens*) in open water. The margins supported dense common clubrush (*Schoenoplectus lacustris*) that graded into marsh habitat (GM1). The marsh supported water horsetail (Equisetum fluviatile), water forget-me-not (*Myosotis scorpioides*), brooklime (*Veronica beccabunga*), water mint (*Mentha aquatica*), greater spearwort (*Ranunculus lingua*), iris (*Iris psuedacorus*), marsh cinquefoil (*Comarum palustre*), creeping buttercup (*Ranunculus repens*), bogbean and marsh bedstraw (*Galium palustris*). The pond was bordered by improved pasture (GA1).

With the exception of three-spined stickleback (recorded via sweep netting), and despite good physical suitability for a range of species (i.e. cyprinids), the pond(s) was not considered of fisheries value given the ephemeral nature of the Glennafosha River at this location and inherent access issues for fish from downstream habitats. Despite some suitability for white-clawed crayfish none were recorded via sweep netting. There was some suitability for smooth newt (*Lissotriton vulgaris*) and common frog (*Rana temporaria*) although neither were recorded during the survey. No otter signs were recorded in vicinity of the site.

No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via sweep sampling (**Appendix B**).

Given that the pond supported a good diversity of macrophyte plants and supported surrounding marsh habitat in can be considered of higher conservation value. Therefore, the aquatic ecological evaluation of site A1 was of **local importance (lower value) (Table 4.4).**

Plate 4.1 Representative image of site A1 at an inline pond on the Glennafosha River, July 2022

4.1.2 Site A2 – Glennafosha River, Claretuam Bridge

Site A2 was located on the Glennafosha River (30G69) at Claretuam Bridge (N83 road), the Proposed Grid Connection underground cabling route crosses the river within the existing bridge, approx. 0.8km upstream of the Clare River confluence. The lowland depositing river (FW2) had been extensively straightened and deepened historically, with resulting 2.5m-high steep earthen embankments along the channel. The river at this location was dry at the time of survey (and appeared to rarely convey water flows). The ephemeral channel (in a karstic landscape) averaged 2m wide with a dry bed of limestone bedrock, boulder and cobble. Given an absence of water, macrophytes and aquatic bryophytes were absent with high terrestrial encroachment from herbaceous species such as great willowherb (*Epilobium hirsutum*). The narrow riparian zones supported scattered hawthorn (*Crataegus monogyna*) and ash (*Fraxinus excelsior*) with rank grasses. The site was bordered by semi-improved pasture (GA1) with a seasonal pond/wetland located upstream of the road crossing.

Site A2 was not of fisheries value given its dry, ephemeral nature and absence of aquatic habitats. Under wetted conditions, the river would still provide poor suitability for fish species or white-clawed crayfish and none were recorded present. No otter signs were recorded in the vicinity of the site.

Given the dry nature of the site, it was not possible to collected a biological water quality sample at the time of survey.

Given the absence of aquatic habitats in the ephemeral channel, 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 Glennafosha River at Claretuam Bridge, July 2022 (ephemeral, dry channel)

4.1.3 Site A3 – Clare River, Cloonmore Bridge

Site A3 was located on the Clare River (30C01) at Cloonmore Bridge on the N83 road, the Proposed Grid Connection underground cabling route crosses the river within the existing bridge. The lowland depositing river (FW2) had been extensively straightened and deepened historically as part of arterial drainage works, with resulting very steep V-shaped banks of up to 8m in height. Nevertheless, the river retained high flow rates and some semi-natural characteristics. The river averaged 8-10m wide and varied from 0.4m to 1.8m deep. The profile comprised deep glide habitat with very localised riffle and pool. The substrata were dominated by large boulder, cobble and localised patches of coarse gravel. The site supported frequent water crowfoot (*Ranunculus* sp.), curled pondweed (*Potamogeton crispus*) and perfoliate pondweed (*Potamogeton perfoliatus*) in riffle areas upstream of the bridge. Boulders supported abundant *Rhynchostegium riparoides* with occasional *Fontinalis antipyretica* and *Brachythecium rivulare*. Despite hydromorphological impacts, given the presence of several key indicator species (EC, 2013), the aquatic vegetation community was representative of the Annex I habitat '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]'. The steep banks supported scattered bramble (*Rubus fruticosus* agg.) scrub with frequent hawthorn and dry meadow habitat (GS2). The site was bordered by semi-improved pasture (GA1).

Atlantic salmon (*Salmo salar*), brown trout (*Salmo trutta*), European eel (*Anguilla anguilla*) and stone loach (*Barbatula barbatula*) were recorded via electro-fishing at site A3 (**Appendix A**). The site was a very good quality salmonid nursery with abundant broken glide habitat and localised riffle. The deeper glide and pool was considered good holding habitat for larger salmonids. Spawning habitat was present locally in gravel and cobble areas between boulders. The site was of poor value for lamprey given the high energy of the channel and absence of depositing littorals. There was good suitability for European eel and one very large adult was recorded during the survey. Despite suitability for white-clawed crayfish none were recorded during the survey. Two regular otter spraint sites were recorded upstream of the bridge (ITM 540885, 749769 & 540881, 749786). These contained fish remains only.

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

Given the location of the site with the Lough Corrib SAC (00297), the aquatic ecological evaluation of site A3 was of **international importance (Table 4.4)**. The site also supported salmonids (including Atlantic salmon), European eel and Annex I floating river vegetation [3260].

Plate 4.3 Representative image of site A3 on the Clare River at Cloonmore Bridge, July 2022

4.1.4 Site A4 – Killeelaun River, Cloontooa

Site A4 was located on the Killeelaun River (30K46) at a local road (L6141) where the Proposed Grid Connection underground cabling route crosses the river within the existing bridge, approximately 200m downstream of the M17 road crossing. The small lowland depositing river (FW2) had been extensively straightened and deepened historically with resulting poor hydromorphology and a steep trapezoidal channel (banks to 5m in height). The river averaged a homogenous 3m wide and 0.4m deep and suffered from low summer flows at the time of survey. The profile comprised slow-flowing glide with no riffle or pool areas. The substrata were dominated by cobble and gravel but these were exposed to very heavy siltation. The site was heavily vegetated with frequent fool's watercress (*Apium nodiflorum*), common duckweed (*Lemna minor*), ivy-leaved duckweed (*Lemna trisulca*), lesser water parsnip (*Berula erecta*) and branched bur-reed (*Sparganium erectum*). Blue water speedwell (*Veronica anagallis-aquatica*), water forget-me-not and water plantain (*Alisma plantago-aquatica*) were occasional. Small pondweed (*Potamogeton berchtoldii*) and broad-leaved pondweed (*Potamogeton natans*) were also occasional in addition to spiked water-milfoil (*Myriophyllum spicatum*) and water starwort (*Callitriche* sp.). Given the presence of several key indicator species (EC, 2013), the aquatic vegetation community was representative of the Annex I habitat '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]'. Filamentous algae covered 30% surface area of the channel bed, indicating significant enrichment. The steep banks supported intermittent hedgerows of hawthorn and bramble and dry meadow habitat (GS2). The site was bordered by semi-improved pasture (GA1).

Three-spined stickleback (*Gasterosteus aculeatus*) and ten-spined stickleback (*Pungitius pungitius*) were the only fish species recorded via electro-fishing at site A4 (**Appendix A**). The heavily modified site was not of value to salmonids or lamprey given enrichment, very heavy siltation, low flows and historical modifications. Whilst there was some low suitability for European eel and white-clawed crayfish, none were recorded. Two otter spraint sites (one regular) were recorded upstream of the bridge crossing and contained both bird and fish remains (ITM 541977, 749951 & ITM 541967, 749970).

Biological water quality, based on Q-sampling, was calculated as **Q2-3 (poor status)** (**Appendix 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.

Despite evident hydromorphological impacts, the presence of Annex I floating river vegetation [3260] and utilisation by otter supported that the ecological evaluation was of **local importance (higher value) (Table 4.4).**

Plate 4.4 Representative image of site A4 on the Killeelaun River, July 2022

4.1.5 Site A5 – unnamed stream, Cloontooa

Site A5 was located on an unnamed Clare River tributary at a local road (L6141) where the Proposed Grid Connection underground cabling route crosses the stream within the existing road crossing. The diminutive lowland depositing stream (FW2) had been extensively straightened and deepened historically with resulting poor hydromorphology and U-shaped channel with 2m-high banks. The stream flowed under the local road via a pipe culvert and averaged 0.5m wide and 0.05m deep. The stream suffered from low summer flows at the time of survey. The profile comprised shallow riffle and glide. The substrata were dominated by small boulder, cobble and coarse gravel. Despite low flows, siltation was low overall. The site was heavily vegetated with abundant fool's watercress with occasional watercress (*Nasturtium officinale*), ivy-leaved duckweed, brooklime and water starwort (*Callitriche* sp.). The moss *Rhynchostegium riparoides* was common on boulders with the liverwort *Pellia endiviifolia* present locally. Filamentous algae was present (5%), indicating enrichment. The

riparian areas were dominated by mature grey willow (*Salix cinerea*) and ash with dense bramble in the understories. The site was bordered by semi-improved pasture (GA1) and wet grassland (GS4).

Three-spined stickleback were the only fish species recorded via electro-fishing at site A5 (**Appendix A**). With the exception of low densities of this species, the site was not of fisheries value given extensive historical modifications, very shallow water and poor flows. Whilst there was some low suitability for European eel and white-clawed crayfish, none were recorded. No otter signs were recorded in vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q3 (poor status)** (**Appendix 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, 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 an unnamed Clare River tributary, July 2022

4.1.6 Site A6 – Clare River, Corrofin Bridge

Site A6 was located on the Clare River (30C01) at Corrofin Bridge approximately 7km downstream of Site A3. The high energy, lowland depositing river (FW2) had been extensively straightened and deepened historically as part of arterial drainage works, with resulting vertical banks of 6-9m in height cut into limestone bedrock. Nevertheless, the river retained some semi-natural characteristics. The river averaged 12-14m wide and varied from 0.4m to >2m deep. The deep U-shaped profile comprised deep glide and pool habitat with only very occasional riffle areas. The substrata were dominated by bedrock and large boulder with more limited cobble and gravels. The site did not support macrophytes due to very high flow rates. However, *Rhynchostegium riparoides* was frequent with occasional *Brachythecium rivulare* on bedrock and boulders. Filamentous algae was not observed given the very fast-flowing water and dominance of bryophyte vegetation on boulders. The steep banks supported meadowsweet (*Filipendula ulmaria*), bramble, common valerian (*Valeriana officinalis*) and reed

canary grass (*Phalaris arundinacea*) with mature treelines of sycamore (*Acer psuedoplatanus* and ash. The site was bordered by narrow fringes of calcareous grassland (GS1/GS2), improved pasture (GA1) and amenity grassland (GA2).

Atlantic salmon and brown trout were the only fish species recorded via electro-fishing at site A6 (**Appendix A**). The site was considered a moderate quality salmonid nursery habitat given historical modifications. The more localised shallow glide and riffle areas offered the only viable nursery areas. Spawning habitat quality was also moderate at best given the more limited gravels. Good quality holding habitat was present in deep glide and pool. Suitability for lamprey was poor overall given the high energy of the site and absence of depositing littorals. Abundant boulders and deep glide and pool habitat provided good quality refugia for European eel (although none were recorded). Despite good suitability, no white-clawed crayfish were recorded (50 refugia searched). However, crayfish remains were identified in a single otter spraint recorded c.200m downstream of the bridge (ITM 542690, 743173).

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

Given the location of the site with the Lough Corrib SAC (00297), the aquatic ecological evaluation of site A6 was of **international importance (Table 4.4)**. The site also supported salmonids (including Atlantic salmon) and otter.

Plate 4.6 Representative image of site A6 on the Clare River at Corrofin Bridge, July 2022

4.1.7 Site A7 – Clare River, Lackagh Bridge

Site A7 was located on the Clare River (30C01) at Lackagh Bridge approximately 9km downstream of site A6. The high energy, lowland depositing river (FW2) had been extensively straightened and deepened historically as part of arterial drainage works, with resulting vertical banks of 6-9m in height cut into limestone bedrock. Nevertheless, the river retained some semi-natural characteristics. The river averaged 10-12m wide and varied from 0.7 to 1.8m deep. The deep U-shaped profile comprised deep glide and pool habitat with only very occasional riffle areas. The substrata were dominated by

bedrock and large boulder with more limited cobble and gravels which were restricted to small pockets between bedrock crevices. The site did not support macrophytes due to very high flow rates. However, *Rhynchostegium riparoides* and *Fissidens* sp. moss was present on submerged boulder and bedrock. Filamentous algae was not observed given the very fast-flowing water and dominance of bryophyte vegetation on boulders. The steep banks supported ivy (*Hedera helix*), herb Robert (*Geranium robertianum*), Hart's tongue (*Asplenium scolopendrium*) with mature sycamore and ash on the bank tops. The site was bordered by improved pasture (GA1).

Atlantic salmon and brown trout were the only fish species recorded via electro-fishing at site A7 (**Appendix A**). The site was considered a moderate quality salmonid nursery habitat given historical modifications. The more localised shallow glide and riffle areas offered the only viable nursery areas. Spawning habitat quality was also moderate at best given the more limited gravels. Good quality holding habitat was present in deep glide and pool. Suitability for lamprey was poor overall given the high energy of the site and absence of depositing littorals. Abundant boulders and deep glide and pool habitat provided good quality refugia for European eel (although none were recorded). Despite good suitability, no white-clawed crayfish were recorded (c.45 refugia searched). However, crayfish were detected via eDNA analysis (**Table 4.1**). An otter spraint site was recorded on a marginal boulder c.50m downstream of the bridge (ITM 541860, 736398). This contained fish remains only.

Biological water quality, based on Q-sampling, was calculated as **Q4 (good status)** (**Appendix B**). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the location of the site within the Lough Corrib SAC (000297), the aquatic ecological evaluation of site A7 was of **international importance (Table 4.4).** The site also supported salmonids (including Atlantic salmon) and otter, with white-clawed crayfish detected via eDNA analysis.

Plate 4.7 Representative image of site A7 on the Clare River at Lackagh Bridge, July 2022

4.1.8 Site B1 – Cregg River, Aucloggeen

Site B1 was located on the upper reaches of Cregg River (30C03) at a local road crossing. Situated in a karstic landscape, the small lowland depositing river (FW2) originated from a ponding area with dense growth of fool's watercress, bog pondweed (*Potamogeton polygonifolius*) and water horsetail. Downstream, the river opened into a 6-8m wide channel with slow-flowing glide and localised riffle habitat. The river suffered from low summer flows at the time of survey. The substrata comprised boulder with cobble and coarse gravels that were heavily silted and covered with dense growth of filamentous algae (c.80% cover). The channel supported fools' watercress, narrow-fruited watercress (*Nasturtium microphyllum*), floating sweetgrass (*Glyceria fluitans*) and water mint in the margins. The riparian areas supported marsh ragwort (Jacobaea aquatica), iris, great willowherb, meadowsweet and false oat grass with scattered grey willow. The site was bordered by improved pasture (GA1) with mixed broad-leaved woodland (WD1) present upstream.

European eel and three-spined stickleback were the only fish species recorded via electro-fishing at site B1 (**Appendix A**). The site was a poor quality spawning and nursery habitat for salmonids given low summer flows, siltation and eutrophication (none recorded). It was however a moderate quality eel nursery with abundant boulder and cobble with good invertebrate prey resources. There was no suitability for lamprey given the absence of spawning areas. No white-clawed crayfish were recorded and the low summer flows and evident eutrophication likely precluded the species' presence. No otter signs were recorded in vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q3 (poor status)** (**Appendix 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 presence of Red-listed European eel, the aquatic ecological evaluation of site B1 was of **local importance (higher value) (Table 4.4).**

Plate 4.8 Representative image of site B1 on the upper reaches of the Cregg River, July 2022 (emanating from pond/wetland)

4.1.9 Site B2 – Cregg River, Aucloggeen

Site B2 was located on the upper reaches of Cregg River (30C03) at a local road crossing approx. 0.9km downstream of site B1. The lowland depositing river (FW2) had been extensively straightened and deepened historically but retained some semi-natural instream features. The river averaged 6-8m wide and 0.2-0.5m deep but suffered from low summer flows at the time of survey. Slow-flowing glide predominated with only occasional riffle and pool areas. The substrata comprised small boulder with cobble and more extensive gravels that were moderately silted. The site supported abundant lesser water parsnip and very localised branched bur-reed. Upstream of the road crossing, the river was heavily overgrown with bog pondweed and lesser water parsnip, and filamentous algal cover of c.5%. Aquatic bryophyte coverage was high with abundant *Fontinalis antipyretica* present downstream. The riparian areas supported ash, sycamore and grey willow. The site was bordered by semi-improved pasture (GA1), amenity grassland (GA2) and localised calcareous grassland (GS1).

European eel and three-spined stickleback were the only fish species recorded via electro-fishing at site B2 (**Appendix A**). The site was a poor quality salmonid spawning and nursery habitat for salmonids given low summer flows, hydromorphological impacts, siltation and eutrophication (none recorded). It was however a moderate quality eel nursery with abundant boulder and cobble with good invertebrate prey resources. There was no suitability for lamprey given the absence of spawning areas. No white-clawed crayfish were recorded, despite some low suitability. No otter signs were recorded in vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q3 (poor status)** (**Appendix 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 presence of Red-listed European eel, the aquatic ecological evaluation of site B2 was of **local importance (higher value) (Table 4.4).**

Plate 4.9 Representative image of site B2 on the upper reaches of the Cregg River, July 2022

4.1.10 Site B3 – Cregg River, Addergoole Bridge

Site B3 was located on the lower reaches of Cregg River (30C03) at Addergoole Bridge approx. 5.5km downstream of site B2 and 4.5km upstream of the Lough Corrib confluence. The lowland depositing river (FW2) had been extensively straightened and deepened historically with very poor resulting hydromorphology (i.e. canalised river). The large lowland depositing river (FW2) averaged 15-18m wide and 1.5-3m deep. The profile was of deep slow-flowing glide. The substrata comprised mixed cobble, gravels and abundant soft sediment. The site supported extensive submerged beds of bright-leaved pondweed (*Potamogeton nitens*) and invasive Nuttall's pondweed (*Elodea nuttallii*). Filamentous algal mats were also present. The channel margins supported water mint, water forget-me-not, iris and greater spearwort with localised common reed (*Phragmites australis*). The riparian areas were open with scattered hawthorn and graded into semi-improved sheep pasture (GA1).

Electro-fishing was not undertaken at site B2 due to prohibitive depths (**Appendix A**). The site was predominantly of value as a coarse fish habitat, known to support pike (*Esox lucius*), perch (*Perca fluviatilis*), roach (*Rutilus rutilus*) and bream (*Abramis brama*). The site was also considered a good quality European eel habitat. Brown trout are also likely present at the site although there was an absence of spawning or nursery areas. There was poor suitability for lamprey with an absence of spawning areas. No white-clawed crayfish were recorded during the survey and the species was not detected via eDNA analysis (**Table 4.1**). No otter signs were recorded in vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q3-4 (moderate status)** (**Appendix 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). The near threatened mayfly *Kageronia* (*Heptagenia*) *fuscogrisea* (Kelly-Quinn & Regan, 2012) was recorded from the site during the survey. No other macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the location of the site within the Lough Corrib SAC (000297), the aquatic ecological evaluation of site B3 was of **international importance (Table 4.4).**

Plate 4.10 Representative image of site B3 on the Cregg River at Addergoole Bridge, July 2022

4.1.11 Site C1 – unnamed channel, Cluidrevagh

Site C1 was located on the uppermost reaches of an unnamed Ballinduff Stream tributary (unmapped by the EPA). The drainage channel (FW4) averaged 0.5-1m wide and had been extensively straightened historically. The channel was dry at the time of the survey and the dry mud base and absence of macrophyte/aquatic vegetation indicated highly irregular water flows. The open banks supported only scattered bramble scrub with an old dry stone wall along the north bank. The site was bordered by improved pasture (GA1).

Site C1 was not of fisheries value given its dry, ephemeral nature and absence of aquatic habitats. Given the site characteristics and poor connectivity with downstream habitats, it is unlikely that the channel supports fish even under higher flow periods. No otter signs were recorded in the vicinity of the site.

Given the dry nature of the site, it was not possible to collected a biological water quality sample at the time of survey.

Given the absence of aquatic habitats in the ephemeral channel, the aquatic ecological evaluation of site C1 was of **local importance (lower value) (Table 4.4).**

Plate 4.11 Representative image of site C1 on an unnamed Ballinduff Stream tributary, July 2022 (dry, ephemeral channel)

4.1.12 Site C2 – unnamed channel, Bunatober

Site C2 was located on an unnamed Ballinduff Stream tributary (unmapped by the EPA) at a local road crossing approx. 1.7km downstream of site C1. Located in a karstic landscape, the lowland channel (FW2) averaged 2.5-3m wide and had been extensively straightened historically. The channel was dry at the time of the survey although the bed of limestone bedrock, boulder and cobble indicated occasional water flows. Aquatic vegetation was not present. The riparian areas supported scattered mature hawthorn. The site was bordered by semi-improved pasture (GA1) used for sheep grazing.

Site C2 was not of fisheries value given its dry, ephemeral nature and absence of aquatic habitats. The site was considered unlikely to support fish or white-clawed crayfish even under higher flow periods given the seasonality of the downstream, connecting Ballinduff Stream. No otter signs were recorded in the vicinity of the site.

Given the dry nature of the site, it was not possible to collected a biological water quality sample at the time of survey.

Given the absence of aquatic habitats in the ephemeral channel, the aquatic ecological evaluation of site C2 was of **local importance (lower value) (Table 4.4).**

Plate 4.12 Representative image of site C2 on an unnamed Ballinduff Stream tributary, July 2022 (dry, ephemeral channel)

4.1.13 Site C3 – Ballinduff Stream, Knockereen

Site C3 was located on the Ballinduff Stream (30B05) at a local road crossing. Located in a karstic landscape, the semi-natural lowland depositing channel (FW2) averaged 3-5m wide with low-lying banks. The stream was dry at this location at the time of survey. However, the bed of limestone bedrock, boulder and cobble, in addition to some aquatic vegetation, indicted occasional water flows. Fool's watercress was locally frequent with (desiccated) *Fontinalis antipyretica* frequent on more stable boulder and cobble. The riparian areas supported mature hawthorn, hazel and ash. The site was bordered by semi-improved pasture (GA1).

Site C3 was not of fisheries value given its dry, ephemeral nature and absence of aquatic habitats. The site may support fish under higher flow periods given the presence of salmonids, European eel and other species in the lower reaches. Whilst there was physical suitability for white-clawed crayfish, the seasonality of the site likely precludes the species even during wetted periods. No otter signs were recorded in the vicinity of the site.

Given the dry nature of the site, it was not possible to collected a biological water quality sample at the time of survey.

Given the absence of aquatic habitats in the ephemeral channel, the aquatic ecological evaluation of site C3 was of **local importance (lower value) (Table 4.4).**

Plate 4.13 Representative image of site C3 on the Ballinduff Stream, July 2022 (dry, ephemeral channel)

4.1.14 Site C4 – Kilroe Stream, Balrobuck Beg

Site C4 was located on the Kilroe Stream (30K23) approx. 0.6km upstream of the Ballinduff Stream confluence. The lowland depositing stream (FW2) had been historically straightened and deepened and averaged 5-6m wide and 0.4-0.6m deep. The site suffered from low summer flows at the time of survey and the profile was dominated by deep, very slow-flowing glide with localised pool and no riffle areas (i.e. due to historical drainage). The substrata comprised deep silt (to 0.3m) with an absence of hard substrata. The site was heavily vegetated with abundant fool's watercress and branched bur-reed. Water starwort (*Callitriche* sp.) was locally frequent with occasional common duckweed. Filamentous algal cover was high (20%), indicating significant enrichment. The riparian areas supported treelines of mature osier (*Salix viminalis*) and localised ash. The site was bordered by semi-improved pasture (GA1).

Three-spined stickleback was the only fish species recorded via electro-fishing at site C4 (**Appendix A**). With the exception of low densities of this species, the site was not of very poor fisheries value given enrichment, very heavy siltation, low flows and historical modifications. Whilst there was some low suitability for white-clawed crayfish, none were recorded. No otter signs were recorded in the vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q3 (poor status)** (**Appendix 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, the aquatic ecological evaluation of site C4 was of **local importance (lower value) (Table 4.4).**

Plate 4.14 Representative image of site C4 on the Kilroe Stream, July 2022

4.1.15 Site C5 – Ballinduff Stream, N84 road crossing

Site C5 was located on the lower reaches of the Ballinduff Stream (30B05) at the N84 road crossing, approx. 2km downstream of site C3 and 1.1km upstream of the Lough Corrib confluence. The lowland depositing stream (FW2) had been straightened and deepened historically with poor recovery evident. In contrast to upstream (dry channel), the stream averaged 6-8m wide and 1-1.3m deep although suffered from low summer flows at the time of survey. Deep glide predominated with only localised pool and an absence of riffle areas. The substrata comprised scattered boulder with localised gravels but were dominated by silt, sand and clay. The site was heavily vegetated with abundant fool's watercress with occasional lesser water parsnip and water forget-me-not. Upstream of the bridge crossing, branched bur-reed was frequent with occasional broad-leaved pondweed, water mint and mare's-tail (*Hippuris vulgaris*). The duckweed species *Lemna trisulca* and *Lemna minor* were also occasional. The riparian areas supported mature ash with scattered bramble in the understories. The site was bordered by dry meadow habitat (GS2), patches of mixed broad-leaved woodland (WD1) and (upstream) improved pasture (GA1).

Brown trout, European eel, three-spined stickleback, stone loach and pike (*Esox lucius*) were recorded via electro-fishing at site C5 (**Appendix A**). The heavily modified site was of poor value as a salmonid spawning or nursery habitat given evident siltation and hydromorphological pressures. However, some good quality holding habitat was present locally, although the value of the site was reduced by noxious macrophyte coverage. The site was of high suitability for European eel given ample refugia although only a single eel was recorded. The site was of poor value for lamprey given poor flows, an absence of spawning areas and sub-optimal clay-dominated soft sediment accumulations. Despite some good suitability no white-clawed crayfish were recorded via hand searching although the species was detected via eDNA analysis (**Table 4.1**). No otter signs were recorded in the vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q3 (poor status)** (**Appendix 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 presence of salmonids and European eel, in addition to the detection of white-clawed crayfish (via eDNA), the aquatic ecological evaluation of site C5 was of **local importance (higher value) (Table 4.4).**

Plate 4.15 Representative image of site C5 on the Ballinduff Stream at the N84 road crossing, July 2022

4.2 White-clawed crayfish survey

No live white-clawed crayfish were recorded via hand-searching and sweep netting of instream refugia during the surveys undertaken at 11 no. wetted sites in July 2022. However, crayfish remains were identified in otter spraint recorded at site A6 on the Clare River (**Plate 4.16**).

Furthermore, white-clawed crayfish eDNA was detected at site A7 on the Clare River and C5 on the Ballinduff Stream (**Table 4.1**), despite a failure to capture any live individuals via hand searching at these sites. The field inspection of otter spraint sites on the Clare River (site A3, A6) and Killeelaun Stream (A4) did not reveal the presence of any white-clawed crayfish remains.

Crayfish plague was detected at site A7 on the Clare River and site B3 on the Cregg River (see section 4.3 below).

Plate 4.16 White-clawed crayfish remains recorded in otter spraint on the Clare River at site A6 July 2022

4.3 eDNA analysis

Composite water samples collected from the from the Clare River (site A7), Cregg River (B3) and Ballinduff Stream (C5) returned a negative result for freshwater pearl mussel eDNA, i.e. freshwater pearl mussel 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; Appendix C**). These results were considered as evidence of the species' absence at and or upstream of the sampling locations and support the absence of records for the species within the wider survey area.

White-clawed crayfish eDNA was detected at site A7 on the Clare River and C5 on the Ballinduff Stream (8 and 1 positive qPCR replicates out of 12, respectively) (**Table 4.1**; **Appendix C**). However, no crayfish eDNA was detected in the Cregg River at Addergoole Bridge (site B3), i.e. eDNA not present or was present below the limit of detection in a series of 12 qPCR replicates**.**

Crayfish plague eDNA was detected in the Clare River at site A7[1] and Cregg River at site B3 (12 and 2 positive qPCR replicates out of 12, respectively) but was not detected at sites on the Ballinduff Stream (C5) or Abbert River (C4) (**Table 4.1**; **Appendix C**).

[1] Similarly, crayfish plague eDNA was detected on the Clare River at the same location as survey site A7 (Lackagh Bridge) in 2018 and 2019 (White et al., 2019), as well as upstream at Daly's Bridge in 2020 (Swords & Griffin, 2022)

Table 4.1 eDNA results in the vicinity of the Site (positive qPCR replicates out of 12 in parentheses)

Site	Watercourse	Freshwater pearl mussel	White-clawed crayfish	Crayfish plague
A7	Clare River, Lackagh Bridge	Negative (0/12)	**Positive (8/12)**	**Positive (12/12)**
B3	Cregg River, Addergoole Bridge	Negative (0/12)	Negative (0/12)	**Positive (2/12)**
C5	Ballinduff Stream, N84 road crossing	Negative (0/12)	**Positive (1/12)**	Negative (0/12)

4.4 Otter signs

A total of 7 no. otter signs were recorded across 15 no. survey sites during the course of aquatic surveys undertaken in July 2022. All were spraint sites.

Two regular otter spraint sites were recorded at site A3 on the Clare River (upstream of the bridge; ITM 540885, 749769 & 540881, 749786). Spraint was also recorded on the Clare River at sites A6 (ITM 542690, 743173) and A7 (ITM 541860, 736398), respectively. A regular spraint site and single spraint were also recorded on the Killeelaun River at site A4 (ITM 541977, 749951 & ITM 541967, 749970). With the exception of site A7 (which contained remains of white-clawed crayfish; **Plate 4.16**), only fish, mollusc and bird remains were observed in the recorded spraints.

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

4.5 Invasive aquatic species

The invasive macrophyte Nuttall's pondweed (*Elodea nuttallii*) was recorded at site B3 on the lower reaches of the Cregg River (Addergoole Bridge). The species is very widespread in Ireland and is listed on the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations 2011-2021 (S.I. 477/2011). It is considered a high-risk invasive species in Irish waters (O' Flynn et al., 2014).

Whilst not recorded during the surveys, the invasive cyprinid species roach (*Rutilus rutilus*) are present in the Clare and Cregg Rivers (pers. obs.) and have been known in the Corrib catchment since the mid-1970s (Brazier, 2018). Roach is considered a medium impact invasive fish species in Ireland (O'Flynn et al., 2014) and is also listed on the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations 2011-2021 (S.I. 477/2011).

The invasive pathogen crayfish plague (*Aphanomyces astaci*) was detected via eDNA analysis in the Clare River at Lackagh Bridge (site A7) and the Ballinduff Stream at site C5 (see section 4.4 above).

4.6 Biological water quality (macro-invertebrates)

The near threatened (Kelly-Quinn & Regan, 2011) mayfly *Kageronia* (*Heptagenia*) *fuscogrisea* was recorded from site was recorded from site B3 on the lower reaches of the Cregg River (**Appendix B**). No other rare or protected macro-invertebrate species (according to national red lists) were recorded

in the biological water quality samples taken from 10 no. wetted riverine sites or 1 no. sweep sample from pond site A1 in July 2022 (**Appendix B**).

Sites A7 on the Clare River (Lackagh Bridge) achieved **Q4 (good status)** water quality and thus met the 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 4.1**). This was given the presence of one group A taxa in fair numbers (5% of total abundance), namely the mayfly *Heptagenia sulphurea* (**Appendix B**).

Sites A6 on the Clare River and B3 on the Cregg River achieved **Q3-4 (moderate status)** water quality (**Figure 4.1**). This was given the low numbers (<5%) of group A species, namely the mayflies *Ephemera danica* and *Ecdyonurus dispar* (A6) and the near threatened *Kageronia* (*Heptagenia*) *fuscogrisea* (B3) (**Appendix B**).

A total of 7 no. sites on the Clare River (A3), Killeelaun River (A4), unnamed stream (A5), Cregg River (B1, B2), Kilroe Stream (C4) and the Ballinduff Stream (C5) achieved **Q2-3** (A4) **or Q3 (poor status)** (all other sites) based on an absence of group A species; low numbers or an absence of group B species and a dominance of group C species such as the mayflies *Baetis rhodani* and *Seratella ignita*, and freshwater shrimp (*Gammarus duebeni*) (**Appendix B**).

It should be noted that the ratings for sites A4, A5, B1, B2, B3, C4 & C5 were tentative due to low summer flows and or a lack of suitable riffle areas for sampling (Toner et al., 2005).

Sites on the Glennafosha River (A2) and the Ballinduff Stream and an unnamed tributary (C1, C2, & C3) were dry at the time of survey (July 2022) and thus it was not possible to collect a biological water quality sample.

The pond sample from site A1 (located on the ephemeral Glennafosha River) supported a low diversity of invertebrate species including the mayfly Cloeon *simile*, the cased caddis *Phryganea bipunctata*, caseless caddis *Plectrocnemia conspersa* and *Plectrocnemia geniculata*, freshwater hoglouse (*Asellus aquaticus*) and a low number of molluscan species including *Bithynia tentaculata* and *Physa fontinalis* (**Appendix B**).

4.7 Macrophytes and aquatic bryophytes

No rare or protected macrophytes or aquatic bryophytes were recorded at the 15 no. survey sites in July 2022.

The Annex I habitat '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]' (aka floating river vegetation) was present on the Clare River at site A3 (Cloonmore Bridge) and the Killeelaun River at site A4, where several indicator species (EC, 2013) were present including both macrophytes and aquatic bryophytes.

4.8 Aquatic ecological evaluation

An aquatic ecological evaluation of each survey site was based on the results of desktop review (i.e., presence of species of high conservation value), fisheries assessments and habitat assessments, the presence of protected or rare species (e.g. freshwater pearl mussel, white-clawed crayfish, otter), 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 4.4**).

All 3 no. sites on the Clare River (A3, A6 & A7) as well as site B3 on the Cregg River were evaluated as **international importance** given their location within the Lough Corrib SAC (000297).

A total of 5 no. sites including an unnamed pond (A1), the Killeelaun River (A4), Cregg River (B1 & B2), and Ballinduff River (C5) were evaluated as **local importance (higher value)** in terms of their aquatic ecology due to the presence of species and or habitats of higher conservation value (**Table 4.4**).

The remaining 6 no. sites on the Glennafosha River (A2), unnamed Clare River tributary (A5), Ballinduff Stream (C3) and an unnamed tributary (C1, C2) and the Kilroe Stream (C4) 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 and or less than Q4 (good status) water quality (riverine sites only) (**Table 4.4**).

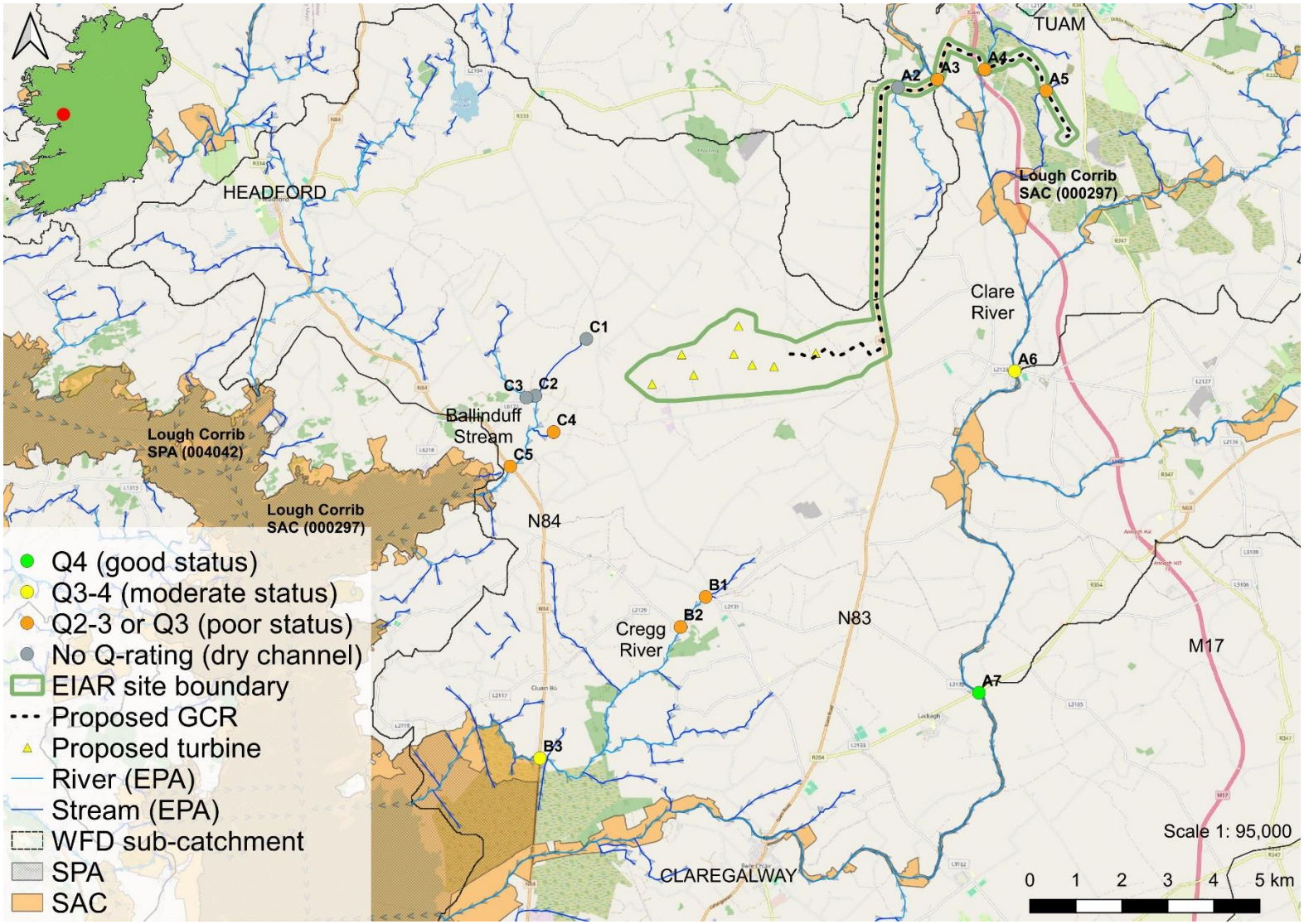

Figure 4.1 Overview of the biological water quality status in the vicinity of the Site, Co. Galway, July 2022

Table 4.2 Summary of fish species of higher conservation value and relative abundances (low, medium, high & very high) recorded via **electro-fishing** per riverine survey site in the vicinity of the Proposed Project, July 2022

Site	Watercourse	Relative abundance				Other species
		Atlantic salmon	Brown trout	*Lampetra* sp.	European eel	
A1	Unnamed pond	n/a – electro-fishing not undertaken				
A2	Glennafosha River	n/a – electro-fishing not undertaken (dry channel)				
A3	Clare River	Medium	Low		Low	Stone loach
A4	Killeelaun River					Three-spined stickleback, ten-spined stickleback
A5	Unnamed stream					Three-spined stickleback
A6	Clare River	Low	Low			
A7	Clare River	Low	Low			
B1	Cregg River				Low	Three-spined stickleback
B2	Cregg River				Low	Three-spined stickleback
B3	Cregg River	n/a – electro-fishing not undertaken (too deep)				
C1	Unnamed river	n/a – electro-fishing not undertaken (dry channel)				
C2	Unnamed river	n/a – electro-fishing not undertaken (dry channel)				
C3	Ballinduff Stream	n/a – electro-fishing not undertaken (dry channel)				
C4	Kilroe Stream					Three-spined stickleback
C5	Ballinduff Stream		Low		Low	Three-spined stickleback, pike

Conservation value: Atlantic salmon (*Salmo salar*), 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 Inland Fisheries Acts 1959 to 2017, brown trout and coarse fish species have no legal protection in Ireland.

Table 4.3 Summary of aquatic species & habitats of higher conservation value recorded in the vicinity of the Proposed Project, July 2022

Site	Watercourse	Freshwater pearl mussel	White-clawed crayfish	Otter signs[4]	Annex I aquatic habitats	Rare or protected macrophytes/ aquatic bryophytes	Rare or protected macro-invertebrates	Other species/habitats of high conservation value
A1	Unnamed pond	None recorded	None recorded	No signs	Not present	None recorded	None recorded	None recorded
A2	Glennafosha River	None recorded	None recorded	No signs	Not present	None recorded	None recorded	None recorded
A3	Clare River	None recorded	None recorded	**2 no. regular spraint sites**	**Floating river vegetation [3260]**	None recorded	None recorded	**Atlantic salmon, European eel**
A4	Killeelaun River	None recorded	None recorded	**2 no. spraint sites**	**Floating river vegetation [3260]**	None recorded	None recorded	None recorded
A5	Unnamed stream	None recorded	None recorded	No signs	Not present	None recorded	None recorded	None recorded
A6	Clare River	None recorded	**None recorded but remains identified in otter spraint**	**Regular spraint site**	Not present	None recorded	**White-clawed crayfish (otter spraint)**	**Atlantic salmon**
A7	Clare River	None recorded; negative eDNA sample	**None recorded but positive eDNA sample**	**Regular spraint site**	Not present	None recorded	**White-clawed crayfish (eDNA only)**	**Atlantic salmon**
B1	Cregg River	None recorded	None recorded	No signs	Not present	None recorded	None recorded	**European eel**
B2	Cregg River	None recorded	None recorded	No signs	Not present	None recorded	None recorded	**European eel**
B3	Cregg River	None recorded; negative eDNA sample	None recorded; negative eDNA sample	No signs	Not present	None recorded	None recorded	None recorded
C1	Unnamed river	None recorded	None recorded	No signs	Not present	None recorded	None recorded	None recorded
C2	Unnamed river	None recorded	None recorded	No signs	Not present	None recorded	None recorded	None recorded
C3	Ballinduff Stream	None recorded	None recorded	No signs	Not present	None recorded	None recorded	None recorded
C4	Kilroe Stream	None recorded	None recorded	No signs	Not present	None recorded	None recorded	None recorded
C5	Ballinduff Stream	None recorded; negative eDNA sample	**None recorded but positive eDNA sample**	No signs	Not present	None recorded	**White-clawed crayfish (eDNA only)**	**European eel**

Conservation value: White-clawed crayfish (*Austropotamobius pallipes*), Atlantic salmon (*Salmo salar*) 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 white-clawed crayfish and otter are protected under the Irish Wildlife Acts 1976-2021. White-clawed crayfish (Füreder et al., 2010) are 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. 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 Inland Fisheries Acts 1959 to 2017, brown trout and coarse fish species have no legal protection in Ireland.

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

Table 4.4 Aquatic ecological evaluation summary of the Proposed Project survey sites according to NRA (2009) criteria

Site no.	Watercourse	EPA code	Evaluation of importance	Rationale summary
A1	Unnamed pond	30G69	**Local importance (higher value)**	Small 0.05ha, well-vegetated mesotrophic inline pond on the ephemeral Glennafosha River; of low fisheries value given evident connectivity issues with downstream habitats; but supporting marsh and wetland habitat of high local conservation value
A2	Glennafosha River	30G69	Local importance (lower value)	Upper reaches of small, historically modified, ephemeral lowland river with poor flows & poor hydromorphology; river dry at this location at the time of survey with an absence of aquatic habitats or species
A3	Clare River	30C01	**International importance**	Located within the Lough Corrib SAC (00297); extensively modified, high-energy lowland alkaline river with some instream recovery & of good value to salmonids; Atlantic salmon, brown trout, European eel & stone loach recorded via electro-fishing; regular otter spraint sites recorded; Annex I floating river vegetation [3260] present; **Q3** (poor status) water quality
A4	Killeelaun River	30K46	**Local importance (higher value)**	Small, extensively modified, heavily-vegetated lowland river with poor hydromorphology, low summer flows & siltation pressures; three-spined & ten-spined stickleback recorded via electro-fishing; regular otter spraint sites recorded; Annex I floating river vegetation [3260] present; **Q2-3** (poor status) water quality (tentative rating)
A5	Unnamed stream	n/a	Local importance (lower value)	Very small, extensively modified lowland stream with poor hydromorphology, low summer flows & low aquatic value; three-spined stickleback recorded via electro-fishing; **Q3** (poor status) water quality (tentative rating)
A6	Clare River	30C01	**International importance**	Located within the Lough Corrib SAC (00297); extensively modified, high-energy lowland alkaline river with some instream recovery & of moderate value to salmonids; low densities of Atlantic salmon & brown trout recorded via electro-fishing; otter spraint site recorded; **Q3-4** (moderate status) water quality
A7	Clare River	30C01	**International importance**	Located within the Lough Corrib SAC (00297); extensively modified, high-energy lowland alkaline river with some instream recovery & of moderate value to salmonids; low densities of Atlantic salmon & brown trout recorded via electro-fishing; otter spraint site recorded; white-clawed crayfish detected via eDNA analysis; **Q4** (good status) water quality
B1	Cregg River	30C03	**Local importance (higher value)**	Uppermost reaches of small, lowland alkaline river emanating from pond with low summer flows & enrichment pressures; European eel & three-spined stickleback recorded via electro-fishing; **Q3** (poor status) water quality (tentative rating)
B2	Cregg River	30C03	**Local importance (higher value)**	Upper reaches of small, historically modified lowland alkaline river with low summer flows & some instream recovery; European eel & three-spined stickleback recorded via electro-fishing; **Q3** (poor status) water quality (tentative rating)
B3	Cregg River	30C03	**International importance**	Located within the Lough Corrib SAC (00297); lower reaches of heavily modified canalised lowland river; electro-fishing not undertaken due to prohibitive depths but site of high coarse fish value; near threatened (Kelly-Quinn & Regan, 2011) mayfly *Kageronia (Heptagenia) fuscogrisea* recorded; **Q3-4** (moderate status) water quality (tentative rating)

Site no.	Watercourse	EPA code	Evaluation of importance	Rationale summary
C1	Unnamed channel	n/a	Local importance (lower value)	Uppermost reaches of historically modified, unmapped ephemeral drainage channel; channel dry at this location at the time of survey with an absence of aquatic habitats or species
C2	Unnamed channel	n/a	Local importance (lower value)	Historically modified, unmapped lowland channel; channel dry at this location at the time of survey with an absence of aquatic habitats or species
C3	Ballinduff Stream	30B05	Local importance (lower value)	Historically modified ephemeral lowland depositing stream; stream dry at this location at the time of survey with an absence of aquatic habitats or species
C4	Kilroe Stream	30K23	Local importance (lower value)	Historically modified, heavily vegetated, heavily silted lowland stream with low summer flows & low aquatic value; three-spined stickleback recorded via electro-fishing; **Q3** (poor status) water quality (tentative rating)
C5	Ballinduff Stream	30B05	**Local importance (higher value)**	Lower reaches of historically modified, heavily vegetated lowland alkaline stream with siltation pressures; brown trout, European eel & pike recorded via electro-fishing; white-clawed crayfish recorded via eDNA analysis; **Q3** (poor status) water quality (tentative rating)

Conservation value: Atlantic salmon (*Salmo salar*), *Lampetra* spp. and otter (*Lutra lutra*) are all listed under Annex II of the Habitats Directive [92/42/EEC]. Furthermore, Atlantic salmon, *Lampetra* spp. are also listed under Annex V of the Habitats Directive [92/42/EEC] while otter are also listed on under Annex IV of the Habitats Directive [92/42/EEC]. Otters (along with their breeding and resting places) are also protected under provisions of the Irish Wildlife Acts 1976 to 2021. 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 Inland Fisheries Acts 1959 to 2017, brown trout and coarse fish species have no legal protection in Ireland.

5. Discussion

5.1 Most valuable areas for aquatic ecology

All 3 no. sites on the Clare River (A3, A6 & A7) as well as site B3 on the Cregg River were evaluated as **international importance** given their location within the Lough Corrib SAC (000297). These sites also supported qualifying interest Atlantic salmon and otter. Red-listed European eel and the Annex I habitat '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]' (aka floating river vegetation) were also present at site A3. White-clawed crayfish remains were recorded in otter spraint at site A6 with crayfish eDNA detected at site A7.

A total of five no. sites on an unnamed pond (A1), the Killeelaun River (A4), Cregg River (B1 & B2) and Ballinduff River (C5) were evaluated as **local importance (higher value)** in terms of their aquatic ecology due to the presence of species and or habitats of higher conservation value (**Table 4.4**). This was due to the presence of higher conservation value species such as salmonids (1 no. sites), European eel (3 no. sites), otter (1 no. site), white-clawed crayfish (1 no. site, eDNA only) and or Annex I aquatic habitats (1 no. site) (**Table 4.4**). The pond site supported wetland and marsh habitat of moderate diversity that are uncommon in the study area and acted as supporting habitat for birds, fish and other species. It was thus also considered of **local importance (higher value).**

The remaining 6 no. sites on the Glennafosha River (A2), unnamed Clare River tributary (A5), Ballinduff Stream (C3) including an unnamed tributary (C1, C2) and the Kilroe Stream (C4) 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 and or less than Q4 (good status) water quality (riverine sites only) (**Table 4.4**). Sites on the Glennafosha River (A2) and the Ballinduff Stream and an unnamed tributary (C1, C2, & C3) were dry at the time of survey (July 2022) and did not support aquatic habitats or species.

5.1.1 Fish species of high conservation value

Atlantic salmon were present at 3 no sites in total, namely all survey sites on the Clare River (sites A3, A6 & A7) (**Table 4.2**). Brown trout were also recorded at these sites, in addition to site C5 on the Ballinduff Stream. Salmonids were present in low numbers, with site A3 on the Clare River supporting the best quality salmonid habitat (very good quality) and the highest relative density of both Atlantic salmon and brown trout (**Appendix A**). Elsewhere, the quality of salmonid was typically poor due to significant hydromorphological pressures resulting from arterial drainage (i.e. extensive straightening & deepening).

No lamprey ammocoetes (*Lampetra* sp.) were recorded during targeted electro-fishing. This was considered to reflect the paucity of suitable nursery (soft sediment) habitat within the vicinity of the Proposed Project, in addition to the presence of sub-optimal or absence of spawning habitat, primarily due to arterial drainage pressures (**Appendix A**).

European eel were only recorded in low densities at a total of 4 no. sites on the Clare River (A3), Cregg River (B1 & B2) and Ballinduff Stream (C5) (**Table 4.1; Appendix A**). The paucity of eel recorded during

the electro-fishing surveys was considered to reflect a combination sub-optimal habitat resulting from historical modifications in addition to low summer flows at numerous survey sites (**Appendix A**).

5.1.2 Otter

Despite widespread suitability, only a low number of otter signs (7 no. spraint sites) were recorded during the survey. Regular spraint sites were recorded at sites A3, A6 and A7 on the Clare River as well as site A4 on the Killeelaun Stream.

This paucity of signs was considered to mainly reflect the influence of low summer flows and historical instream modifications (straightening, deepening) on the health and distribution of fish populations, the key prey resource of otter (Krawczyk et al., 2016; Ruiz-Olmo & Jiménez, 2009). Otters are food-limited and prey availability is a crucial factor in determining mortality, breeding success and the status of local populations (Sittenthaler et al., 2019; Ruiz-Olmo et al., 2002). Furthermore, otter sign marking is routinely associated with prominent features such as large instream boulders, and tree root systems (Almeida et al., 2012). Historical drainage, such as that carried out historically in the vicinity of the Proposed Project, significantly reduces instream habitat heterogeneity (O'Grady, 2017) and the availability or marking areas (outposts), which therefore results in the deposition and detection of fewer otter signs such as spraints, irrespective of watercourse utilisation (e.g. for foraging).

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

5.1.3 White-clawed crayfish & crayfish plague

Despite suitability at numerous sites, no white-clawed crayfish were recorded during targeted surveys of 11 no. wetted sites in July 2022. However, white-clawed crayfish remains were identified in otter spraint recorded at site A6 on the Clare River and white-clawed crayfish eDNA was detected at Lackagh Bridge (site A7) approximately 9km downstream. Whilst no contemporary records are available for white-clawed crayfish in the Clare River (pre-1989 only; **Figure 3.1**), the species was also detected via eDNA at Daly's Bridge (located between survey sites A6 & A7) in 2020 as part of the National Crayfish Plague Surveillance Program (Swords & Griffin, 2022). The species was also detected via eDNA at site C5 on the Ballinduff Stream (**Table 4.1**), despite a failure to record any live specimens via hand searching of instream refugia. The range of white-clawed crayfish in the Lough Corrib SAC site is particularly restricted (Gammell et al., 2021), with populations primarily found in the upper reaches of the Abbert and Grange River sub-catchments, both tributaries of the Clare River (Triturus, 2023; McFarlane et al., 2019). This survey has also confirmed the presence of white-clawed crayfish in the Ballinduff Stream sub-catchment (first known record).

Whilst probably a product of both historical drainage and fluvial connectivity pressures (ephemeral habitats due to the karstic landscape), the scattered distribution of crayfish in the Clare River catchment is likely exacerbated by the occurrence of crayfish plague (*Aphanomyces astaci*). Crayfish plague was first detected (via eDNA) on the Clare River in 2018 (and again in 2019) at Lackagh Bridge (survey site A7) (White et al., 2019), as well as upstream at Daly's Bridge in 2020 (Swords & Griffin, 2022). The pathogen was also detected on the Clare River (Lackagh Bridge) during the current survey (July 2022), as well as the Cregg River (Addergoole Bridge), another tributary of Lough Corrib. Crayfish plague, which can cause up to 100% mortality in white-clawed crayfish populations (Edgerton et al.,

2004), is listed as one of the world's 100 worst invasive species (GISD, 2022; Lowe et al., 2000) and is becoming highly prevalent across Ireland. *Aphanomyces astaci* is considered an obligate crayfish parasite not capable of surviving for a long period outside a crayfish host (Strand et al., 2011; Söderhall & Cerenius, 1999). Therefore, the simultaneous detection of both crayfish plague and white-clawed crayfish signatures at the same site following a known plague outbreak (e.g. Clare River; NPWS, 2019) is an unusual but increasingly common observation in Ireland (pers. obs.).

Only a single genotype of crayfish plague (group or haplotype A) has been identified in the Corrib catchment to date[2] (Swords & Griffin, 2022; White et al., 2019). In Europe, this genotype has exhibited low pathogenicity, persisting with a low prevalence in native crayfish populations acting as carriers (Basso et al., 2023; Svoboda et al., 2016; Makkonen et al., 2012). This may be due to this strain's decreased ability of penetrating into the cuticle of the crayfish, thus reducing infection rates (Francesconi et al., 2021). Latent infections and at least partial resistance to (certain strains of) crayfish plague have been reported in white-clawed crayfish in continental Europe (Martínez-Ríos et al., 2022; Jussila et al., 2021; Martín-Torrijos et al., 2017) and has also been hypothesised in Ireland in light of recent monitoring data (Mirimin et al., 2022; pers. obs.). Thus, the detection and continued coexistence of white-clawed crayfish and crayfish plague in the Clare River indicates a lower virulence strain of the pathogen and may suggest some natural resistance in crayfish populations within the catchment.

5.1.4 Macro-invertebrates & biological water quality

The mayfly *Kageronia* (*Heptagenia*) *fuscogrisea* was recorded from site B3 on the lower reaches of the Cregg River (**Appendix B**). The species is primarily found in well-vegetated reaches of alkaline rivers and is listed as near threatened in Ireland due to population declines (Kelly-Quinn & Regan, 2012).

No other rare or protected macro-invertebrate species (according to national red lists) were recorded in the biological water quality samples taken from 10 no. wetted riverine sites or 1 no. sweep sample from pond site A1 in July 2022 (**Appendix B**).

Site A7 on the Clare River (Lackagh Bridge) achieved **Q4 (good status)** water quality and thus met the 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 4.1**). The remaining 9 no. wetted riverine sites achieved **Q3-4 (moderate status)** (sites A6 & B3) or **Q2-3 or Q3 (poor status)** (sites A3, A4, A5, B1, B2, C4 & C5).

With the exception of site A7 on the Clare River, the biological water quality in the vicinity of the Proposed Project was unsatisfactory and was not meeting good status targets. Hydromorphology (channelisation, resulting from arterial drainage) is the primary threat to water quality within the survey area (EPA, 2019) and this was observed during the site surveys. Furthermore, low summer flows typical of the wider karstic survey area also influenced biological water quality in July 2022.

[2] The eDNA techniques used in this survey detected presence/absence of crayfish plague only. It does not define the genotype of crayfish plague present

5.1.5 Macrophytes, bryophytes & Annex I Habitats

No rare or protected rare macrophytes/aquatic bryophytes were recorded during the survey. Sites A3 on the Clare River and A4 on the Killeelaun River supported Annex I floating river vegetation habitat [3260].

5.2 Aquatic ecology summary

The watercourses in the vicinity of the Proposed Project were typically lowland channels which had been extensively straightened and or deepened historically as part of arterial drainage and land reclamation works, resulting in poor hydromorphology and reduced habitat heterogeneity. Whilst some good instream recovery had occurred locally (e.g. Clare River), siltation and hydromorphological pressures were evident throughout the survey area. The highest value watercourses within vicinity of the Proposed Project in terms of aquatic ecology were those with higher flow volumes and better instream recovery from arterial drainage, namely the Clare River and, to a lesser degree, the Cregg River and Ballinduff Stream.

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7. Appendix A – fisheries assessment report

Please see accompanying fisheries assessment report

Fisheries assessment for Laurclavagh Renewable Energy Development, Co. Galway

Prepared by Triturus Environmental Ltd. for MKO

October 2023

Please cite as:

Triturus (2023). Fisheries assessment report for Laurclavagh Renewable Energy Development, Co. Galway. Report prepared by Triturus Environmental Ltd. for MKO. October 2023.

Table of contents

1. Introduction

1.1 Background

Triturus Environmental Ltd. were commissioned by MKO to undertake a baseline fisheries assessment of numerous watercourses in the vicinity of the proposed Laurclavagh Renewable Energy Development, located approximately 9km south-west of Tuam, Co. Galway (**Figure 2.1**).

The survey was undertaken to establish baseline fisheries data used in the preparation of the EIAR for the Proposed Project. In order to gain an accurate overview of the existing and potential fisheries value of the riverine watercourses within the vicinity of the Proposed Project, a catchment-wide electro-fishing survey across 14 no. riverine sites was undertaken (**Table 2.1; Figure 2.1**). Electro-fishing helped to identify the importance of the watercourses as nurseries and habitats for salmonids, lamprey species and European eel (*Anguilla anguilla*). Other species of lower conservation value were also recorded. The presence and or absence of fish populations and or associated supporting habitat would help inform impact assessment and any subsequent mitigation for the Proposed Project.

Triturus Environmental Ltd. made an application under Section 14 of the Fisheries (Consolidation) Act, 1959 as substituted by Section 4 of the Fisheries (Amendment) Act, 1962, to undertake a catchment-wide electro-fishing survey in the vicinity of the Proposed Project. Permission was granted on the 28th June 2022 and the survey was undertaken on Tuesday 12th to Thursday 14th July 2022.

1.2 Fisheries asset of the survey area

The Clare River (93km in length) was extensively straightened and deepened as part of arterial drainage works in the 1950s and 1960s (Kelly et al., 2011). The river is known to support Atlantic salmon (*Salmo salar*), brown trout (*Salmo trutta*), European eel (*Anguilla anguilla*), perch (*Perca fluviatilis*), pike (*Esox lucius*), three-spined stickleback (*Gasterosteus aculeatus*), ten-spined stickleback (*Pungitius pungitius*), stone loach (*Barbatula barbatula*) and non-native roach (*Rutilus rutilus*) in addition to lamprey (*Lampetra* sp.) (O'Briain et al., 2019a; Kelly et al., 2015, 2011; Rooney et al., 2014; O'Connor, 2007). Brown trout growth in the river has been noted as 'very fast' based on the criteria of Kennedy and Fitzmaurice (1971) (Kelly et al., 2011). From a genetic perspective, The Clare River and its tributaries rivers contribute significantly to the adult brown trout population of Lough Corrib (Delanty et al., 2021; Massa-Gallucci et al., 2010). The Clare River catchment lies within an extensive area of karstic limestone and, as such, the Clare River has been described as not being a 'natural river' but more like an 'aqueduct' linking a series of pre-existing lakes, turloughs and reaches of stream (Delanty et al., 2021).

The Cregg River, a short 11km-long tributary of Lough Corrib, is known to support Atlantic salmon and brown trout (O'Reilly, 2009) in addition to a range of coarse fish species in its lower reaches including perch, pike, bream (*Abramis brama*) and roach (pers. obs.). No L*ampetra* sp. were recorded from the Cregg River during targeted surveys undertaken in 2006 (O'Connor, 2007) or 2013 (Rooney et al., 2014).

Fisheries data for the other watercourses surveyed was not available at the time of survey.

2. Methodology

2.1 Fish stock assessment (electro-fishing)

A single anode Smith-Root LR24 backpack (12V DC input; 300V, 100W DC output) was used to electro-fish sites on watercourses in the vicinity of the Proposed Project (**Table 2.1, Figure 2.1**) on Tuesday 12th to Thursday 14th July 2022 following notification to Inland Fisheries Ireland and under the conditions of a Department of the Environment, Climate and Communications (DECC) licence. Both river and holding tank water temperature was monitored continually throughout the survey to ensure temperatures of 20°C were not exceeded, thus minimising stress to the captured fish due to low dissolved oxygen levels. A portable battery-powered aerator was also used to further reduce stress to any captured fish contained in the holding tank.

Salmonids, European eel and other captured fish species were transferred to a holding container with oxygenated fresh river water following capture. To reduce fish stress levels, anaesthesia was not applied to captured fish. All fish were measured to the nearest millimetre and released in-situ following a suitable recovery period.

As three primary species groups were targeted during the survey, i.e., salmonids, lamprey, and eel, the electro-fishing settings were tailored for each species. By undertaking electro-fishing using the rapid electro-fishing technique (see methodology below), the broad characterisation of the fish community at each sampling reach could be determined as a longer representative length of channel can be surveyed. Electro-fishing methodology followed accepted European standards (CEN, 2003) and adhered to best practice (e.g., CFB, 2008).

2.1.1 Salmonids and European eel

For salmonid species and European eel, as well as all other incidental species, electro-fishing was carried out in an upstream direction for a 10-minute CPUE, an increasingly common standard approach for wadable streams (Matson et al., 2018). A total of approx. 50-100m channel length was surveyed at each site, where feasible, in order to gain a better representation of fish stock assemblages. At certain, more minor watercourse sites or sites with limited access, it was more feasible to undertake electro-fishing for a 5-minute CPUE. Discrepancies in fishing effort (CPUE) between sites are accounted for in the subsequent results section (**Table 3.1**).

Relative conductivity of the water at each site was checked in-situ with a conductivity meter and the electro-fishing backpack was energised with the appropriate voltage and frequency to provide enough draw to attract salmonids and European eel to the anode without harm. For the high conductivity waters of the sites (draining limestone geologies) a voltage of 200-250v, frequency of 35-40Hz and pulse duration of 3.5-4ms was utilised to draw fish to the anode without causing physical damage.

2.1.2 Lamprey

Electro-fishing for lamprey ammocoetes was conducted using targeted box quadrat-based electro-fishing (as per Harvey & Cowx, 2003) in objectively suitable areas of sand/silt, where encountered. As lamprey take longer to emerge from silts and require a more persistent approach, they were targeted at a lower frequency (30Hz) burst DC pulse setting which also allowed detection of European eel in

sediment, if present. Settings for lamprey followed those recommended and used by Harvey & Cowx (2003), APEM (2004) and Niven & McAuley (2013). Using this approach, the anode was placed under the water's surface, approx. 10-15cm above the sediment, to prevent immobilising lamprey ammocoetes within the sediment. The anode was energised with 100V of pulsed DC for 15-20 seconds and then turned off for approximately five seconds to allow ammocoetes to emerge from their burrows. The anode was switched on and off in this way for approximately two minutes. Immobilised ammocoetes were collected by a second operator using a fine-mesh hand net as they emerged.

Lamprey species were identified to species level, where possible, with the assistance of a hand lens, through external pigmentation patterns and trunk myomere counts as described by Potter & Osborne (1975) and Gardiner (2003).

2.2 Fisheries habitat

A broad appraisal of the upstream and downstream habitat at each site was also undertaken to evaluate the wider contribution to salmonid and lamprey spawning and general fisheries habitat. River habitat surveys and fisheries assessments were also carried out utilising elements of the approaches in the River Habitat Survey Methodology (EA, 2003) and Fishery Assessment Methodology (O'Grady, 2006) to broadly characterise the riverine sites (i.e., channel profiles, substrata etc.).

2.3 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. Specific consideration was given to highly virulent crayfish plague (*Aphanomyces astaci*) given the known distribution of white-clawed crayfish and historical outbreaks in the wider Clare River catchment. Surveys were undertaken at sites in a downstream order to minimise the risk of upstream propagule mobilisation of pathogens and invasive species. 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 Triturus staff are certified in 'Good fieldwork practice: slowing the spread of invasive non-native species' by the University of Leeds.

Table 2.1 Location of *n*=15 fisheries survey sites in the vicinity of the Proposed Project

Site no.	Watercourse	EPA code	Location	X (ITM)	Y (ITM)
A1*	Unnamed pond	30G69	Rusheens North	540587	748080
A2	Glennafosha River	30G69	Claretuam Bridge, N83	540067	749581
A3	Clare River	30C01	Cloonmore Bridge, N83	540922	749751
A4	Killeelaun River	30K46	L6141 crossing, Cloontooa	541952	749972
A5	Unnamed stream	n/a	L6141 crossing, Cloontooa	543287	749509
A6	Clare River	30C01	Corrofin Bridge	542607	743416
A7	Clare River	30C01	Lackagh Bridge, R354	541826	736425
B1	Cregg River	30C03	Aucloggeen	535883	738508
B2	Cregg River	30C03	L2119 road crossing, Aucloggeen	535336	737856
B3	Cregg River	30C03	Addergoole Bridge, N84	532279	735004
C1	Unnamed channel	n/a	Cluidrevagh	533289	744115
C2	Unnamed channel	n/a	Bunatober	532180	742882
C3	Ballinduff Stream	30B05	Knockereen	531982	742840
C4	Kilroe Stream	30K23	Balrobuck Beg	532576	742092
C5	Ballinduff Stream	30B05	N84 road crossing	531634	741344

* fisheries appraisal only

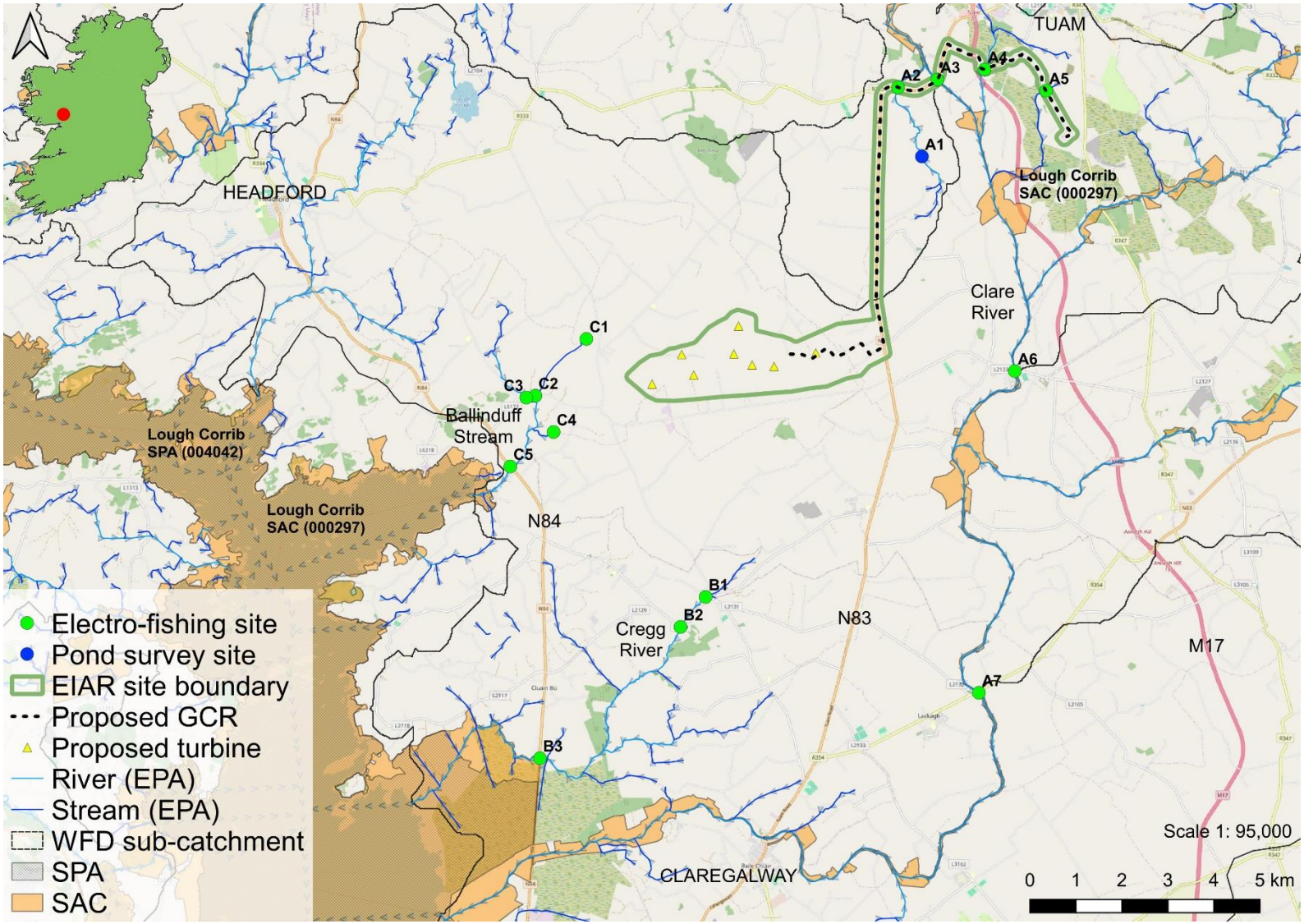

Figure 2.1 Overview of the *n*=15 electro-fishing and fisheries appraisal survey sites in vicinity of the Proposed Project

3. Results

A catchment-wide electro-fishing survey of *n*=14 sites in the vicinity of the Proposed Project was conducted on Tuesday 12th to Friday 15th July 2022 following notification to Inland Fisheries Ireland. A fisheries appraisal was also undertaken on 1 no. pond site (site A1). The results of the survey are discussed below in terms of fish population structure, population size and the suitability and value of the surveyed areas as nursery and spawning habitat for salmonids, European eel and lamprey species. Scientific names are provided at first mention only.

3.1 Fisheries assessment & appraisal

3.1.1 Site A1 – Unnamed pond, Rusheens North

Site A1 was located at an inline pond (part of a series of 6 no. ponds) on the upper reaches of the Glennafosha River (EPA code: 30G69). Except for three-spined stickleback (recorded via sweep netting), site A1 (despite good physical suitability for a range of species, namely cyprinids) was not considered of fisheries value given the ephemeral nature of the Glennafosha River at this location and inherent access issues for fish from downstream habitats.

Plate 3.1 Representative image of site A1 at an inline pond on the Glennafosha River, July 2022

3.1.2 Site A2 – Glennafosha River, Claretuam Bridge

Site A2 on the Glennafosha River was not of fisheries value given its dry, ephemeral nature and absence of aquatic habitats. Under wetted conditions, the river would still provide poor suitability for fish species given extensive instream modifications.

Plate 3.2 Representative image of site A2 on the Glennafosha River at Claretuam Bridge, July 2022 (ephemeral, dry channel)

3.1.3 Site A3 – Clare River, Cloonmore Bridge

Atlantic salmon (*Salmo salar*) (*n*=13), brown trout (*Salmo trutta*) (*n*=9), European eel (*Anguilla anguilla*) (*n*=1) and stone loach (*Barbatula barbatula*) (*n*=8) were recorded via electro-fishing at site A3 on the Clare River at Cloonmore Bridge (**Figure 3.1**). The site supported the highest densities of salmonids recorded during the survey (**Table 3.1**).

The site was a very good quality salmonid nursery with abundant broken glide habitat and localised riffle. The deeper glide and pool was considered good holding habitat for larger salmonids. Spawning habitat was present locally in gravel and cobble areas between boulders. The site was of poor value for lamprey given the high energy of the channel and absence of depositing littorals. There was good suitability for European eel and one very large adult was recorded during the survey.

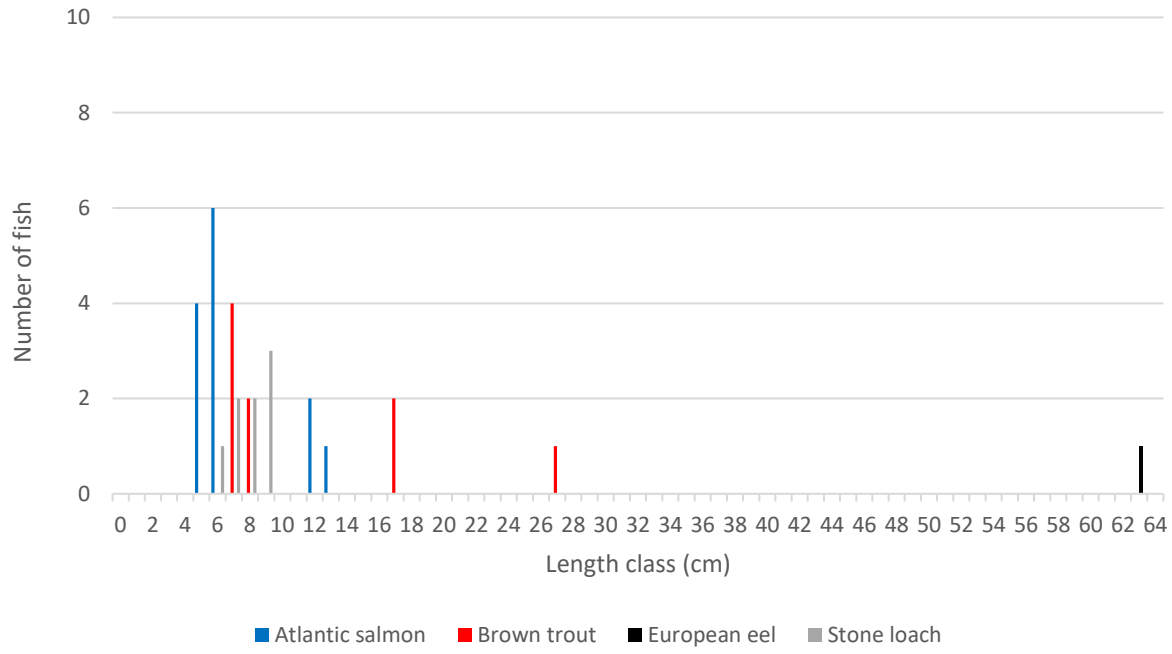

Figure 3.1 Length frequency distribution recorded via electro-fishing at site A3 on the Clare River at Cloonmore Bridge, July 2022

Plate 3.3 Representative image of site A3 on the Clare River at Cloonmore Bridge, July 2022

3.1.4 Site A4 – Killeelaun River, Cloontooa

Three-spined stickleback (*Gasterosteus aculeatus*) (*n*=9) and ten-spined stickleback (*Pungitius pungitius*) (*n*=2) were the only fish species recorded via electro-fishing at site A4 on the Killeelaun River (**Figure 3.2**).

The heavily modified site was not of value to salmonids or lamprey given enrichment, very heavy siltation, low flows and historical modifications. Whilst there was some low suitability for European eel, none were recorded.

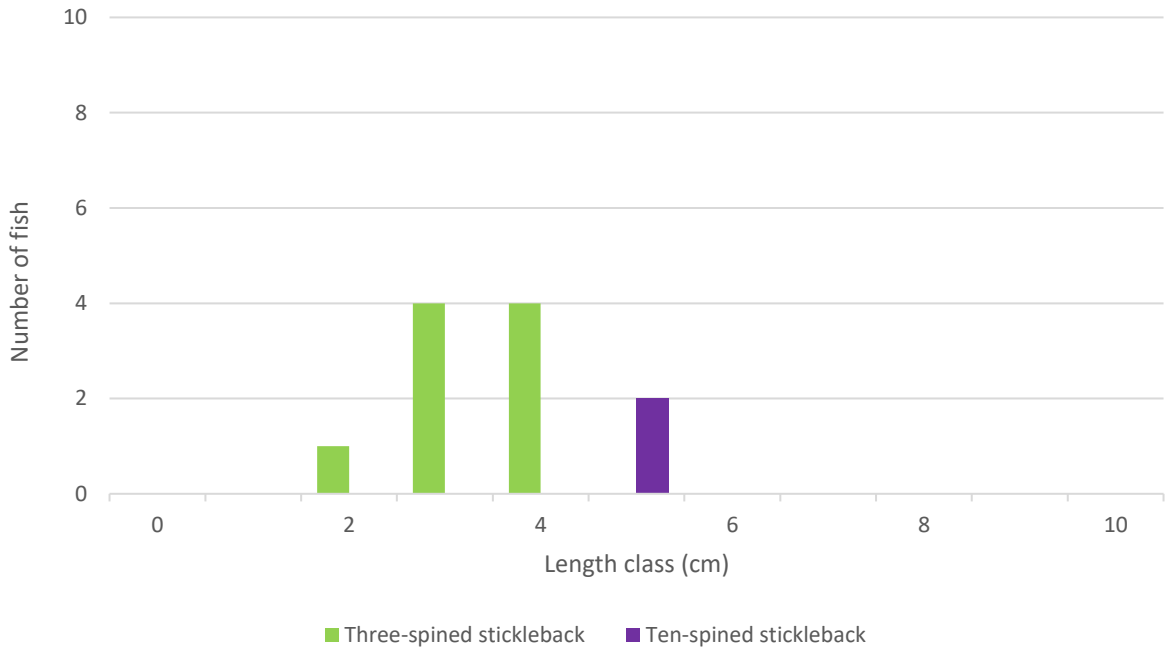

Figure 3.2 Length frequency distribution recorded via electro-fishing at site A4 on the Killeelaun River, July 2022

Plate 3.4 Representative image of site A4 on the Killeelaun River, July 2022

3.1.5 Site A5 – unnamed stream, Cloontooa

Three-spined stickleback (*n*=10) were the only fish species recorded via electro-fishing at site A5 on an unnamed Clare River tributary (**Figure 3.3**).

Apart from low densities of this species, the site was not of fisheries value given extensive historical modifications, very shallow water and poor flows. Whilst there was some low suitability for European eel, none were recorded.

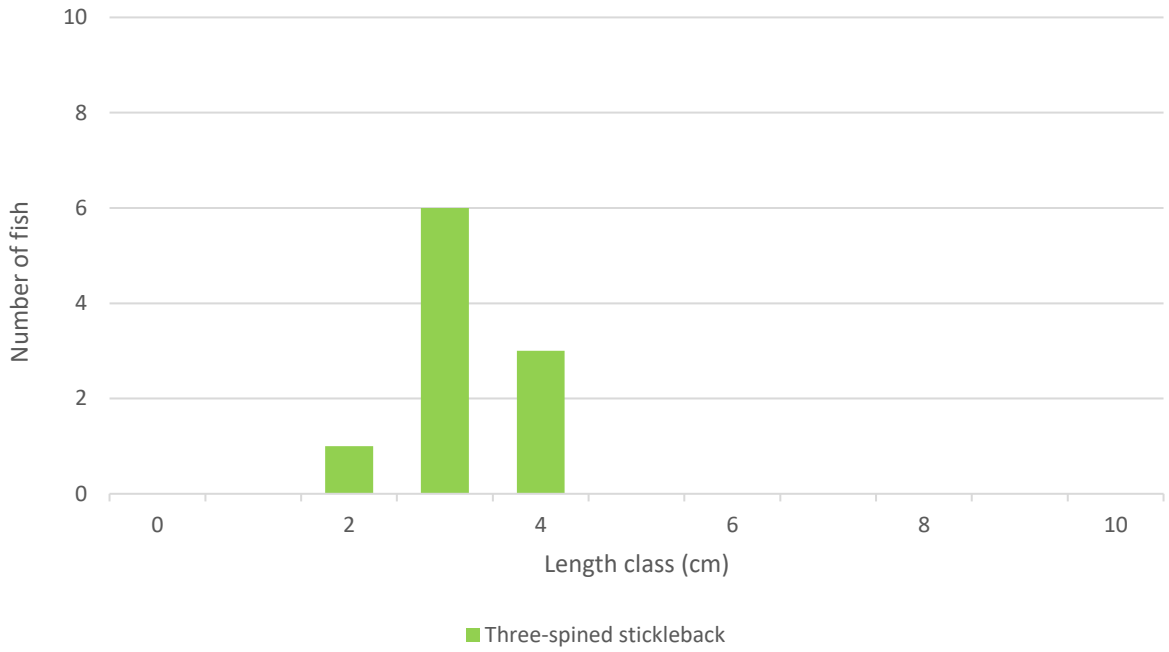

Figure 3.3 Length frequency distribution recorded via electro-fishing at site A5 on an unnamed Clare River tributary, July 2022

Plate 3.5 Representative image of site A5 on an unnamed Clare River tributary, July 2022

3.1.6 Site A6 – Clare River, Corrofin Bridge

Atlantic salmon (*n*=8) and brown trout (*n*=8) were the only fish species recorded via electro-fishing at site A6 on the Clare River at Corrofin Bridge (**Figure 3.4**).

The semi-natural site was considered a moderate quality salmonid nursery habitat given historical modifications, supporting only a low density of salmonids. The more localised shallow glide and riffle areas offered the only viable nursery areas. Spawning habitat quality was also moderate at best given the more limited gravels. Good quality holding habitat was present in deep glide and pool. Suitability

for lamprey was poor overall given the high energy of the site and absence of depositing littorals (none recorded). Abundant boulders and deep glide and pool habitat provided good quality refugia for European eel (although none were recorded).

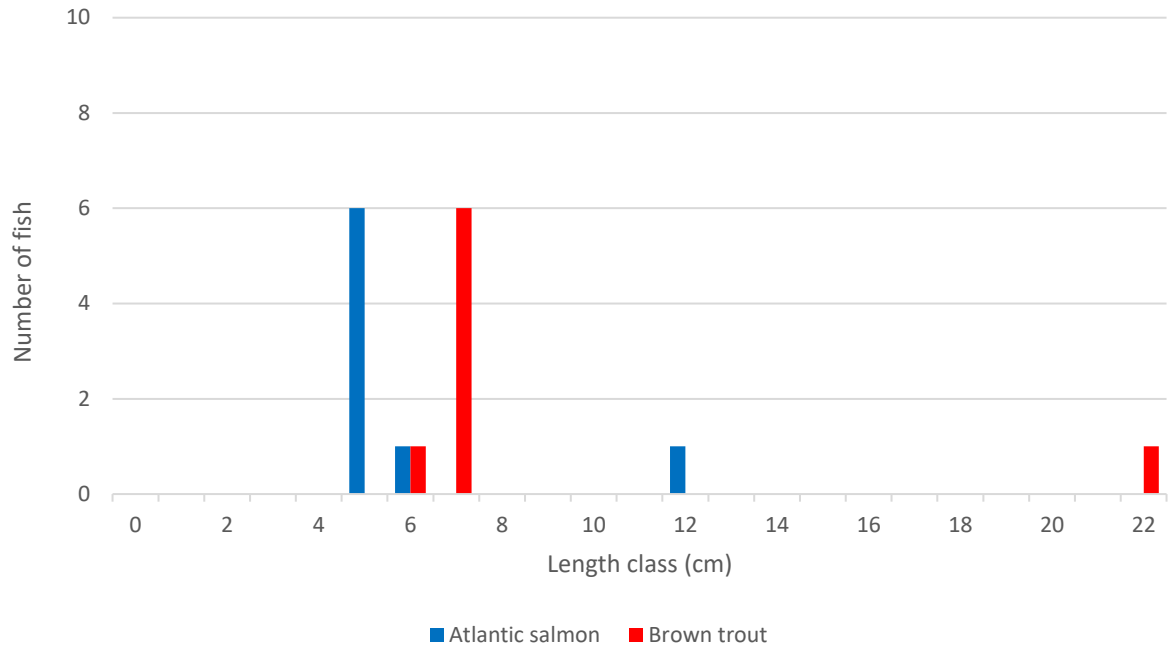

Figure 3.4 Length frequency distribution recorded via electro-fishing at site A6 on the Clare River, July 2022

Plate 3.6 Representative image of site A6 on the Clare River at Corrofin Bridge, July 2022

3.1.7 Site A7 – Clare River, Lackagh Bridge

Atlantic salmon (*n*=6) and brown trout (*n*=5) were the only fish species recorded via electro-fishing at site A7 on the Clare River at Lackagh Bridge (**Figure 3.5**).

The high energy, semi-natural site was considered a moderate quality salmonid nursery habitat given historical modifications, supporting only a low density of salmonids. The more localised shallow glide and riffle areas offered the only viable nursery areas. Spawning habitat quality was also moderate at best given the more limited gravels. Good quality holding habitat was present in deep glide and pool. Suitability for lamprey was poor overall given the high energy of the site and absence of depositing littorals. Abundant boulders and deep glide and pool habitat provided good quality refugia for European eel (although none were recorded).

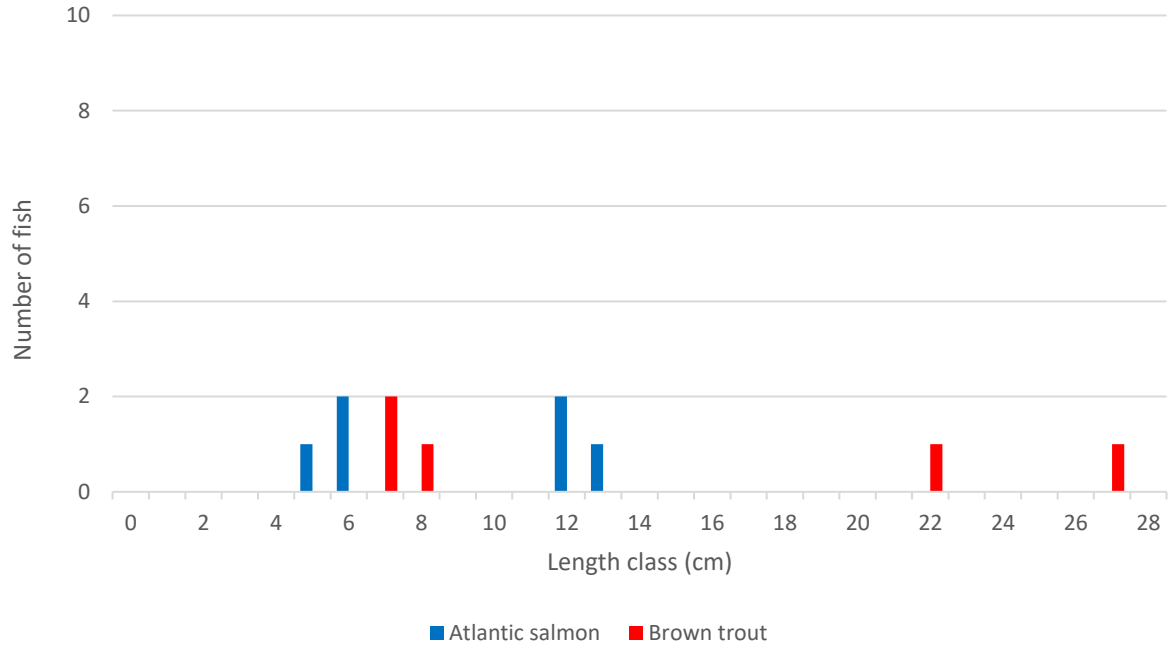

Figure 3.5 Length frequency distribution recorded via electro-fishing at site A7 on the Clare River, July 2022

Plate 3.7 Mixed cohort Atlantic salmon recorded at site A7 on the Clare River at Lackagh Bridge, July 2022

3.1.8 Site B1 – Cregg River, Aucloggeen

European eel (*n*=3) and three-spined stickleback (*n*=17) were the only fish species recorded via electro-fishing at site B1 on the upper reaches of Cregg River (**Figure 3.6**).

The site was a poor-quality spawning and nursery habitat for salmonids given low summer flows, siltation and eutrophication (none recorded). It was however a moderate quality eel nursery with abundant boulder and cobble with good invertebrate prey resources. There was no suitability for lamprey given the absence of spawning areas.

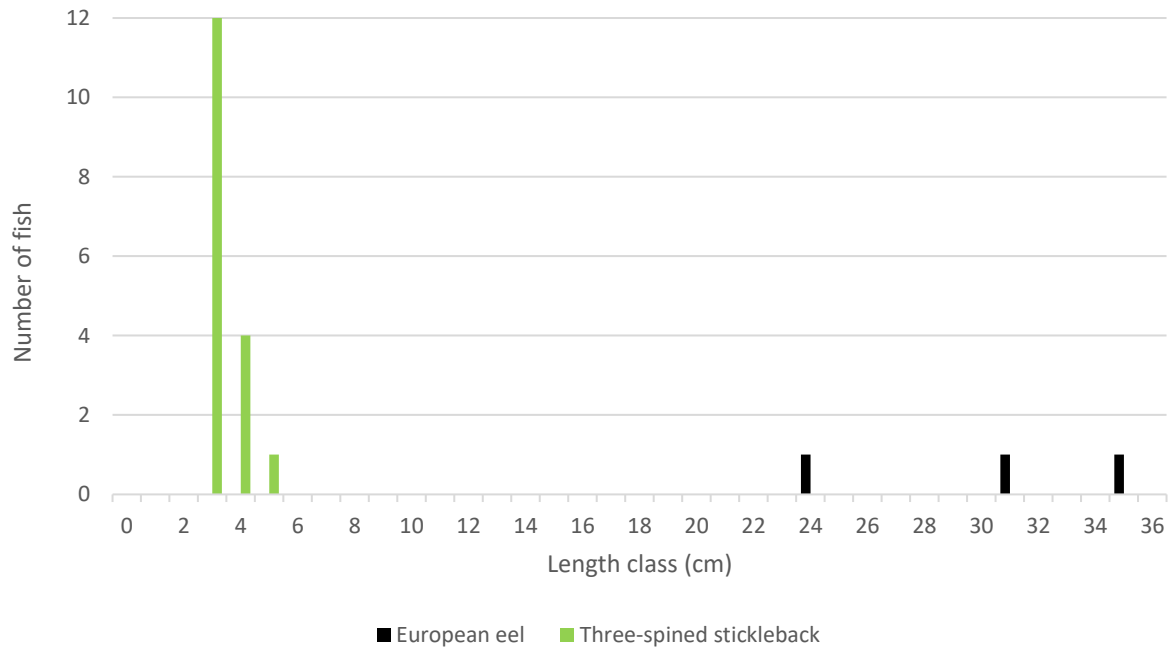

Figure 3.6 Length frequency distribution recorded via electro-fishing at site B1 on the Cregg River, July 2022

Plate 3.8 European eel and three-spined stickleback recorded at site B1 on the Cregg River, July 2022

3.1.9 Site B2 – Cregg River, Aucloggeen

European eel and three-spined stickleback were the only fish species recorded via electro-fishing at site B2 on the upper reaches of Cregg River (**Figure 3.7**).

The site was a poor-quality salmonid spawning and nursery habitat for salmonids given low summer flows, hydromorphological impacts, siltation and eutrophication (none recorded). It was however a moderate quality eel nursery with abundant boulder and cobble with good invertebrate prey resources. There was no suitability for lamprey given the absence of spawning areas.

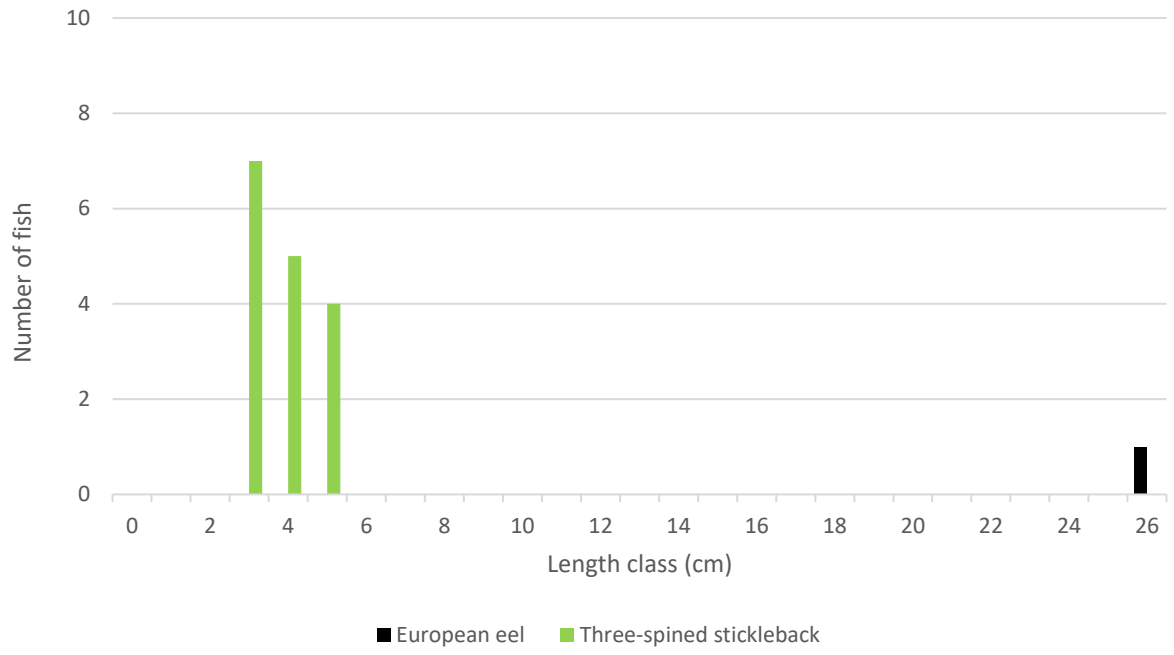

Figure 3.7 Length frequency distribution recorded via electro-fishing at site B2 on the Cregg River, July 2022

Plate 3.9 Representative image of site B2 on the upper reaches of the Cregg River, July 2022

3.1.10 Site B3 – Cregg River, Addergoole Bridge

Electro-fishing was not undertaken at site B2 due to prohibitive depths on the lower reaches of Cregg River at Addergoole Bridge (>1.5-2m). The slow-flowing, canalised site was predominantly of value as a coarse fish habitat, known to support pike (*Esox lucius*), perch (*Perca fluviatilis*), roach (*Rutilus rutilus*) and bream (*Abramis brama*). The site was also considered a good quality European eel habitat. Brown trout are also likely present at the site although there was an absence of spawning or nursery areas. There was poor suitability for lamprey with an absence of spawning areas.

Plate 3.10 Representative image of site B3 on the Cregg River at Addergoole Bridge, July 2022

3.1.11 Site C1 – unnamed channel, Cluidrevagh

Site C1 was located on the uppermost reaches of an unnamed Ballinduff Stream tributary (unmapped by the EPA). The site was not of fisheries value given its dry, ephemeral nature and absence of aquatic habitats. Given the site characteristics and poor connectivity with downstream habitats, it is unlikely that the channel supports fish even under higher flow periods.

Plate 3.11 Representative image of site C1 on an unnamed Ballinduff Stream tributary, July 2022 (dry, ephemeral channel)

3.1.12 Site C2 – unnamed channel, Bunatober

Site C2 was located on an unnamed Ballinduff Stream tributary (unmapped by the EPA) at a local road crossing approx. 1.7km downstream of site C1. The site was not of fisheries value given its dry, ephemeral nature and absence of aquatic habitats. The site was considered unlikely to support fish even under higher flow periods given the seasonality of the downstream, connecting Ballinduff Stream.

Plate 3.12 Representative image of site C2 on an unnamed Ballinduff Stream tributary, July 2022 (dry, ephemeral channel)

3.1.13 Site C3 – Ballinduff Stream, Knockereen

Site C3 on the Ballinduff Stream was not of fisheries value given its dry, ephemeral nature and absence of aquatic habitats. The site may support fish under higher flow periods given the presence of salmonids, European eel and other species in the lower reaches.

Plate 3.13 Representative image of site C3 on the Ballinduff Stream, July 2022 (dry, ephemeral channel)

3.1.14 Site C4 – Kilroe Stream, Balrobuck Beg

Three-spined stickleback (*n*=9) was the only fish species recorded via electro-fishing at site C4 on the Kilroe Stream (**Figure 3.8**). Apart from low densities of this species, the site was not of very poor fisheries value given enrichment, very heavy siltation, low flows and historical modifications.

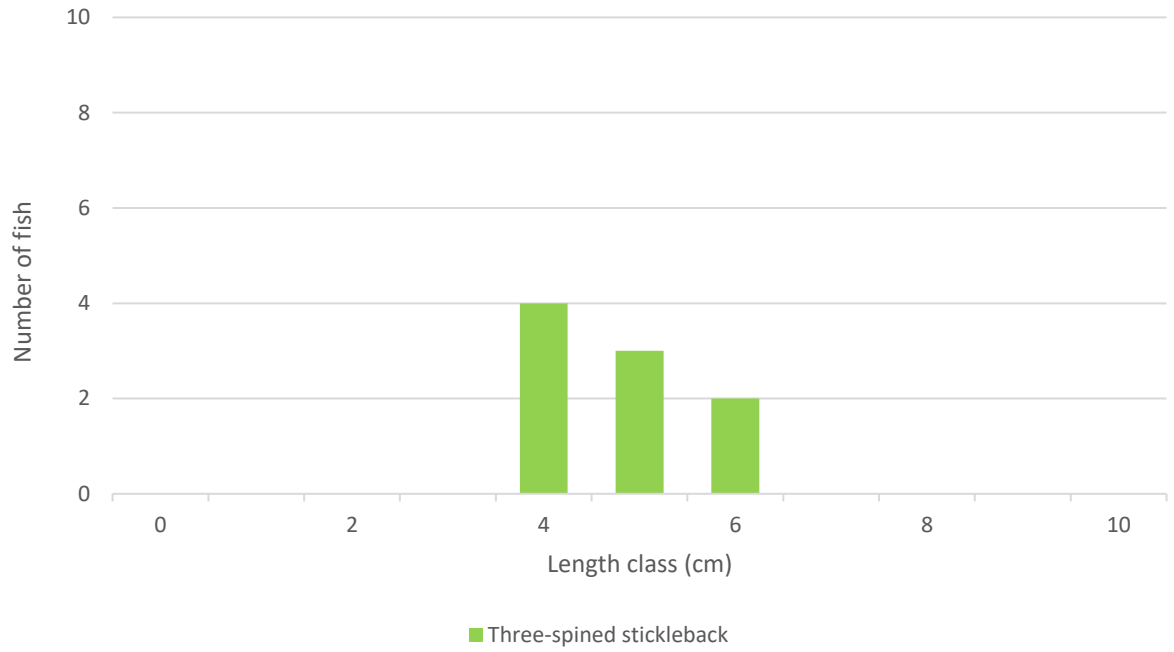

Figure 3.8 Length frequency distribution recorded via electro-fishing at site C4 on the Kilroe Stream, July 2022

Plate 3.14 Representative image of site C4 on the Kilroe Stream, July 2022

3.1.15 Site C5 – Ballinduff Stream, N84 road crossing

Brown trout, European eel, three-spined stickleback, stone loach and pike (*Esox lucius*) were recorded via electro-fishing at site C5 on the lower reaches of the Ballinduff Stream (**Appendix A**).

The heavily modified site was of poor value as a salmonid spawning or nursery habitat given evident siltation and hydromorphological pressures. However, some good quality holding habitat was present locally, although the value of the site was reduced by noxious macrophyte coverage. The site was of high suitability for European eel given ample refugia although only a single eel was recorded. The site

was of poor value for lamprey given poor flows, an absence of spawning areas and sub-optimal clay-dominated soft sediment accumulations.

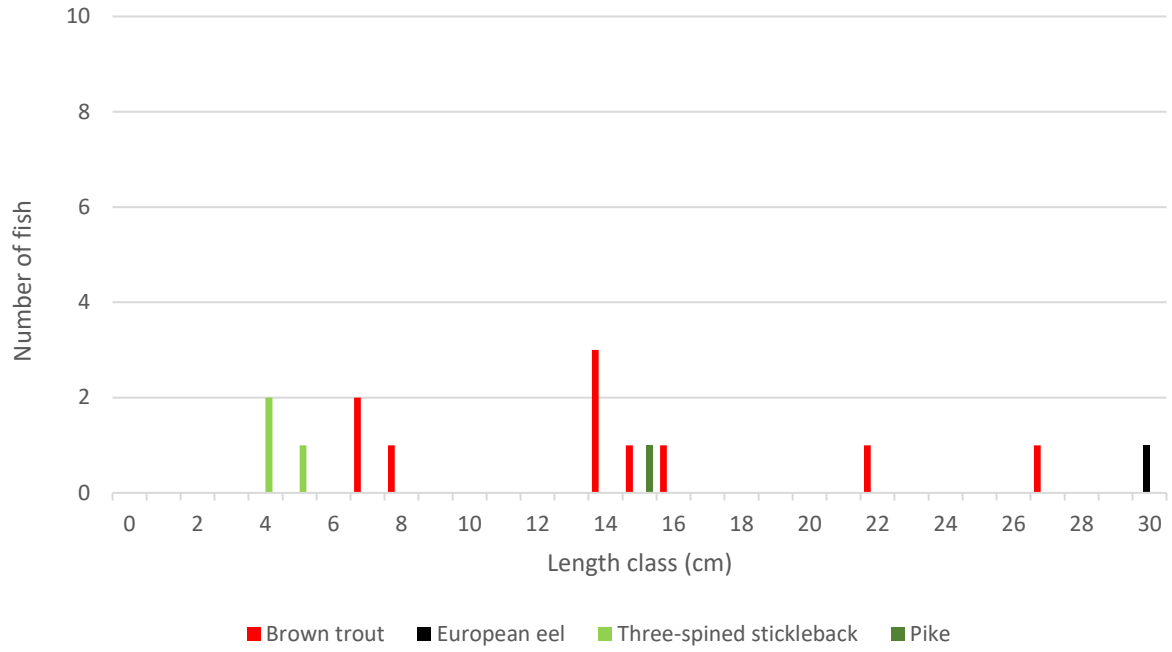

Figure 3.9 Length frequency distribution recorded via electro-fishing at site C5 on the Ballinduff Stream, July 2022

Plate 3.15 Adult brown trout recorded at site C5 on the Ballinduff Stream, July 2022

Table 3.1 Fish species densities per m^2 recorded at **riverine sites** in the vicinity of the Proposed Project via electro-fishing in July 2022 (values in **bold** represent the highest densities recorded for each species, respectively)

Site	Watercourse	CPUE (elapsed time)	Approx. area fished (m^2)	Fish density (per m^2)						
				Atlantic salmon	Brown trout	European eel	Pike	Three-spined stickleback	Ten-spined stickleback	Stone loach
A1	Glennafosha River	n/a	n/a - unsuitable for electro-fishing	n/a	n/a	n/a	n/a	n/a	n/a	n/a
A2	Glennafosha River	n/a	n/a - dry channel	n/a	n/a	n/a	n/a	n/a	n/a	n/a
A3	Clare River	10	240	**0.054**	**0.038**	0.004	0.000	0.000	0.000	**0.033**
A4	Killeelaun River	10	150	0.000	0.000	0.000	0.000	0.060	**0.013**	0.000
A5	Unnamed stream	5	50	0.000	0.000	0.000	0.000	**0.200**	0.000	0.000
A6	Clare River	10	300	0.027	0.027	0.000	0.000	0.000	0.000	0.000
A7	Clare River	10	250	0.024	0.020	0.000	0.000	0.000	0.000	0.000
B1	Cregg River	10	200	0.000	0.000	**0.015**	0.000	0.085	0.000	0.000
B2	Cregg River	10	360	0.000	0.000	0.008	0.000	0.044	0.000	0.000
B3	Cregg River	n/a	n/a - too deep for electro-fishing	n/a	n/a	n/a	n/a	n/a	n/a	n/a
C1	Unnamed river	n/a	n/a - dry channel	n/a	n/a	n/a	n/a	n/a	n/a	n/a
C2	Unnamed river	n/a	n/a - dry channel	n/a	n/a	n/a	n/a	n/a	n/a	n/a
C3	Ballinduff Stream	n/a	n/a - dry channel	n/a	n/a	n/a	n/a	n/a	n/a	n/a
C4	Kilroe Stream	10	200	0.000	0.000	0.000	0.000	0.045	0.000	0.000
C5	Ballinduff Stream	10	250	0.000	0.024	0.004	**0.004**	0.012	0.000	0.000

Table 3.2 Summary of fish species of higher conservation value and relative abundances (low, medium, high & very high) recorded via **electro-fishing** per riverine survey site in the vicinity of the Proposed Project, July 2022

Site	Watercourse	Relative abundance				Other species
		Atlantic salmon	Brown trout	*Lampetra* sp.	European eel	
A1	Unnamed pond	n/a – electro-fishing not undertaken				
A2	Glennafosha River	n/a – electro-fishing not undertaken (dry channel)				
A3	Clare River	Medium	Low		Low	Stone loach
A4	Killeelaun River					Three-spined stickleback, ten-spined stickleback
A5	Unnamed stream					Three-spined stickleback
A6	Clare River	Low	Low			
A7	Clare River	Low	Low			
B1	Cregg River				Low	Three-spined stickleback
B2	Cregg River				Low	Three-spined stickleback
B3	Cregg River	n/a – electro-fishing not undertaken (too deep)				
C1	Unnamed river	n/a – electro-fishing not undertaken (dry channel)				
C2	Unnamed river	n/a – electro-fishing not undertaken (dry channel)				
C3	Ballinduff Stream	n/a – electro-fishing not undertaken (dry channel)				
C4	Kilroe Stream					Three-spined stickleback
C5	Ballinduff Stream		Low		Low	Three-spined stickleback, pike

Conservation value: Atlantic salmon (*Salmo salar*), 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 Inland Fisheries Acts 1959 to 2017, brown trout and coarse fish species have no legal protection in Ireland.

4. Discussion

The watercourses in the vicinity of the Proposed Project were typically lowland channels which had been extensively straightened and or deepened historically as part of drainage and land reclamation works, resulting in poor hydromorphology and reduced habitat heterogeneity. Whilst some good instream recovery had occurred locally (e.g. Clare River), siltation and hydromorphological pressures were evident throughout the survey area. Historical straightening and deepening of watercourses damages habitat and hydromorphological heterogeneity, removes instream structure and refugia, encourages sediment deposition and invariably results in an irreparable reduction in fisheries potential, particularly for salmonids (O'Briain et al., 2019b; O'Grady et al., 2017, O'Grady, 2006) but also European eel and lamprey species (King et al., 2015). Furthermore, bank clearance works which typically accompany arterial drainage (as observed in this survey) reduce riparian cover along watercourses and increase thermal stress to fish (especially less thermally-plastic salmonids) having multiple effects on populations (O'Briain et al., 2020, 2017). Low summer water levels and ephemeral conditions are a characteristic of the (partly karstic) Clare River catchment and were evidently an issue for fish populations in the Cregg River and Ballinduff Stream sub-catchments.

Whilst a total of 7 no. sites supported either stickleback species only or no fish populations, watercourses with higher flow volumes and superior habitats supported fish species of high conservation value such as Atlantic salmon, and European eel, in addition to brown trout, pike and stone loach.

Mixed cohort Atlantic salmon were present at 3 no sites in total, namely all survey sites on the Clare River (sites A3, A6 & A7) (**Table 3.2**). Brown trout were also recorded at these sites, in addition to site C5 on the Ballinduff Stream. Salmonids were present in low numbers, with site A3 on the Clare River supporting the best quality salmonid habitat (very good quality) and the highest relative density of both Atlantic salmon and brown trout (**Table 3.1**). From a genetic perspective, the Clare River and its tributaries rivers contribute significantly to the adult brown trout population of Lough Corrib (Delanty et al., 2021; Massa-Gallucci et al., 2010). Elsewhere, the quality of salmonid was typically poor due to significant hydromorphological pressures resulting from arterial drainage (i.e. extensive straightening & deepening) which have led to a paucity of suitable spawning and nursery habitat as well as reduced habitat heterogeneity. The location of the Ballinduff Stream in a karstic landscape and the ephemeral nature of the upper sub-catchment precluded the presence of salmonids (or indeed any fish species) from all but the lower reaches, despite some physical habitat suitability (e.g. hard substrata, some instream recovery from historical modifications).

No lamprey ammocoetes (*Lampetra* sp.) were recorded during targeted electro-fishing (**Table 3.1, 3.2**). This was considered to reflect the paucity of suitable nursery (soft sediment) habitat within the vicinity of the Proposed Project, in addition to sub-optimal spawning habitat. Owing to their relatively small morphologies, *Lampetra* species such as brook lamprey require clean, fine gravels in which to dig their redds (Dawson et al., 2015; Rooney et al., 2013; Lasne et al., 2010) although areas may also include fractions of sand, larger gravels, and cobble (Nika & Virbickas, 2010). Spawning habitat in the vicinity of the Proposed Project was appreciably sparse and of poor quality due to significant historical modifications (i.e. removal of substrata) and siltation pressures. Furthermore, lamprey ammocoetes require the deposition of fine, organic-rich sediment ≥5cm in depth in which to burrow and mature (Aronsuu & Virkkala, 2014; Goodwin et al., 2008; Gardiner, 2003). Whilst such areas were locally

present on the Cregg River and Ballinduff Stream, low summer flows characteristic of the karstic landscape reduce the suitability for lamprey. Ammocoete dispersal and settlement is passive and entirely regulated by local, dynamic hydrographical (flow) regimes (Kelly & King, 2001; Malmqvist, 1983; Potter, 1980; Hardisty & Potter 1971) and distribution is often sporadic in watercourses which suffer from low summer flows and poor fluvial connectivity. In the Clare River, naturally high flow rates and hydromorphological modifications discourage the deposition of soft sediments and therefore significantly restrict the distribution of lamprey ammocoetes. The patchy distribution and sub-optimal lamprey habitat has also been observed during previous surveys of the wider Corrib catchment, including the Clare and Cregg Rivers (O'Connor, 2007; Byrne et al., 2000).

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). Despite suitability at numerous survey sites, European eel were only recorded in low densities at a total of 4 no. sites on the Clare River (A3), Cregg River (B1 & B2) and Ballinduff Stream (C5) (**Table 3.2**). Eel have previously been recorded in very low densities from the wider Clare and Corrib River catchments (Gordon et al., 2021; O'Briain et al., 2019; Kelly et al., 2015, 2011). The paucity of eel from the survey sites largely reflected the poor hydromorphology and reduced instream habitat heterogeneity resulting from extensive historical modifications, providing a low frequency of suitable refugia (e.g. boulders, pools) required by the species (Laffaille et al., 2003). Low summer flows would also negatively influence the distribution of eel and their prey resources. The high-quality eel habitat present in the downstream-connecting Lough Corrib (the sole pathway from marine habitats to the surveyed watercourses) and lower reaches of adjoining tributaries would also likely reduce the colonisation of the upper reaches of rivers such as the Clare River, Cregg River and Ballinduff Stream.

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8. Appendix B – Q-sample results (biological water quality)

Table 8.1 Macro-invertebrate Q-sampling results for 11 no. wetted sites in the vicinity of the Proposed Project, July 2022

Group	Family	Species	A1	A3	A4	A5	A6	A7	B1	B2	B3	C4	C5	EPA class
Ephemeroptera	Ephemeridae	*Ephemera danica*					1							A
Ephemeroptera	Heptageniidae	*Ecdyonurus dispar*					1	2						A
Ephemeroptera	Heptageniidae	*Heptagenia sulphurea*						5						A
Ephemeroptera	**Heptageniidae**	***Kageronia (Heptagenia) fuscogrisea*** [3]									**1**			**A**
Ephemeroptera	Baetidae	*Cloeon simile*	3								5			B
Ephemeroptera	Baetidae	*Alainites muticus*						1						B
Plecoptera	Leuctridae	*Leuctra hippopus*		4				5						B
Trichoptera	Cased caddis pupa	sp. indet.	1								1			B
Trichoptera	Lepidostomatidae	*Lepidostoma hirtum*					4							B
Trichoptera	Limnephilidae	*Anabolia nervosa*									1			B
Trichoptera	Limnephilidae	*Drusus annulatus*							4					B
Trichoptera	Limnephilidae	sp. indet.						1	1					B
Trichoptera	Limnephilidae	*Limnephilus lunatus*			1							10		B
Trichoptera	Limnephilidae	*Potamophylax cingulatus*							1					B
Trichoptera	Phryganeidae	*Phryganea bipunctata*	6											B
Trichoptera	Sericostomatidae	*Sericostoma personatum*		2										B
Odonata	Coenagrionidae	*Coenagrion* sp.			1									B
Ephemeroptera	Baetidae	*Baetis rhodani*				39	32		71			7	92	C
Ephemeroptera	Ephemerellidae	*Serratella ignita*		62			39	29	31		1	1	47	C
Trichoptera	Hydropsychidae	*Hydropsyche siltalai*		12			9	2						C
Trichoptera	Polycentropodidae	*Plectrocnemia conspersa*	4			2	1							C
Trichoptera	Polycentropodidae	*Plectrocnemia geniculata*	4											C
Trichoptera	Polycentropodidae	*Polycentropus kingi*									1		4	C
Trichoptera	Rhyacophilidae	*Rhyacophila dorsalis*		2		1		2						C
Crustacea	Gammaridae	*Gammarus duebeni*	4	99	1	14	64	12	34			3	58	C

Group	Family	Species	A1	A3	A4	A5	A6	A7	B1	B2	B3	C4	C5	EPA class
Coleoptera	Dytiscidae	*Colymbetes fuscus*								1				C
Coleoptera	Dytiscidae	Dytiscidae larva			2						1		2	C
Coleoptera	Dytiscidae	*Hydroporus tessellatus*			1									C
Coleoptera	Dytiscidae	*Ilybius fuliginosus*								1				C
Coleoptera	Dytiscidae	*Nebrioporus despressus*			4									C
Coleoptera	Elmidae	*Elmis aenea*		17		5	3	1					10	C
Coleoptera	Elmidae	*Limnius volckmari*		1										C
Coleoptera	Gyrinidae	Gyrinidae larva	1											C
Coleoptera	Gyrinidae	*Gyrinus substriatus*			1									C
Coleoptera	Haliplidae	*Brychius elevatus*			3				4					C
Coleoptera	Haliplidae	*Haliplus ruficollis* group							1	3	1			C
Coleoptera	Hydrophilidae	*Helophorus brevipalpis*			3				1	1				C
Coleoptera	Hydrophilidae	*Helophorus grandis*			1									C
Diptera	Ceratopogonidae	sp. indet.			1									C
Diptera	Chironomidae	non-*Chironomus* spp.	2	22		2	2		17		8	4	5	C
Diptera	Culicidae	sp. indet.								12		1		C
Diptera	Psychodidae	sp. indet.				1								C
Diptera	Simuliidae	sp. indet.						1					1	C
Hemiptera	Corixidae	Corixidae nymph			7						1			C
Hemiptera	Notonectidae	Notonecta nymph									1			C
Gastropoda	Bithnyiidae	*Bithynia tentaculata*	9	1	24						7			C
Gastropoda	Planorbidae	*Planorbis planorbis*			1						4			C
Gastropoda	Lymnaeidae	*Stagnicola fuscus*			1						2			C
Gastropoda	Planorbidae	*Planorbis carinatus*									3			C
Arachnida	Hydrachnidiae	sp. indet.	2	2								1	1	C
Hirudinidae	Piscicolidae	*Piscicola* sp.			2									C
Crustacea	Asellidae	*Asellus aquaticus*	28	1	62	3			2	1	1	2	11	D

Group	Family	Species	A1	A3	A4	A5	A6	A7	B1	B2	B3	C4	C5	EPA class
Mollusca	Lymnaeidae	*Ampullacaena balthica*	1		3				2	1	2	1		D
Mollusca	Physidae	*Physa fontinalis*	5		4						5	1	1	D
Mollusca	Sphaeriidae	sp. indet.	7										45	D
Hirudinidae	Glossiphoniidae	sp. indet.											1	D
Diptera	Chironomidae	*Chironomus* spp.	1	2	3				1	1	2		1	E
Annelidae	Oligochaeta	sp. indet.						1	1					n/a
Abundance			**78**	**227**	**126**	**67**	**156**	**62**	**171**	**21**	**48**	**31**	**279**	
Q-rating			n/a	Q3	Q2-3*	Q3*	Q3-4	Q4	Q3*	Q3*	Q3-4*	Q3*	Q3*	
WFD status			n/a	Poor	Poor	Poor	Mod	Good	Poor	Poor	Mod	Poor	Poor	

* tentative Q-rating due to poor flows and or a lack of suitable riffle areas for sampling (Toner et al., 2005)

[3] Listed as 'near threatened' in Ireland (Kelly-Quinn & Regan, 2011)

9. Appendix C – eDNA analysis lab report

SureScreen Scientifics

Folio No: E15117
Report No: 1
Client: Triturus Environmental Limited
Contact: Ross Macklin

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: 19/07/2022
Date results reported: 27/07/2022
Matters affecting result: None

TARGET SPECIES: Crayfish plague *(Aphanomyces astaci)*

Lab ID	Site Name	OS Reference	SIC	DC	IC	Result	Positive Replicates
FK90	A7	-	Pass	Pass	Pass	Positive	12/12
FK192	C5	-	Pass	Pass	Pass	Negative	0/12
FK194	B3 Creg River N84	-	Pass	Pass	Pass	Positive	2/12

SureScreen Scientifics

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

Lab ID	Site Name	OS Reference	SIC	DC	IC	Result	Positive Replicates
FK90	A7	-	Pass	Pass	Pass	Negative	0/12
FK192	C5	-	Pass	Pass	Pass	Negative	0/12
FK194	B3 Creg River N84	-	Pass	Pass	Pass	Negative	0/12

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

Lab ID	Site Name	OS Reference	SIC	DC	IC	Result	Positive Replicates
FK90	A7	-	Pass	Pass	Pass	Positive	8/12
FK192	C5	-	Pass	Pass	Pass	Positive	1/12
FK194	B3 Creg River N84	-	Pass	Pass	Pass	Negative	0/12

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

Reported by: **MSc Gabriela Danickova** Approved by: **Chelsea Warner**

SureScreen Scientifics

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.

SureScreen Scientifics

INTERPRETATION OF RESULTS

SIC: **Sample Integrity Check** [Pass/Fail]
When samples are received in the laboratory, they are inspected for any tube leakage, suitability of sample (not too much mud or weed etc.) and absence of any factors that could potentially lead to inconclusive results.

DC: **Degradation Check** [Pass/Fail]
Analysis of the spiked DNA marker to see if there has been degradation of the kit or sample, between the date it was made to the date of analysis. Degradation of the spiked DNA marker may indicate a risk of false negative results.

IC: **Inhibition Check** [Pass/Fail]
The presence of inhibitors within a sample are assessed using a DNA marker. If inhibition is detected, samples are purified and re-analysed. Inhibitors cannot always be removed, if the inhibition check fails, the sample should be re-collected.

Result: **Presence of eDNA** [Positive/Negative/Inconclusive]

Positive: DNA was identified within the sample, indicative of species presence within the sampling location at the time the sample was taken or within the recent past at the sampling location.

Positive Replicates: Number of positive qPCR replicates out of a series of 12. If one or more of these are found to be positive the pond is declared positive for species presence. It may be assumed that small fractions of positive analyses suggest low level presence, but this cannot currently be used for population studies. Even a score as low as 1/12 is declared positive. 0/12 indicates negative species presence.

Negative: eDNA was not detected or is below the threshold detection level and the test result should be considered as evidence of species absence, however, does not exclude the potential for species presence below the limit of detection.

Inconclusive: Controls indicate inhibition or degradation of the sample, resulting in the inability to provide conclusive evidence for species presence or absence.

Triturus Environmental Ltd.

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