Planning and Environmental Consultants

Aquatic Baseline Report

Briskalagh Renewable Energy Development

DOCUMENT DETAILS

Client:	**Briskalagh Ltd.**
Project Title:	**Briskalagh Renewable Energy Development**
Project Number:	**230502**
Document Title:	**Aquatic Baseline Report**
Document File Name:	**ABR F – 2024.07.05 – 230502**

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Rev	Status	Date	Author(s)	Approved By
01	Final	05/07/2024	AvdGM/NR	PR

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1. INTRODUCTION

1.1 Background

MKO has been appointed to conduct an Aquatic Baseline Survey and subsequent Aquatic Baseline Report for the area within and in the vicinity of the proposed Briskalagh Wind Farm Development.

Aquatic Baseline Surveys were undertaken in September 2023 and desk studies were conducted in September 2023 and June 2024. This report describes the baseline aquatic condition of the lands within and in the vicinity of the proposed Briskalagh Wind Farm Development and acts as an aquatic baseline record to which future records and monitoring can be compared.

1.2 Statement of Authority

Aquatic Baseline Surveys were undertaken by Aran von der Geest Moroney (B.Sc.), Colin Murphy (B.Sc., M.Sc.) and Aoife Joyce (B.Sc.) on the 13th and 14th of September 2023, on the 21st and the 22nd of March 2024 by Aran von der Geest Moroney (B.Sc.), Niamh Rowan (B.Sc.) and Ryan Connors (B.Sc., M.Sc.) and on the 27th of June 2024 by Fiona Killeen (B.Sc.) and Adam Scott (B.Sc., M.Sc.) of MKO.

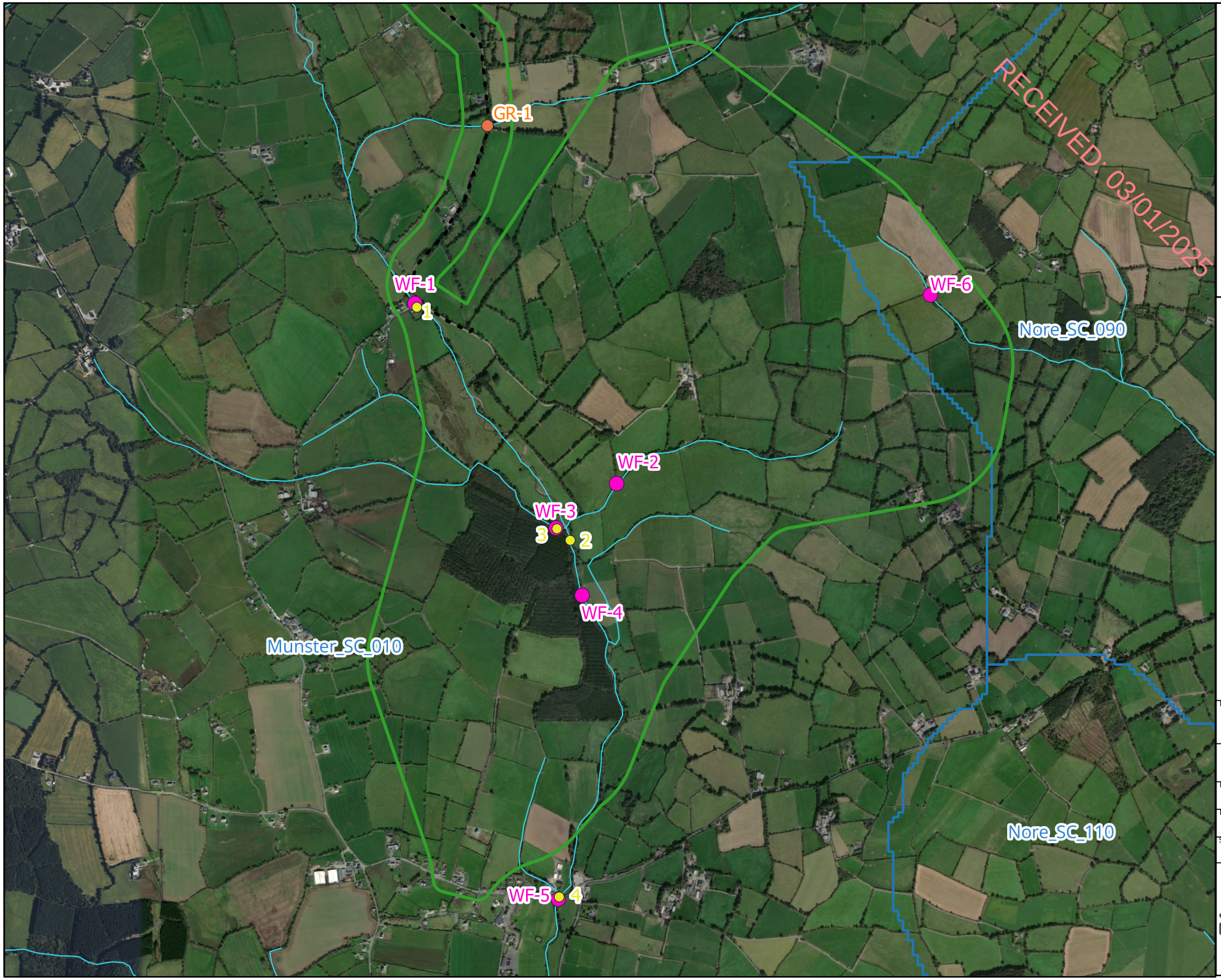
This report has been prepared by Aran von der Geest Moroney and Niamh Rowan. This report has been reviewed by Pat Roberts (B.Sc., MCIEEM). Pat Roberts has over 18 years' experience in professional ecological consultancy and has undertaken Appropriate Assessments and Impact Assessments for a wide range of projects.

1.3 Survey Locations

The aquatic baseline surveys for the proposed wind farm took place in the vicinity of Kilmanagh and Briskalagh, Co. Kilkenny. The survey locations are shown in Figure 1-1 for proposed wind farm survey locations and Figure 1-2 for proposd grid route survey locations. Agricultural grassland land use dominates the landscape surrounding the proposed survey locations with areas of plantation forestry also present. Aquatic Baseline surveys were undertaken within the vicinity of the proposed wind farm and along the proposed grid route.

Within the vicinity of the proposed wind farm 6 survey locations were chosen located within two separate sub catchments. Five survey locations were located within the Munster_SC_010 hydrological sub catchment and one survey location is located within the Nore_SC_090 hydrological sub catchment. Within the Munster_SC_010 sub catchment the surveys were conducted on the Tullaroan Stream and its tributaries the Briskalagh and Foylatalure. Within the Nore_SC_090 sub catchment a survey was planned to be undertaken on the Bregagh [Kilkenny] watercourse however at the time of survey the Bregagh [Kilkenny] watercourse was dry and unable to be surveyed Another location on the Bregagh [Kilkenny] watercourse (Irish Grid Ref: S 43485 52988) was visited; however, this section of the watercourse was also dry at the time of survey.

Along the proposed grid route 13 survey locations were chosen located within two separate sub catchments. Three survey locations were located within the Munster_SC_010 hydrological sub catchment and ten survey location is located within the Nore_SC_070 hydrological sub catchment. Within the Munster_SC_010 sub catchment the surveys were conducted on the Tullaroan Stream and the Blackbottom watercourse. Within the Nore_SC_070 sub catchment surveys were conducted on the River Nore, Lisdowney [Stream] watercourse, Lismaine watercourse, Nuenna watercourse, tributary of the Nuenna watercourse (unmapped and unnamed watercourse), Monabrika / Freshford_Lots watercourse, Knockown watercourse, Ballylarkin_Upper watercourse and the Arigna [Kilkenny] watercourse.



Map Legend

- EIAR Site Boundary
- Proposed Grid Route
- Proposed Wind Farm Survey Locations
- eDNA survey locations
- Proposed Grid Route Survey Locations
- WFD Rivers
- WFD Subcatchments

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Drawing Title: Proposed Wind Farm Aquatic Survey Locations

Project Title: Briskalagh Renewable Energy Development

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AvdGM	PR
Project No.	Drawing No.
230502	Fig 1-1
Scale	Date
1:20,000	03.07.2023

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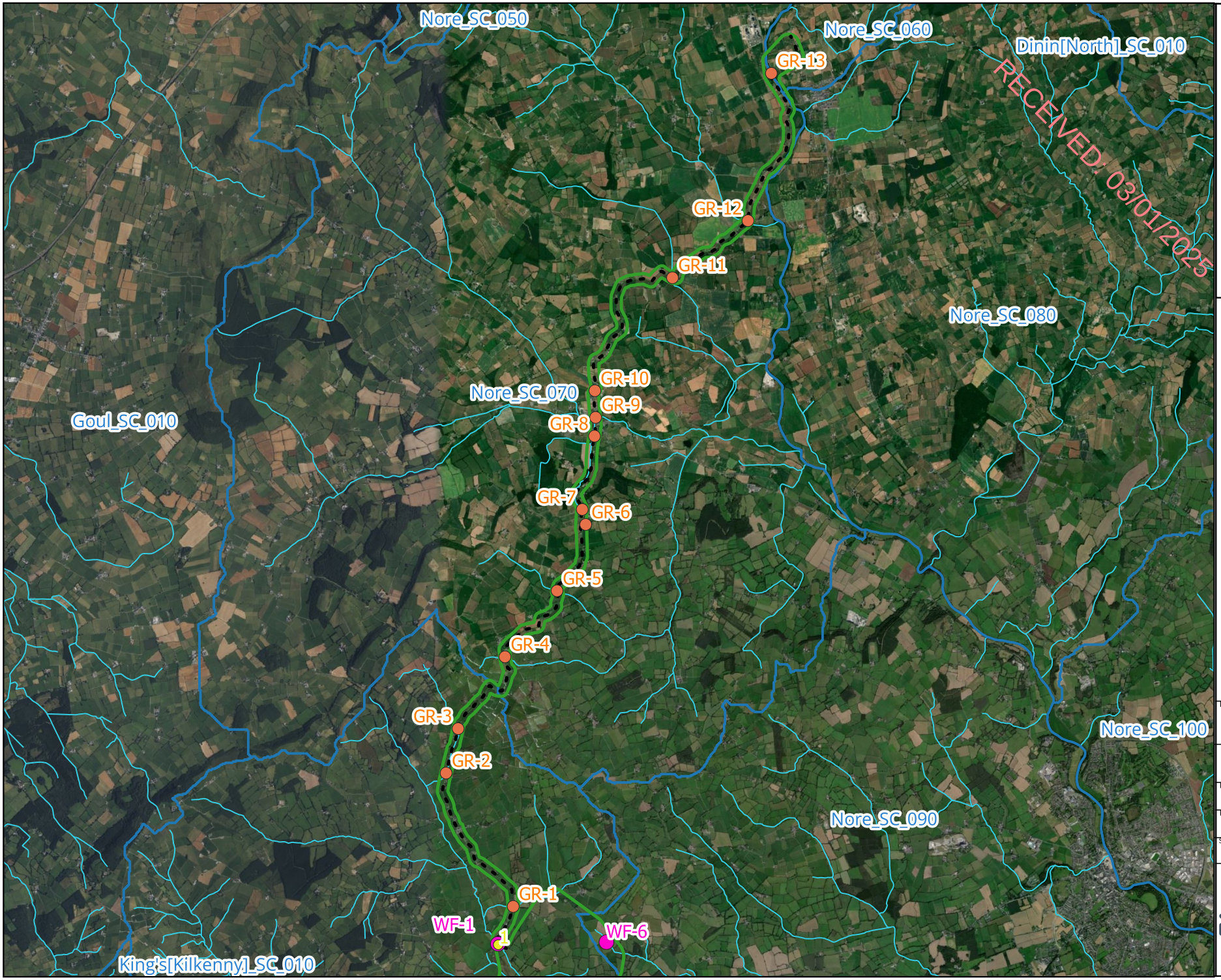

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Map Legend

- EIAR Site Boundary
- Proposed Grid Route
- Proposed Wind Farm Survey Locations
- eDNA survey locations
- Proposed Grid Route Survey Locations
- WFD Rivers
- WFD Subcatchments

Drawing Title: Proposed Grid Route Aquatic Survey Locations

Project Title: Briskalagh Renewable Energy Development

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AvdGM	PR
Project No.	Drawing No.
230502	Fig 1-2
Scale	Date
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2. METHODOLOGIES

2.1 River Habitat Assessment

Aquatic Habitat Assessments/ Appraisals were undertaken in order to determine the riverine habitat types present at each of the survey locations within and in the vicinity of the proposed project site. The survey design and methodologies were derived from current ecological best practice guidance documents. Habitats were classified in accordance with the national habitat classification system used in Ireland - A Guide to Habitats in Ireland (Fossitt (2000)

Riverine habitat assessments were conducted utilising elements of the following methodologies and literature to characterise the selected sites along the watercourse:

- Environment Agency's 'River Habitat Survey in Britain and Ireland Field Survey Guidance Manual 2003' (EA, 2003)
- Irish Heritage Council's 'A Guide to Habitats in Ireland' (Fossitt, 2000).

The survey was devised to gather ecological baseline information including any habitat features that could potentially support protected Qualifying Interest species associated with EU designated sites within the wider area. In addition, the survey had regard to the potential presence of problematic invasive alien species with an emphasis on those species listed on the 'Third Schedule' of Regulations 49 & 50 of the Birds and Natural Habitats Regulations 2011. The assessments have regard to the NRA guidance document - Guidelines on management of noxious weeds and non-native invasive plant species on national roads. National Roads Authority (NRA, 2010).

During the site visit, additional information on any other species of local biodiversity value occurring within the site was recorded in order to provide a complete baseline understanding of the development site.

All sites were assessed in terms of the following variables:

- Channel width and depth.
- Bank profiles, including bank height and composition.
- Substrate type, listing substrate fractions in order of dominance.
- Flow type.
- In-stream macrophyte and aquatic bryophytes occurring and the prominence of each (DAFOR scale).
- Water clarity and colouration.
- Riparian vegetation composition.

2.2 Fisheries Habitat Assessment

An assessment/ appraisal of the riverine habitats at each sample location was undertaken to determine the potential for watercourses within the study area to support fish species including salmonids, lamprey spp. and European eel among other fish species likely to utilise the watercourses within the study area.

Fisheries habitat assessments were conducted utilising elements of the following methodologies and literature to characterise the selected sites along the watercourse:

- Environment Agency's 'River Habitat Survey in Britain and Ireland Field Survey Guidance Manual 2003' (EA, 2003)
- Irish Heritage Council's 'A Guide to Habitats in Ireland' (Fossitt, 2000).
- 'Channels & Challenges. Enhancing Salmonid Rivers'. Irish Freshwater Fisheries Ecology & Management Series (O'Grady, 2006)

- 'Ecology of the Atlantic Salmon' (Hendry & Cragg-Hine, 2003)
- Life Cycle Unit method (Kennedy, 1984; O'Connor & Kennedy, 2002)
- 'Ecology of the River, Brook, and Sea Lamprey' (Maitland, 2003)
- NPWS Irish Wildlife Manuals lamprey surveys (O'Connor, 2004; O'Connor, 2006; and O'Connor, 2007)

2.3 Electrofishing Surveys

Electro-fishing operations for the purpose of forming baseline fisheries data of the proposed Wind farm site were undertaken on the 13th and 14th of September 2023.

A 5-minute timed Qualitative survey was undertaken at each survey location to determine presence/ absence of fish species within the study area while adhering to best practice methodology (Electric Fishing in Wadeable Reaches, Central Fisheries Board (CFB, 2008)), and remaining in line with European standards for electrofishing (CEN, 2003). Two suitably qualified ecologists conducted electro-fishing operations at the 5 no. electro-fishing locations as per Fig 1-1, using an E-fish EF-500B-SYS Electric Fishing Backpack System.

Fish captured during electro-fishing operations were kept in a holding container with oxygenated water. Stress to fish via temperature and low oxygen levels was monitored by consistently and continually checking water temperature both in the river/ watercourse being surveyed and the holding container in order to ensure temperatures of 20°C were not surpassed. All fish temporarily captured during the survey were identified to species and measured. All fish temporarily captured were allowed to recover and were returned to the watercourse in the vicinity of where they were collected.

An assessment/ appraisal of the riverine habitats at each sample location was undertaken to determine the potential for watercourses within the study area to support fish species including salmonids, lamprey spp. and European eel among other fish species likely to utilise the watercourses within the study area.

Biosecurity measures were followed as per Section 2.7 below.

2.4 Macroinvertebrate Surveys

The methodology followed was the same as that used by the EPA for their national water sampling regime (Toner *et al.* 2005). A two-minute kick sample was collected from a stream bed area of approximately one square metre with a standard handnet (250 mm x 250 mm, with a 300 mm bag depth and a 1 mm mesh size). One minute hand searches, of large objects such as tree branches or stones, was undertaken prior to each of the kick samples. The kick sampling time was then divided proportionally among the habitats present in the area, such as fast-moving riffles, shallow water, and silted banks. Samples were sorted on site with identified species classed into groups according to their pollution tolerance levels, as per Environmental Protection Agency (EPA) practice (Toner et al., 2005). Specimens were identified using the FBA Guide to Freshwater Invertebrates (Dobson *et al.*, 2012).

Table 3-2. EPA Quality Rating (Q) System.

Biotic Index	Quality Status	Quality Status	Quality Class	Condition
Q5, Q4-5	High	Unpolluted	Class A	Satisfactory
Q4	Good	Unpolluted	Class A	Satisfactory
Q3-4	Moderate	Slightly Polluted	Class B	Unsatisfactory
Q3, Q2-3	Poor	Moderately Polluted	Class C	Unsatisfactory
Q2, Q1-2, Q1	Bad	Seriously Polluted	Class D	Unsatisfactory

2.5 Otter Surveys

Otter surveys were conducted as per TII/NRA (2009) guidelines (Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes). This involved a search for all Otter signs e.g. spraints, scat, prints, slides, trails, couches and holts upstream and downstream of proposed survey locations. Within the proposed wind farm study area otter surveys were conducted 150m upstream and downstream of all survey points. Along the proposed grid route study otter surveys were conducted in the vicinity of all survey locations due to the small-scale works proposed to be undertaken along the proposed grid route and the association with such works and the existing road. In addition to the width of the rivers, a 10m riparian buffer (both banks) is considered to comprise part of the Otter habitat (NPWS 2009. Threat Response Plan: Otter (2009-2011).

2.6 eDNA Surveys

The proposed wind farm is located wholly within an area classified as "Catchments with previous records of *Margaritifera*, but current status unknown" as well as being located upstream of NPWS mapped White-clawed Crayfish records. As such eDNA sampling for both Freshwater Pearl Mussel and White-clawed Crayfish as well as Crayfish Plague were undertaken.

eDNA samples in select watercourses within the study area were undertaken to determine presence of Freshwater Pearl Mussel (FWPM), White-clawed Crayfish (WCC) and Crayfish Plague (CP).

2.7 Biosecurity Measures

Biosecurity measures which were implemented followed *IFI Biosecurity Protocol for Field Survey Work*, (IFI, 2010). Due to increasingly prevalent spread of crayfish plague in Ireland and to prevent the spread of aquatic invasive species all equipment was scrubbed and cleaned prior to and post works with Virkon Aquatic. Additionally, all equipment was cleaned with Virkon Aquatic between survey sites to minimise the potential for the spread of invasives between watercourses/ survey sites. Any instance of invasive species recorded was recorded and conveyed to IFI upon the Electro-fishing survey data return.

3. DESK STUDY

A Desk Study was conducted to gather baseline information from online sources and records on the aquatic habitats and aquatic dependent species within the vicinity of the survey area.

In preparation of the desk study, the following sources were used to gather information:

- Review of online web-mappers: National Parks and Wildlife Service (NPWS), EPA, Water Framework Directive (WFD),
- Review of OS maps and aerial photographs of the survey area.

3.1 EPA Water Quality.

Within the proposed Wind farm study area, the rivers surveyed are as follows; Bregagh (Kilkenny) [EPA Code: 15B02], Tullaroan Stream [EPA Code: 15T02], Foylatalure [EPA Code: 15F10], Briskalagh [EPA Code: 15B98] and some tributaries to the aforementioned rivers and streams. The proposed wind farm survey locations are located within the Tullaroan Stream_030 and Breagagh (Kilkenny)_010 river sub basins, the Munster_SC_010 and the lNore_SC_090 hydrological sub-catchments, Nore hydrological catchment (Catchment ID: 15), and hydrometric area 15 (Nore).

Within the proposed grid route study area, the rivers surveyed are as follows; River Nore [EPA Code: 15N01] and its associated tributaries; Lisdowney stream [EPA Code: 15L02], Lismaine [EPA Code: 15N01], Nuenna River (including Monabrika River and Freshford Lots) [EPA Code: 15N02], Arigna River (including Ballylarkin Upper) [EPA Code: 15A01], Tullaroan Stream_010 and Tullaroan Stream_020 (including Blackbottom stream) [EPA Code: 15T02]. All survey locations are located within the Nore WFD Hydrological Catchment [Catchment ID: 15], within the Southeastern River Basin District. 10 of 13 aquatic sample sites are located within Nore_SC_070 sub-catchment [sub-catchment ID: 15_21], While the remaining three sites are located within Munster_SC_010 sub-catchment [sub-catchment ID: 15_5].

The EPA Envision map viewer was consulted on 17th of June 2024 regarding the water quality status and risk of the rivers which comprise the proposed wind farm survey locations and the proposed grid route survey locations. Table 3-1 presents a summary of the waterbody WFD status for 2013-2018, waterbody WFD status for 2016-2021 and WFD 3rd Cycle River Waterbodies Risk Projection.

Table 3-1 WFD Status and Risk of watercourses.

River Name	Waterbody WFD Status for 2013-2018	Waterbody WFD Status for 2016-2021	WFD 3rd Cycle River Waterbodies Risk Projection
River Nore	Good	Good	Not at risk
Lisdowney stream	Good	Moderate	At risk
Lismaine stream	Good	Good	Not at risk
Nuenna River	Moderate	Poor	At risk
Arigna (Kilkenny)	Moderate	Moderate	At risk
Tullaroan Stream_010	Poor	Moderate	Review
Tullaroan Stream_020	Good	Good	Not at risk
Bregagh (Kilkenny)	Poor	Poor	At Risk
Foylatalure	Good	Good	Review

Briskalagh	Good	Good	Review

The Biotic Index of Water Quality (BIWQ) was developed in Ireland by the Environmental Protection Agency (EPA). Q-values are assigned using a combination of habitat characteristics and structure of the macro-invertebrate community within the waterbody. Individual macro-invertebrate families are classified according to their sensitivity to organic pollution and the Q-value is assessed based primarily on their relative abundance within a sample.

The EPA Envision map viewer was consulted on 17th of June 2024 regarding the water quality status of the rivers which comprise the proposed wind farm survey locations and the proposed grid route survey locations. Q-rating data is available for the Tullaroan Stream within the study area. The upstream EPA monitoring point at the Bridge in Oldtown was given a Q rating of 4- 'Good' in 2022. There were 12 EPA monitoring points within the vicinity of the study area (Table 3-12).

Table 3-2 EPA Water Quality Data

Watercourse Name	Sampling Station	Location	Sampling Year	Q-Value & Water Quality Status
Nore_120	0.5 km u/s Ballyragget [Station Code: RS15N011400]	E 244309, N 171108	2020	Q3-4 - Moderate
	Bridge in Ballyragget [Station Code: RS15N011450]	E 244524.4, N 170820.7	2022	Q4 - Good
Nore_140	1.5 km d/s Ballyragget [Station Code: RS15N011500]	E244004, N169342	1991	Q3-4 - Moderate
Lisdowney_010 [EPA Code: 15L02]	Bridge North of Lisdowney Crossroads [Station Code: RS15L020100]	E 241096.21, N 171295.01	2022	Q3-4 - Moderate
	Bridge East of Lisdowney Crossroads [Station Code: RS15L020200]	E 241462.38, N 170979.97	1991	Q3 - Poor
Nuenna_020	Nuenna Freshford East Bridge [Station Code: RS15N020200]	E 240690.88, N 164836.38	2022	Q3 - Poor
	Upstream Freshford Wastewater Treatment Plant [Station Code: RS15N020240]	E 240981.32, N 164776.97	2022	Q3 - Poor
	~40m u/s Freshford primary discharge [Station Code: RS15N020250]	E 241050.6, N 164761.81	2022	Q3 - Poor
	1km d/s Freshford [Station Code: RS15N020300]	E 241387, N 164583	2022	Q3-4 - Moderate
Tullaroan stream_010	Tullaroan stream - Bridge in Tullaroan [Station Code: RS15T020100]	E 237754.39 N 156851.77	1987	Q2-3 - Poor
Tullaroan stream_020	Bridge at Oldtown [Station Code: RS15T020250]	E 238818.03 N 154691.82	2022	Q4 - Good
Tullaroan stream_030	Tullaroan stream - Bridge East of	E 239409.35, N 152284.11	1991	Q4 - Good

	Kilmanagh [Station Code: RS15T020300]			

3.2 Salmonid River Status.

Aquatic sampling sites within both the wind farm study area and proposed grid route study area are hydrologically connected to the main channel river Nore, which is designated as salmonid waters under S.I 293 (1988). Salmonid waters are those fresh waters classified under the first schedule, which are *'capable of supporting Salmon (Salmo salar), Trout (Salmo trutta), Char (Salvelinus) and Whitefish (Coregonus)'* species. Sampling site GR-13 within the proposed grid route study area is located along the main channel River Nore.

3.3 NPWS Data.

3.3.1 Freshwater Pearl Mussel

Aquatic survey locations GR-13 – GR-4 were located within the Nore Middle *Margaritifera* sensitive area, which is listed as a catchment of extant freshwater pearl mussel outside of the SAC populations listed in S.I. 296 of 2009. Aquatic survey locations GR-1 – GR-3 and all eDNA and electrofishing sites were located in the Nore Lower *Margaritifera* sensitive area, which is listed as a catchment with previous records of *Margaritifera,* but current status is unknown.

3.3.2 White-clawed Crayfish

The incidence of White-Clawed Crayfish has been recorded by NPWS approx. 7.2km and 8.2km downstream of the wind farm study area along Tullaroan Stream_030 and Munster_030 watercourses and approx. 12.6km and 15.2km upstream of the proposed grid route study area, along the main channel River Nore and Goul_060, respectively. There are no records of White-clawed Crayfish within or directly adjacent to the proposed Wind Farm study area or Grid Route study areas.

3.3.3 Annex I habitats

There are no mapped instances of freshwater Annex I habitats within or in the vicinity of the proposed wind farm or grid route study areas. An area of residual alluvial woodland lies approx. 6km from survey point WF-6.

4. FIELD SURVEY RESULTS

4.1 Aquatic Survey Results.

The following field surveys were carried out on the 13th and 14th of September 2023, the 21st and the 22nd of March 2024 and the 27th of June 2024. No significant constraints or limitations in gathering information were encountered.

Aquatic Baseline surveys were undertaken within the vicinity of the proposed wind farm and along the proposed grid route.

Aquatic Baseline Surveys undertaken in the vicinity of the proposed wind farm include:

- River habitat assessment,
- Fisheries habitat assessment,
- Electrofishing surveys,
- Macroinvertebrate surveys,
- Otter Surveys
- eDNA surveys

Aquatic Baseline Surveys undertaken along the proposed Grid Route include:

- River habitat assessment,
- Fisheries habitat assessment,
- Macroinvertebrate surveys,
- Otter Surveys

The below sections (4.1.1 & 4.1.2) summarise and describe the proposed wind farm survey locations and the proposed grid route survey locations in line with the above survey types.

Appendix I presents a collated record of the species found at each survey location electrofishing was conducted on.

Appendix II presents a collated record of the Q-Values assigned across all survey locations.

4.1.1 Proposed Wind Farm Survey Locations

4.1.1.1 WF Survey Site 1 (WF-1)

Survey site WF-1 was located on the Tullaroan Stream watercourse (IG Ref.: S 38826 54683). This section of the Tullaroan Stream watercourse was categorised as a **depositing/ lowland river (FW2).** Properties of the watercourse at this sample location are provided in Table 4-1 below and a representative photograph of the survey location is shown in Plate 4-1.

Table 4-1 Properties of the watercourse at survey location WF-1

Properties	Record			
Average Depth (m)	10-50cm			
Average Bank Width (m)	4m			
Wet Width (m)	4m			
Flow	Low – moderate			
Colour	No distinct colouring			
Clarity	Clear with plumes of silt when disturbed			
Bank height (m)	LHB	1.5m	RHB	1.5m

Dominant Substrates	Boulder: <5% Cobble: 30% Large Gravel and Fine Gravel: 50% Sand (0.25–2mm) and Silt (<0.25mm): 15%
Substratum Condition	Moderately compacted

Plate 4-1 Representative picture of Survey Location WF-1

The watercourse at this survey location had low to medium flow and velocity. Water was clear and had no distinct colouration however there was a degree of siltation which was easily disturbed during the survey creating plumes of silt and fine sediment. Submerged and emergent macrophytes were uncommon with <10% percentage cover. The substrate of the watercourse was dominated by cobbles, large gravels and fine gravels. A one span road bridge and concrete apron was present at the upstream extent of the survey location. The right-hand bank (RHB) consisted of a retaining wall classified as **Buildings and artificial surfaces (BL3)** with a riparian **Treeline (WL2)** growing on the RHB and providing shade to the channel. As a result of this the channel is confined laterally and may have reduced floodplain connectivity. Species growing atop the RHB consisted predominantly of sycamore (*Acer pseudoplatanus*), ash (*Fraxinus excelsior*), bramble (*Rubus fruticosus agg*), nettle (*Urtica dioica*) and ivy (*Hedera helix*). The left-hand bank (LHB) had been historically raised and was classified as **improved agricultural grassland (GA1).** Species present along the LHB and watercourse margin consisted of cocks foot (*Dactylis glomerata*), dock (*Rumex obtusifolius*), nettle, watercress (*Nasturtium officinale*) and willowherb (*Epilobium* sp.). Land use on the RHB consisted of a treeline and further south-west a residential dwelling while land use on the LHB consisted of agricultural pasture.

Salmonid spawning and nursery habitat was assessed as moderate at this survey location while holding habitat was assessed as good. While appropriate levels of shading and suitable gravel substrate for spawning and nursery habitat were present the substrate was moderately compacted and a contiguous layer of silt overlayed areas of gravels. Areas of concrete apron at the upstream extent of the survey

location also reduced the quality of the spawning habitat. A deeper pool section was present adjacent to the RHB and this area offered moderate holding habitat to salmonids. Spawning habitat for lamprey (*lampetra* spp.) was assessed as poor in this location due to the moderately compacted substrate and nursery habitat for lamprey species was assessed as poor – moderate due to the presence of some softer sediments at bank margins and within sections of the deeper pool habitat at the RHB. While pools along the RHB offered some suitable habitat to European eel (*Anguilla anguilla*) due to the low proportion of large substate and lack of undercut banks, overhangs or submerged roots the survey location was assessed as having poor suitability to support European eel.

A 5-minute qualitative electrofishing survey was conducted at this survey location using methodologies described in Section 2.3 of this report. Species recorded include brown trout (*Salmo trutta*), Atlantic salmon (*Salmo salar*), and stone loach (*Barbatula barbatula*). Brown trout was the most common species recorded followed by Atlantic salmon and then stone loach. Table 4-2 presents the results of the electrofishing survey at this location.

Table 4-2 Electrofishing results at survey location WF-1

Species	Length
Brown Trout (*Salmo trutta*)	22cm
Brown Trout (*Salmo trutta*)	18cm
Brown Trout (*Salmo trutta*)	18cm
Brown Trout (*Salmo trutta*)	19.5cm
Brown Trout (*Salmo trutta*)	17cm
Salmon (*Salmo salar*)	8cm
Brown Trout (*Salmo trutta*)	9.5cm
Brown Trout (*Salmo trutta*)	9.5cm
Brown Trout (*Salmo trutta*)	9.5cm
Salmon (*Salmo salar*)	7cm
Salmon (*Salmo salar*)	10cm
Brown Trout (*Salmo trutta*)	7.5cm
Stone Loach (*Barbatula barbatula*)	8.5cm
Stone Loach (*Barbatula barbatula*)	7cm
Salmon (*Salmo salar*)	10cm
Salmon (*Salmo salar*)	8.5cm
Salmon (*Salmo salar*)	7.5cm
Stone Loach (*Barbatula barbatula*)	6.5cm
Salmon (*Salmo salar*)	7cm

Kick-sampling was carried out in areas of riffle and glide. Properties of the stream at survey location WF-1 are shown in Table 4-1. Macroinvertebrate diversity was moderate and density was high. The Q rating assigned to survey location WF-1 was **Q3–Poor**, on the basis that Group C were the dominant indicator group in this sample (Approx. 95%, comprising of 82 individuals from six separate 'Pollution Tolerant' taxa), Group A– 'very pollution sensitive' taxa were absent and Group B– 'moderately pollution sensitive' taxa were present in small numbers (Approx. 5%, comprising of 4 individuals from one 'Moderately Pollution Sensitive' taxa). Group D and Group E taxa were absent from the sample. One dead Group A taxa (*Ecdyonurus* sp.) was recorded however as it was dead when recording and as no other instances of the species were recorded this was discounted and not included in the final results. The results of the kick-sample are summarised in Table 4-3.

Table 4-3 Results of macroinvertebrates sample at survey location WF-1

Indicator Group	Taxon	Abundance
Group A – Very Pollution Sensitive	-	-
Group B – Moderately Pollution Sensitive	*Leuctra sp.*	4
Group C – Pollution Tolerant	*Baetis rhodani*	20
	Rhyacophila sp.	3
	Gammarus sp.	15

	Hydropsyche sp.	1
	Ephemerellidae sp.	3
	Simuliidae spp.	40
Group D – Very Pollution Tolerant	-	-
Group E – Most Pollution Tolerant	-	-

Additional Survey Recordings in the vicinity of Survey Location WF-1

Downstream of the survey location point, evidence of watercourse alterations was observed on the Tullaroan Stream watercourse (Irish Grid Ref: S 38910 54596). The banks of the watercourse had been recently altered with evidence of some riverbed alterations also with bank material within the watercourse channel. This area of watercourse was heavily silted at the time of survey compared to the section immediately upstream with bank alterations likely being the cause of excess siltation.

Plate 4-2 Area of altered watercourse downstream of survey location WF-1.

At the bridge structure at the upstream extent of the survey location there was a pipe extracting water from the watercourse.

While undertaking the otter survey at the survey location, Otter (*Lutra lutra*) spraint and tracks were recorded. The Otter spraint contained some crayfish remains. There were no other otter signs recorded at this survey location.

A kingfisher (*Alcedo atthis*) flew upstream through the survey location during the survey. No kingfisher burrows were recorded within the vicinity of the survey area.

4.1.1.2 WF Survey Site 2

Survey site WF-2 was located on the Briskalagh watercourse (IG Ref.: S 39634 53973). This section of the Briskalagh watercourse was categorised as a highly historically modified **eroding/ upland river (FW1).** Properties of the watercourse at this sample location are provided in Table 4-4 below and a representative photograph of the survey location is shown in Plate 4-3.

Table 4-4 Properties of the watercourse at survey location WF-2

Properties	Record
Average Depth (m)	5-20cm
Average Bank Width (m)	1.5m
Wet Width (m)	1.5m
Flow	Low – moderate
Colour	No distinct colouring but heavily silted
Clarity	Clear with significant plumes of silt when disturbed
Bank height (m)	LHB 1.5m RHB 1.5m
Dominant Substrates	Cobble: 20% Large Gravel and Fine Gravel: 40% Sand: 10% Silt: 30%, with silt also forming a contiguous layer over much of the other substrates
Substratum Condition	Compacted in the area of channel where cattle cross but relatively uncompacted otherwise

Plate 4-3 Representative picture of Survey Location WF-2

The watercourse at this survey location had low to medium flow and velocity. Water was clear and had no distinct colouration however there was a heavy degree of siltation which was easily disturbed during the survey creating plumes of silt and fine sediment that lingered in suspension. The substrate of the watercourse was dominated by cobbles, large gravels and fine gravels and silt with a contiguous silt layer also present over a high proportion of the river bed substrate. A section of the channel at the survey location is used as a crossing point between fields and as such the substrate in this area is compacted. The right-hand bank (RHB) consisted of **improved agricultural grassland (GA1)** with a field boundary **Hedgerow (WL1)** growing on the RHB and providing heavy shade to the channel. As a result sections of the channel were tunnelled and low amounts of light penetrated. Species

characterising the hedgerow on the RHB consisted predominantly of ash, bramble, beech (*Fagus sp.*) and nettle. The left-hand bank (LHB) was classified as **improved agricultural grassland (GA1).** Species present along the LHB and watercourse margin consisted predominantly of cocks foot, dock and nettle. Land use on the RHB and LHB consisted of agricultural pasture.

Salmonid spawning, nursery and holding habitat was assessed as poor at this survey location as the river bed substrate was heavily compacted in some sections and there was a contiguous heavy layer of silt covering the courser substrate. Spawning habitat for lamprey (*lampetra* spp.) was assessed as poor in this location due to the areas of compacted substrate and gravels covered by silt. Nursery habitat for lamprey species was assessed as poor due to the presence of areas of softer sediment accumulations at bank margins but otherwise unsuitable habitat. Due to the lack of suitably large substate and low proportion of undercut banks, overhangs or submerged roots the survey location was assessed as having poor suitability to support European eel.

A 5-minute qualitative electrofishing survey was conducted at this survey location using methodologies described in Section 2.3 of this report. Species recorded include brown trout, stone loach, and minnow (*Phoxinus phoxinus*). Minnow was the most common species recorded followed by brown trout and then stone loach. Table 4-5 presents the results of the electrofishing survey at this location.

Table 4-5 Electrofishing results at survey location WF-2

Species	Length
Brown Trout (*Salmo trutta*)	8.5cm
Brown Trout (*Salmo trutta*)	8cm
Brown Trout (*Salmo trutta*)	7.7cm
Stone Loach (*Barbatula barbatula*)	8.7cm
Minnow (*Phoxinus phoxinus*)	5.7cm
Minnow (*Phoxinus phoxinus*)	5.5cm
Minnow (*Phoxinus phoxinus*)	2cm
Minnow (*Phoxinus phoxinus*)	2cm

Kick-sampling was carried out in areas of riffle and glide and pool. Properties of the stream at survey location WF-2 are shown in Table 4-4. Macroinvertebrate diversity was poor and density was high. The Q rating assigned to survey location WF-2 was a low **Q3–Poor**. This score was assigned on the basis that Group C were the dominant indicator group in this sample (Approx. 92%, comprising of 54 individuals from two separate 'Pollution Tolerant' taxa), Group A– 'very pollution sensitive' taxa and Group B– 'moderately pollution sensitive' taxa were entirely absent. Group D 'Very Pollution Tolerant' taxa and Group E 'Most Pollution Tolerant' taxa were present in small numbers. The results of the kick-sample are summarised in Table 4-6.

Table 4-6 Results of macroinvertebrates sample at survey location WF-2

Indicator Group	Taxon	Abundance
Group A – Very Pollution Sensitive	-	-
Group B – Moderately Pollution Sensitive	-	-
Group C – Pollution Tolerant	*Baetis rhodani*	4
	Gammarus sp.	50
Group D – Very Pollution Tolerant	*Asellus sp.*	3
Group E – Most Pollution Tolerant	*Chironomus sp.*	2

4.1.1.3 WF Survey Site 3

Survey site WF-3 was located on the Foylatalure watercourse (IG Ref.: S 39384 53787). This section of the Foylatalure watercourse was categorised as a historically modified **depositing/ lowland river (FW2).** Properties of the watercourse at this sample location are provided in

Table 4-7 below and a representative photograph of the survey location is shown in Plate 4-4.

Table 4-7 Properties of the watercourse at survey location WF-3

Properties	Record			
Average Depth (m)	30-60cm			
Average Bank Width (m)	2m			
Wet Width (m)	2m			
Flow	Low – moderate			
Colour	Slightly brown in colour and heavily silted			
Clarity	Slightly turbid with significant plumes of silt when disturbed			
Bank height (m)	LHB	2m	RHB	1.5m
Dominant Substrates	Cobble: 15% Large Gravel: 30% Fine Gravel: 25% Sand: 20% Silt: 10%, with silt forming a contiguous layer over much of the other substrates			
Substratum Condition	Moderately compacted in sections			

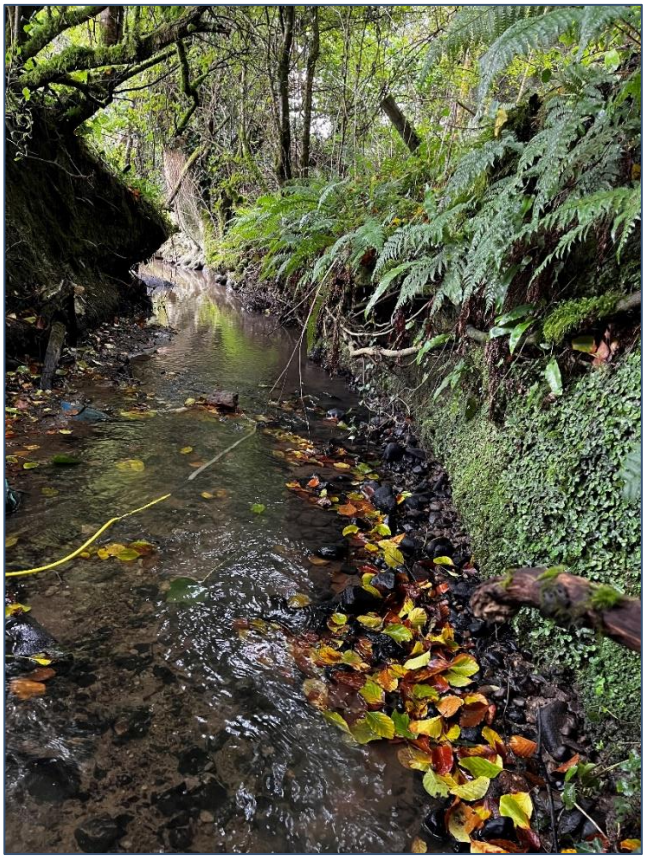

Plate 4-4 Representative picture of Survey Location WF-3

The watercourse at this survey location had low to medium flow and velocity. Water was slightly turbid and there was a heavy degree of siltation which was easily disturbed during the survey creating plumes of silt and fine sediment that lingered in suspension. Siltation was heaviest towards the confluence with the Tullaroan watercourse downstream of the survey location. The substrate of the watercourse was dominated by large gravels and fine gravels with a contiguous silt layer also present over large areas of the river bed substrate. Trash such as an old barrel and plastic containers were also present within the channel. The right-hand bank (RHB) consisted of **mixed broadleaved woodland (WD1)** providing moderate - heavy shade to the channel. Species characterising the woodland on the RHB consisted predominantly of hawthorn (*Crataegus monogyna*), holly (*Ilex aquifolium*), ash, elderberry (*Sambucus nigra*), ivy, bramble, nettle and golden scaly male fern (*Dryopteris affinis*). The left-hand bank (LHB) consisted of an ash dominated **treeline (WL2)** and **scrub (WS1)** habitat. Species present atop the LHB consisted predominantly of ash, bramble and nettle. Land use on the RHB consisted of plantation forestry while land use on the LHB past the treeline consisted of an area of agricultural pasture.

Salmonid spawning and nursery habitat was assessed as poor due to the heavy silatation of the watercourse. Salmonid holding habitat was assessed as moderate at this survey location due to the the presence of some deeper holding pools along the channel within the survey location. Spawning habitat for lamprey (*lampetra* spp.) was assessed as poor in this location due to the relative lack of clean gravels. Nursery habitat for lamprey species was assessed as poor due to the presence of areas of softer sediments at bank margins but otherwise unsuitable habitat. Along the watercourse there were a number of deeper pools, undercut banks, overhangs and submerged roots which provided moderate suitability to support European eel.

A 5-minute qualitative electrofishing survey was conducted at this survey location using methodologies described in Section 2.3 of this report. Species recorded include brown trout, minnow, three-spined stickleback (*Gasterosteus aculeatus*) and European eel (*Anguilla anguilla*). Minnow was the most common species recorded followed by brown trout, three-spined stickleback and then European eel. The single European eel recorded was not captured. Table 4-8 presents the results of the electrofishing survey at this location.

Table 4-8 Electrofishing results at survey location WF-3

Species	Length
Minnow (*Phoxinus phoxinus*)	6.3cm
Minnow (*Phoxinus phoxinus*)	6cm
Minnow (*Phoxinus phoxinus*)	6cm
Minnow (*Phoxinus phoxinus*)	6.5cm
Minnow (*Phoxinus phoxinus*)	6.3cm
Minnow (*Phoxinus phoxinus*)	6.5cm
Minnow (*Phoxinus phoxinus*)	7cm
Minnow (*Phoxinus phoxinus*)	5.8cm
Minnow (*Phoxinus phoxinus*)	6.5cm
Minnow (*Phoxinus phoxinus*)	5.5cm
Minnow (*Phoxinus phoxinus*)	6.5cm
Minnow (*Phoxinus phoxinus*)	6.3cm
Minnow (*Phoxinus phoxinus*)	4.5cm
Minnow (*Phoxinus phoxinus*)	4.5cm
Minnow (*Phoxinus phoxinus*)	4.5cm
Brown Trout (*Salmo trutta*)	10cm
Brown Trout (*Salmo trutta*)	9.5cm
Brown Trout (*Salmo trutta*)	9.5cm
Brown Trout (*Salmo trutta*)	8cm
Brown Trout (*Salmo trutta*)	7cm
Three-spined stickleback (*Gasterosteus aculeatus*)	2cm
Three-spined stickleback (*Gasterosteus aculeatus*)	2cm
Three-spined stickleback (*Gasterosteus aculeatus*)	2cm

Three-spined stickleback (*Gasterosteus aculeatus*)	2cm
European Eel (*Anguilla anguilla*)	(not caught, approx. 15-18cm in length)

Kick-sampling was carried out in areas of riffle and glide. Properties of the stream at survey location WF-3 are shown in

Table 4-7. Macroinvertebrate diversity was poor – moderate and density was low-moderate. The Q rating assigned to survey location WF-3 was a **Q3–Poor**. This score was assigned on the basis that Group C were the dominant indicator group in this sample (Approx. 86%, comprising of 24 individuals from three separate 'Pollution Tolerant' taxa), Group A– 'very pollution sensitive' taxa were entirely absent, Group B– 'moderately pollution sensitive' were present in low numbers, Group D 'Very Pollution Tolerant' taxa were present in small numbers and Group E 'Most Pollution Tolerant' taxa were absent from the sample. The results of the kick-sample are summarised in Table 4-9.

Table 4-9 Results of macroinvertebrates sample at survey location WF-3

Indicator Group	Taxon	Abundance
Group A – Very Pollution Sensitive	-	-
Group B – Moderately Pollution Sensitive	*Leuctra sp.*	1
	Sericostomatide sp.	1
Group C – Pollution Tolerant	*Elmidae sp.*	6
	Gammarus sp.	15
	Hydracarina sp.	3
Group D – Very Pollution Tolerant	*Asellus sp.*	2
Group E – Most Pollution Tolerant	-	-

Additional Survey Recordings in the vicinity of Survey Location WF-3

Downstream of the survey location point, evidence of watercourse alterations were observed on the confluence of the Tullaroan Stream, Foylatalure and Briskalagh watercourses (Irish Grid Ref: S 39413 53797). The banks of the watercourse had been recently altered along with evidence of some riverbed alterations and watercourse diversion. A section of the old watercourse route prior to diversion has been filled in with material. This area of watercourse was heavily silted at the time of survey with bank and riverbed alterations likely being the cause of excess siltation. Downstream of the filled in section of the old watercourse, a deep and heavily silted pool now cut off from upstream flows was present on the left hand side of the watercourse route.

Plate 4-5 Area of altered watercourse downstream of survey location WF-3 at the confluence of the Tullaroan stream, Foylatalure and Briskalagh watercourses.

4.1.1.4 WF Survey Site 4

Survey site WF-4 was located on the Tullaroan stream watercourse (IG Ref.: S 39491 53513). This section of the Tullaroan stream watercourse was categorised as a **depositing/ lowland river (FW2).** Properties of the watercourse at this sample location are provided in Table 4-10 below and a representative photograph of the survey location is shown in Plate 4-6.

Table 4-10 Properties of the watercourse at survey location WF-4

Properties	Record			
Average Depth (m)	5-30cm (80cm pool)			
Average Bank Width (m)	4m - 10m			
Wet Width (m)	4m - 8m			
Flow	Low – moderate			
Colour	No distinct coloration			
Clarity	Clear but slightly turbid in pools			
Bank height (m)	LHB	2m	RHB	2.2m
Dominant Substrates	Boulder: <1% Cobble: 20% Large Gravel: 50% Fine Gravel: 20% Sand and silt: 10%			
Substratum Condition	Loose and relatively uncompacted			

Plate 4-6 Representative picture of Survey Location WF-4

The watercourse at this survey location had low to medium flow and velocity. Water was clear with no discernible coloration but was slightly turbid within pools. There were patches of silt and light siltation in areas of the channel but also large expanses of clean courser material. Water depth increased with distance downstream of the survey location. The substrate of the watercourse was dominated by cobble, large gravels and fine gravels. The right-hand bank (RHB) consisted of **mixed broadleaved woodland (WD1)** providing moderate shade to the channel. Species characterising the woodland on the RHB consisted predominantly of alder (*alnus glutinosa*), ash, bramble, and bindweed (*Calystegia sp.*). The left-hand bank (LHB) consisted of a willow (*Salix sp.*) riparian **treeline (WL2)**. Land use on the RHB consisted of plantation forestry while land use on the LHB past the riparian treeline consisted of an area of agricultural pasture.

Salmonid spawning, nursery and holding habitat were assessed as good due to the lack of significant siltation, suitably sized gravels for spawning, uncompacted gravels, deeper holding pools and a split of 30% riffle – 40% glide and 30% pool habitat providing good macroinvertebrate habitat and as such suitable foraging areas. Spawning habitat for lamprey (*lampetra* spp.) was assessed as good due to the presence of clean gravels and nursery habitat was considered to be moderate as while there were occasional areas of fine sediment within the channel along the bank sides. Along the watercourse there were a number of deeper pools, undercut banks and overhangs which provided moderate suitability to support European eel.

A 5-minute qualitative electrofishing survey was conducted at this survey location using methodologies described in Section 2.3 of this report. Species recorded include Atlantic salmon, brown trout, minnow, and three-spined stickleback (*Gasterosteus aculeatus*). Atlantic salmon was the most common species recorded followed by brown trout and then three-spined stickleback and minnow. Table 4-11 presents the results of the electrofishing survey at this location.

Table 4-11 Electrofishing results at survey location WF-4

Species	Length
Atlantic Salmon (*Salmo salar*)	9.5cm
Atlantic Salmon (*Salmo salar*)	8.5cm
Atlantic Salmon (*Salmo salar*)	9.5cm
Atlantic Salmon (*Salmo salar*)	9.5cm
Atlantic Salmon (*Salmo salar*)	9cm
Atlantic Salmon (*Salmo salar*)	8cm
Brown Trout (*Salmo trutta*)	30cm
Brown Trout (*Salmo trutta*)	19.5cm
Brown Trout (*Salmo trutta*)	7cm
Brown Trout (*Salmo trutta*)	9cm
Brown Trout (*Salmo trutta*)	8cm
Minnow (*Phoxinus phoxinus*)	6.5cm
Three-spined stickleback (*Gasterosteus aculeatus*)	3cm

Kick-sampling was carried out in areas of riffle and glide. Properties of the stream at survey location WF-4 are shown in Table 4-10. Macroinvertebrate diversity was moderate - high and density was high. The Q rating assigned to survey location WF-3 was a **Q3-4 –Moderate**. This score was assigned on the basis that Group C were the dominant indicator group in this sample (Approx. 93%, comprising of 167 individuals from eight separate 'Pollution Tolerant' taxa), Group A– 'very pollution sensitive' taxa were represented by one taxa in small numbers, Group B– 'moderately pollution sensitive' were represented by one taxa in small numbers, Group D 'Very Pollution Tolerant' taxa were present in small numbers and Group E 'Most Pollution Tolerant' taxa were absent from the sample. The results of the kick-sample are summarised in Table 4-12.

Table 4-12 Results of macroinvertebrates sample at survey location WF-4

Indicator Group	Taxon	Abundance
Group A – Very Pollution Sensitive	*Ecdyonurus sp.*	6
Group B – Moderately Pollution Sensitive	*Glossosomatidae sp.*	1
Group C – Pollution Tolerant	*Baetis rhodani*	50
	Ephemerellidae sp.	4
	Gammarus sp.	30
	Elmidae sp.	3
	Rhyacophila sp.	6
	Hydropsyche sp.	4
	Simuliidae sp.	50
	Chironomidae sp.	20
Group D – Very Pollution Tolerant	*Asellus sp.*	1
	Erpobdella sp.	5
Group E – Most Pollution Tolerant	-	-

4.1.1.5 WF Survey Site 5

Survey site WF-5 was located on the Tullaroan stream watercourse (IG Ref.: S 39394 52279). This section of the Tullaroan stream watercourse was categorised as a **depositing/ lowland river (FW2).** Properties of the watercourse at this sample location are provided in Table 4-13 below and a representative photograph of the survey location is shown in Plate 4-7.

Table 4-13 Properties of the watercourse at survey location WF-5

Properties	Record
Average Depth (m)	10-50cm
Average Bank Width (m)	6m - 8m
Wet Width (m)	6m - 8m

Flow	Low – moderate			
Colour	No distinct coloration			
Clarity	Clear but plumes of silt when disturbed			
Bank height (m)	LHB	2m	RHB	2.5m
Dominant Substrates	Boulder: <5% Cobble: 20% Large Gravel: 40% Fine Gravel: 25% Sand and silt: 10%			
Substratum Condition	Somewhat compacted in some areas upstream towards bridge feature but more loose and relatively uncompacted downstream			

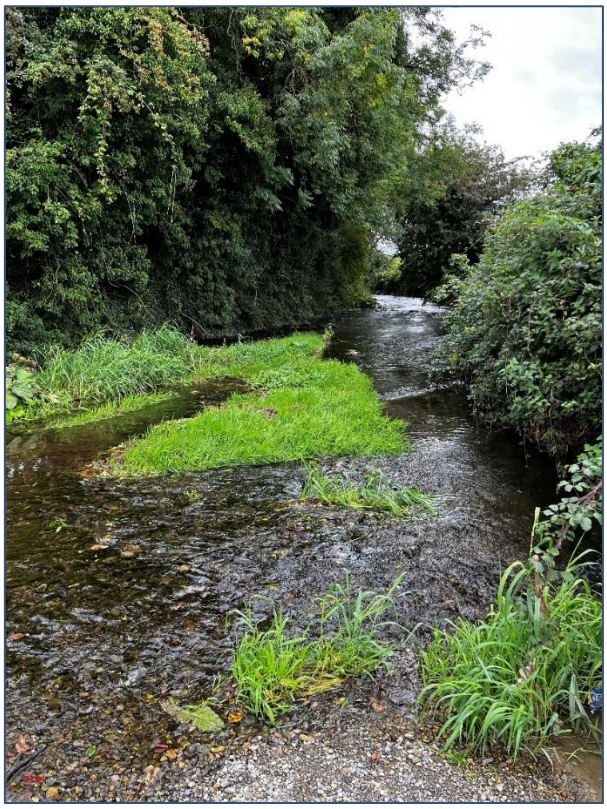

Plate 4-7 Representative picture of Survey Location WF-5

The watercourse at this survey location had low to medium flow and velocity. Water was clear with no discernible coloration. Plumes of silt were released into suspension when disturbed. The substrate of the watercourse was dominated by cobble, large gravels and fine gravels. Gravels had accumulated at the right hand bank leaving an exposed area of gravels during the flow conditions at the time of survey. A number of vegetated mid-channel gravel bars were also present within the channel in areas of shallow water. Excessive green algae growth was found on the cobbles and gravels and covered approximately 70% of the river bed substrate. A two-span bridge with a concrete apron and one support pillar within the channel was located at the upstream extent of the survey location. Flow of water was blocked through one of the spans of the bridge by a buildup of vegetated substrate and earthen deposits. The right hand bank (RHB) consisted of built land (**buildings and artificial surfaces (BL3)**) and bramble **scrub (WS1)** which quickly graded into a football pitch considered under **amenity grassland (GA2)** at the downstream extent of the survey area. The left-hand bank (LHB) consisted of a willow, ash and ivy dominated riparian **treeline (WL2)** which graded into an **agricultural grassland (GA1)** further from the bankside. Land use on the RHB consisted of urban townland and recreation while land use on the LHB past the riparian treeline consisted of an area of agricultural pasture.

Salmonid spawning and nursery habitat were assessed as poor – moderate as while there were large areas of suitable substrate this substate was compacted in areas and was covered in green algal growths within approx. 70% of the survey location. Salmonid holding habitat was assessed as moderate due to the presence of deeper holding pool habitat within the survey location. Spawning habitat for lamprey (*lampetra* spp.) was assessed as poor – moderate due to the presence of suitable substrate but with some compaction of substrate and excess algal growths. Nursery habitat for lamprey was considered to be poor-moderate as while there were occasional areas of fine sediment within the channel and along the bank sides within deeper pools but also areas of compacted substrate. Along the watercourse there were a number of deeper pools, undercut banks and overhangs which provided moderate suitability to support European eel.

A 5-minute qualitative electrofishing survey was conducted at this survey location using methodologies described in Section 2.3 of this report. Species recorded include Atlantic salmon and brown trout. Atlantic salmon was the most common species recorded followed by brown trout. Table 4-14 presents the results of the electrofishing survey at this location.

Table 4-14 Electrofishing results at survey location WF-5

Species	Length
Atlantic Salmon (*Salmo salar*)	10cm
Atlantic Salmon (*Salmo salar*)	9.5cm
Atlantic Salmon (*Salmo salar*)	9.3cm
Atlantic Salmon (*Salmo salar*)	9cm
Atlantic Salmon (*Salmo salar*)	9cm
Atlantic Salmon (*Salmo salar*)	8.5cm
Atlantic Salmon (*Salmo salar*)	8.5cm
Atlantic Salmon (*Salmo salar*)	7.7cm
Atlantic Salmon (*Salmo salar*)	7.5cm
Atlantic Salmon (*Salmo salar*)	7cm
Atlantic Salmon (*Salmo salar*)	7cm
Atlantic Salmon (*Salmo salar*)	6.7cm
Brown Trout (*Salmo trutta*)	9.5cm
Brown Trout (*Salmo trutta*)	6.7cm

Kick-sampling was carried out in areas of riffle and glide. Properties of the stream at survey location WF-4 are shown in Table 4-13. Macroinvertebrate diversity was moderate and density was high. The Q rating assigned to survey location WF-3 was a **Q3 Poor**. This score was assigned on the basis that Group C were the dominant indicator group in this sample (Approx. 99%, comprising of 223 individuals from six separate 'Pollution Tolerant' taxa), Group A– 'very pollution sensitive' taxa were entirely absent, Group B– 'moderately pollution sensitive' were represented by one taxa in small numbers, Group D 'Very Pollution Tolerant' taxa were absent from the sample and Group E 'Most Pollution Tolerant' taxa were absent from the sample. The results of the kick-sample are summarised in Table 4-15.

Table 4-15 Results of macroinvertebrates sample at survey location WF-5

Indicator Group	Taxon	Abundance
Group A – Very Pollution Sensitive	-	-
Group B – Moderately Pollution Sensitive	*Leuctra sp.*	1
Group C – Pollution Tolerant	*Baetis rhodani*	100
	Ephemerellidae sp.	6
	Gammarus sp.	100
	Elmidae sp.	4
	Hydropsyche sp.	3
	Simuliidae sp.	10
Group D – Very Pollution Tolerant	-	-
Group E – Most Pollution Tolerant	-	-

4.1.1.6 WF Survey Site 6

Survey site WF-6 was located on the Bregagh [Kilkenny] watercourse (IG Ref.: S 40905 54732). This section of the Bregagh [Kilkenny] watercourse was categorised as an **eroding/ upland river (FW1).** At the time of survey the survey location was dry with no water within the channel. The watercourse was trenched between two banks which had been historically raised. Bank heights wee approx. 3-4m on both sides of the channel. A hazel **treeline (WL2)** grew from the bank face and tunnelled the channel providing considerable shading. The channel width was approximately 2m. Substrate consisted predominantly of cobble, gravels and fine gravels. Land use both sides of the channel consisted of **agricultural grassland (GA1)** habitat. A representative photograph of the survey location is shown in Plate 4-8.

Plate 4-8 Representative picture of Survey Location WF-6

Another survey location was chosen downstream on the Bregagh [Kilkenny] watercourse in order to gather baseline aquatic data however the river at this downstream location (S 43485 52988) was also dried out and further aquatic surveys were not completed. A representative photograph of the further downstream location is shown in Plate 4-7.

Plate 4-9 Representative picture of the attempted downstream Location (Downstream of WF-6)

4.1.2 Proposed Grid Route Survey Locations

4.1.2.1 GR Survey Site 1 (GR-1)

Survey site GR-1 was located along an **Eroding/Upland (FW1)** section of Tullaroan stream, a tributary of the River Nore (IG Ref.: S 39108 55426). Properties of the stream at sample point GR-1 are shown in Table 4-16 and a representative photograph of the survey location is shown in

Plate 4-10

Table 4-16 Properties of the stream at sample point GR-1

Properties	Record			
Average Depth (m)	0.4			
Average Bank Width (m)	1.5			
Wet Width (m)	1.5			
Bank height (m)	LHB	1.8	RHB	1.8
Flow	Moderate flow and fast velocity			
Colour	No distinct colouration			
Clarity	Clear when undisturbed			
Dominant Substrates	Boulder: 10% Cobble: 50% Gravel: 30% Fine gravel: 10%			
Substratum Condition	Semi-compacted			

Plate 4-10 Representative picture of Sampling Point – GR-1

This section of watercourse was characterised by eroded and undercut earth banks, with large boulder and cobble substrate along the watercourse margin. Large cobble was the predominant substrate type and was semi-compacted. Water was very clear when undisturbed, with no colouration. A slight degree of siltation was observed in the watercourse during the kick-sampling process. Stream discharge was moderate, with fast water velocity. An unvegetated midpoint gravel bar was exposed in lower flow.

The kick sample was taken in areas of riffle and glide, downstream of a moderate bridge structure which was <10m of the stream bank length, with no in-channel supports and a raised concrete apron. Both right and left-hand banks displayed areas of poaching where livestock enter the watercourse, with low, sloping bare earth banks. Tipped debris in the form of metal gates were present in the channel.

WS1 scrub made up of >50% Bramble (*Rubus fruticosus agg.)* and stunted Hawthorn trees (*Crataegus monogyna*), lined the stream channel. The presence of scrub, as well as the raised nature of the banks at the kick-sample location, provided moderate shading to the channel margins. Fields adjacent to the right- and left-hand banks were composed of species-poor **improved agricultural grassland (GA1)** used heavily for grazing and were predominated by Perennial Rye-Grass *(Lolium perenne).* Riparian vegetation on the bank tops included Lesser Celandine (*Ficaria verna*), Common Nettle (*Urtica dioica*), Dock (*Rumex sp.*), Creeping Buttercup (*Ranunculus repens),* Cow Parsley (*Anthriscus sylvestris*) and Soft Rush (*Juncus effusus).* Submergent macrophytes includes *Fontinalis spp.*.

Macroinvertebrate diversity and density were low and moderate, respectively. The Q rating assigned to GR-1 was **Q3-4 –Moderate**, on the basis that at least one 'very pollution sensitive' Group A taxon was present in low numbers (6 *Brachyptera sp.* were identified); 'pollution sensitive' taxa made up 8% of the sample (7 individuals across two taxa in Groups A and B). 'Pollution tolerant' Group C species made up 92% of the sample, with *Baetis rhodani* being the dominant species. Taxa from Groups D and E were absent. Results of kick sampling are summarised in Table 4-17.

Table 4-17 Results of macroinvertebrates sample at GR-1.

Indicator Group	Taxon	Abundance
Group A – Very Pollution Sensitive	*Brachyptera sp.*	6

Group B – Moderately Pollution Sensitive	*Leuctra sp.*	1
Group C – Pollution Tolerant	*Baetis rhodani*	60
	Chironomidae sp.	8
	Gammarus sp.	5
	Simuliidae sp.	10
Group D – Very Pollution Tolerant	-	-
Group E – Most Pollution Tolerant	-	-

While this section of river displayed relatively clean, mobile gravel and cobble amongst transitional riffle-glides areas with accelerated flow, GR-1 was considered a moderate quality spawning ground and nursery due to the presence of an upstream barrier in the form of a raised concrete bridge apron, which separated potential salmonid and lamprey spawning grounds in areas of riffle-glide up and downstream of the bridge structure The presence of finer, organic sediments adjacent to undercut banks away from areas of faster flow were identified as moderate lamprey *sp.* ammocoete habitat. A Brook Lamprey (*Lamprey planeri*) identified in the kick sample at GR-1 is shown in

Plate 4-11.

Plate 4-11 Image of the Brook Lamprey identified in the kick-sample at Sampling Point GR-1

4.1.2.2 GR Survey Site 2 (GR-2)

Survey site GR-2 was located along an **Eroding/Upland (FW1)** section of Blackbottom stream, a tributary of Tullaroan Stream located within the Nore catchment (IG Ref.: S 37817 57980). Properties of the stream at sample point GR-2 are shown in Table 4-18 and a representative photograph of the survey location is shown in Plate 4-12.

Table 4-18 Properties of the stream at sample point GR-2

Properties	Record			
Average Depth (m)	0.4			
Average Bank Width (m)	1.5			
Wet Width (m)	1.5			
Bank height (m)	LHB	1	RHB	1.5
Flow	Moderate flow with fast velocity			
Colour	No distinct colouration			
Clarity	Very clear when undisturbed			
Dominant Substrates	Bedrock: 10% Boulder (> 128mm): 30%			

	Cobble (>32–128mm): 20% Gravel (8-32mm): 20% Fine gravel (2-8mm): 10% Sand (0.25–2mm): 5% Silt (<0.25mm): 5%
Substratum Condition	Semi-compacted

Plate 4-12 Representative picture of Sampling Point – GR-2

This section of watercourse was characterised by high, heavily eroded and undercut earth banks, with large boulders along the watercourse. Artificially reprofiled bank faces downstream of the kick-sample laterally confined the watercourse. Water was very clear when undisturbed, with no colouration. A moderate degree of siltation was observed in the watercourse during the kick-sampling process.

The kick sample was taken in areas of riffle amid a pool-riffle-glide complex. A small secondary channel which joined this section of stream was located upstream of the kick-sample location, as well as a major bridge structure with in-channel abutment support and a raised concrete apron; the presence of which created an artificial step-pool. The watercourse was culverted through one of two bridge arches, with water seemingly abstracted from the second arch via a black pipe. A secondary black pipe ran instream along the surveyed stretch of watercourse (see Plate 4-13). Stream discharge was moderate, with fast water velocity.

Plate 4-13 Representative picture of upstream of Sampling Point – GR-2, including the bridge structure, concrete apron and abstraction pipes

WS1 scrub made up of >50% Bramble, Gorse (*Ulex europaeus*) and stunted Hawthorn trees (*Crataegus monogyna*), interspersed with Willow trees (*Salix spp.*) was the predominant left-hand bank land use. Riparian vegetation on the right-hand bank included Lesser Celandine (*Ficaria verna*), Primrose (*Primula vulgaris*) Cleaver (Galium aparine), Common Nettle (*Urtica dioica*) and Dock (*Rumex sp.*). Emergent macrophytes included rushes (*Juncus sp.)* and *Fontinalis spp.,* which were present on emergent boulders. Land use extending from the right-hand bank featured heavily modified **agricultural grassland (GA1)** composed primarily of Perennial Rye-Grass *(Lolium perenne)* and Meadow-grasses (*Poa spp.).*

Macroinvertebrate diversity and density were high. The Q rating assigned to GR-2 was **Q4 –Good**, on the basis that at least one 'very pollution sensitive' Group A taxon was present in reasonable numbers (16 *Rhithrogena sp.* were identified). 'Pollution sensitive' taxa made up 29% of the sample (29 individuals across five taxa in Groups A and B) and 'pollution tolerant' Group C species made up 71% of the sample, with *Baetis rhodani* being the dominant species. Two individual specimens from two separate group D taxon were present, while the 'most pollution tolerant' taxa from Group E were absent. Results of kick sampling are summarised in Table 4-19.

Table 4-19 Results of macroinvertebrates sample at GR-2

Indicator Group	Taxon	Abundance
Group A – Very Pollution Sensitive	*Brachyptera sp.*	3
	Heptagenia sp.	4
	Rhithrogena sp.	16
Group B – Moderately Pollution Sensitive	*Leuctra sp.*	3
	Glossomatidae sp.	3
Group C – Pollution Tolerant	*Baetis rhodani*	30
	Chironomidae sp.	8
	Gammarus sp.	5

	Hydropsyche sp.	5
	Rhyacophila sp.	1
	Simuliidae sp.	20
Group D – Very Pollution Tolerant	*Glossiphonidae sp.*	1
	Naididae sp.	1
Group E – Most Pollution Tolerant	-	-

The pool-riffle-glide sequence in this section of river provided a varied river depth profile, with an area of pool downstream of the raised bridge apron providing moderate holding habitat for salmonid species. Tree canopy and scrub, as well as the raised nature of the banks, provided moderate shading to the channel margins. Despite the presence of accelerated flow, cobble and gravel substrata present were both semi-compacted with some silt deposition, most likely as a result of excessive bank erosion and reprofiling. Therefore, spawning habitat for both salmonids and lamprey were moderate. Areas of finer sediment alongside marginal refugia provided moderate habitat for *Lamprey sp.* ammocoetes. A dead salmonid parr was identified in the river (see Plate 4-14).

Plate 4-14 Image of dead salmonid parr found at Sampling Point – GR-2

4.1.2.3 GR Survey Site (GR-3)

Survey site GR-3 was located along Blackbottom stream, an **Eroding/Upland (FW1)** tributary of Tullaroan Stream, located within the Nore catchment (IG Ref.: S 38048 58836). This section of watercourse was in low flow, with fast velocity in areas of riffle, interspersed between areas of glide and pool. Kick-sampling was carried out in areas of riffle. Properties of the stream at sample point GR-3 are shown in Table 4-20 and a representative photograph of the survey location is shown in Plate 4-15.

Table 4-20 Properties of the stream at sample point GR-3

Properties	Record			
Average Depth (m)	0.2			
Average Bank Width (m)	2			
Wet Width (m)	2			
Bank Height (m)	LHB	0.4	RHB	0.4
Flow	Low with fast velocity			
Colour	Slight yellow			
Clarity	Clear			
Dominant Substrates	Boulder (> 128mm): 10% Cobble (>32–128mm): 50% Gravel (8-32mm): 20% Fine gravel (2-8mm): 15% Sand (0.25–2mm): ~2.5% Silt (<0.25mm): ~2.5%			
Substratum Condition	Compacted			

Plate 4-15 Representative picture of Sampling Point GR-3

Water was clear when undisturbed with yellow colouration, which may be attributed to a slight degree of siltation observed in the watercourse during the kick-sampling process. However, plumes of sand and silt cleared quickly. Substrate, of which cobble was the dominant types, was compacted. While bank heights immediately adjacent to the watercourse were low, steep sided **earthen embankments (BL2)** were present 5m within the riparian buffer zone. Land use for immediately adjacent to both the right- and left-hand banks featured a **treeline** of Hawthorn (*Crataegus monogyna*) and Beech (*Fagus sylvatica*) **(WL2)** and Bramble **scrub** (*Rubus fruticosus agg.)* **(WS1),** which provided moderate shading to the channel margins. Semi-natural, neutral agricultural grassland with *Festuca spp.* and *Poa spp.* grasses extended beyond the immediate riparian buffer zone ***(GS1).*** Moderate littering was present in and around the stream channel.

Riparian vegetation included Bracken (*Pteridium aquilinum*), Lesser Celandine (*Ficaria verna*), Ivy (*Hedera Hibernica*), Cow Parsley (*Anthriscus sylvestris*), Common Nettle (*Urtica dioica*), Dock (*Rumex sp.*) and Creeping Buttercup (*Ranunculus repens*). *Fontinalis and Cladophora spp.* were present on the concrete bridge apron.

Macroinvertebrate diversity and density were moderate and high, respectively. The Q rating assigned to GR-3 was a high **Q4 –Good**, on the basis that at least one 'very pollution sensitive' Group A taxon was present in reasonable numbers (15 *Rhithrogena sp.* were identified). 'Pollution sensitive' taxa made up 29% of the sample (28 individuals across 5 taxa in Groups A and B) and 'pollution tolerant' Group C species made up 70% of the sample, with *Baetis rhodani* and *Gammarus* being the dominant species. A single individual from one group D taxon was present, while species from the 'most pollution tolerant' Group E taxa were absent. Results of kick sampling are summarised in Table 4-21.

Table 4-21 Results of macroinvertebrates sample at GR-3.

Indicator Group	Taxon	Abundance
Group A – Very Pollution Sensitive	*Brachyptera sp.*	5
	Chloroperlidae sp.	5
	Ecdyonurus sp.	1
	Rhithrogena sp.	15

Group B – Moderately Pollution Sensitive	*Leuctra sp.*	2
Group C – Pollution Tolerant	*Baetis rhodani*	30
	Gammarus sp.	30
	Pediciidae sp.	1
	Simuliidae sp.	6
Group D – Very Pollution Tolerant	*Glossiphonidae sp.*	1
Group E – Most Pollution Tolerant	-	-

Deep backwater pools along the left-hand bank, which had formed downstream of a fallen tree and detritus dam, were considered to provide locally good salmonid holding habitat. However, the detritus dam, along with of an intermediate bridge structure (>10m of the bank length, with no in-channel supports and a concrete apron) may act as barriers to upstream fish migration, as well as to downstream transportation of sediment. Canopy layers and marginal vegetation provided suitable shading and a source of instream food and refugia for fish species, while areas of interspersed riffle and glide provided accelerated flow. However, shallower depths and the compacted nature of cobble and gravel substrata meant salmonid spawning and nursery habitat was moderate. A lower proportion of finer substrata in combination with fast flow provided poor habitat for *Lamprey sp.* ammocoetes.

4.1.2.4 GR Survey Site 4 (GR-4)

Survey site GR-4 was located on a section of the Arigna River, a tributary of the River Nore (IG Ref.: S 38961 60218). This historically **Eroding/Upland (FW1)** stream has been both culverted and straightened, resulting in a low, slow flow pattern. The kick-sample was performed downstream of the road culvert in an area of glide. Water was slightly turbid with a heavy degree of siltation, particularly when disturbed. Yellow colouration may be attributed silt-laden water. Substrate, of which fine gravel was the dominant type, was loose. Properties of the stream at sample point GR-4 are shown in Table 4-22 and a representative photograph of the survey location is shown in Plate 4-16.

Table 4-22 Properties of the stream at sample point GR-4

Properties	Record			
Average Depth (m)	0.1			
Average Bank Width (m)	0.6			
Wet Width (m)	0.5			
Bank Height (m)	LHB	1.5	RHB	0.3
Flow	Slow			
Colour	Slightly yellow			
Clarity	Slightly turbid			
Dominant Substrates	Cobble (>32–128mm): 5% Fine gravel (2-8mm): 70% Sand (0.25–2mm): 10% Silt (<0.25mm): 10%			
Substratum Condition	Loose			

Plate 4-16 Representative picture of Sampling point – GR-4

The right-hand bank was low and sloping, with some poaching (i.e. bare soil) evident at the entry point. Riparian vegetation coverage included Bracken (*Pteridium aquilinum*), Lesser Celandine (*Ficaria verna*), Cow Parsley (*Anthriscus sylvestris*), Common Nettle (*Urtica dioica*), Dock (*Rumex sp.*), Creeping Buttercup (*Ranunculus repens)* and Hart's-tongue Fern (*Asplenium scolopendrium*). The right-hand bank ran directly adjacent to a **tarmac road (BL3),** from which two black water pipes passed through the section of stream. The left-hand bank-top, composed of an **earthen embankment (BL2)** was lined with a Hawthorn **hedgerow** (*Crataegus monogyna*) **(WL1)** with Ivy (*Hedera Hibernica*) throughout. Land use immediately behind the hedgerow on the left-hand bank was **improved agricultural grassland (GA1)** predominated by Perennial Rye-Grass (*Lolium perenne*), Instream emergent macrophytes included Fool's watercress (*Apium nodiflorum*). Sycamore trees (*Acer pseudoplatanus*) sparsely lined the opposite roadside, and shade provided by riparian vegetation was negligible.

Macroinvertebrate diversity and density were low and moderate, respectively. The Q rating assigned to GR-4 was **Q3 –Poor**, on the basis that Group A taxa were absent from the sample. One 'moderately pollution sensitive' taxon (*Sericostomatidae sp.*) was present in low numbers, while the remaining 97% of the sample was composed of Group C 'pollution tolerant' or Group D 'very pollution tolerant' taxa (88 individuals across five taxa). Group E taxa were absent. Results of kick sampling are summarised in Table 4-23.

Table 4-23 Results of macroinvertebrates sample at GR-4

Indicator Group	Taxon	Abundance
Group A – Very Pollution Sensitive	-	-
Group B – Moderately Pollution Sensitive	*Sericostomatidae*	3
Group C – Pollution Tolerant	*Baetis rhodani*	40
	Gammarus sp.	40
	Polycentropodidae sp.	2
	Simuliidae sp.	5

Group D – Very Pollution Tolerant	*Ephydra sp.*	1
Group E – Most Pollution Tolerant	-	

Salmonid and lamprey spawning and salmonid nursery and holding habitat were deemed poor at sample site GR-4, due to shallow stream depth, narrow channel width, lack of flow variability and poor-quality substrata (lack of cobble and larger gravel substrata, the majority of which was loose but laden with sand and silt). Despite the presence of finer sediments and organic materials, lamprey *sp.* nursery habitat was also deemed poor due to shallow stream depth and exposed nature of the channel. Shading for fish species was negligible due to lack of canopy cover. Lack of depth or lateral pools, as well as a lack of marginal refugia created by structures such as in-channel roots or boulders saw a lack of suitable eel habitat.

4.1.2.5 GR Survey Site 5 (GR-5)

Survey site GR-5 was located on a section of Ballylarkin Upper stream, a **Depositing/Lowland (FW2)** tributary of the Arigna River within the Nore catchment (IG Ref.: S 39955 61498). Properties of the stream at sample point GR-5 are shown in Table 4-24 and a representative photograph of the survey location is shown in Plate 4-17.

Table 4-24 Properties of the stream at sample point GR-5

Properties	Record			
Average Depth (m)	0.3			
Average Bank Width (m)	4			
Wet Width (m)	3.6			
Bank Height (m)	LHB	1.6	RHB	1.3
Flow	Moderate flow with moderate velocity			
Colour	Slightly yellow			
Clarity	Clear			
Dominant Substrates	Boulder (> 128mm): 5% Cobble (>32–128mm): 40% Gravel (8-32mm): 35% Fine gravel (2-8mm): 10% Sand (0.25–2mm): 5% Silt (<0.25mm): 5%			
Substratum Condition	Semi-compacted			

Plate 4-17 Representative picture of Sampling point – GR-5

This section of the watercourse was in moderate flow, with moderate velocity. Kick-samples were performed across sections of riffle and glide. Water was clear when undisturbed with a slight yellow colouration, which may be attributed to a slight degree of siltation observed in the watercourse during the kick-sampling process. However, plumes of sand and silt cleared quickly. Substrate, of which cobble and larger gravel were the dominant types, was semi-compacted. The section of watercourse was relatively straight, and the channel was laterally confined by raised earthen banks.

Riparian vegetation on the right-hand riverbank included Bracken (Pteridium aquilinum), Lesser Celandine (*Ficaria verna*), Ivy (*Hedera Hibernica*), Cow Parsley (*Anthriscus sylvestris*), Common Nettle (*Urtica dioica*), Dock (*Rumex sp.*), Creeping Buttercup (*Ranunculus repens*) and Hart's-tongue Fern (*Asplenium scolopendrium*). Land use extending beyond the right-hand riparian buffer was **improved agricultural grassland (GA1)**, predominated by Perennial Rye-Grass (*Lolium perenne*). The left-hand bank was composed of a Hawthorn treeline (*Crataegus monogyna*) with Ivy and Bramble **scrub** (*Rubus fruticosus agg.)* **(WS1),** which along with high banks, provided moderate shading to the channel margins. Instream submergent and emergent macrophytes were absent.

Diversity of macroinvertebrates was moderate, while the density of macro-invertebrates was moderate-high. The Q rating assigned to GR-5 was **Q3-4 –Moderate**, on the basis that while 90% of species recorded (85 individuals across six taxa in Groups C and D) were 'pollution tolerant', with *Baetis rhodani* and *Gammarus* being the dominant species, at least one taxon of 'very pollution sensitive' Group A species were present in low numbers (*Ecdyonurus sp.* and *Rhithrogena sp.*). A single group D taxon was present in low numbers, while 'most pollution tolerant' taxa from Group E were absent. Results of kick sampling are summarised in Table 4-25.

Table 4-25 Results of macroinvertebrates sample at GR-5

Indicator Group	Taxon	Abundance
Group A – Very Pollution Sensitive	*Ecdyonurus sp.*	3
	Rhithrogena sp.	5
Group B – Moderately Pollution Sensitive	*Limnephilidae sp.*	1

Group C – Pollution Tolerant	*Baetis rhodani*	30
	Chironomidae sp.	5
	Gammarus sp.	30
	Pediciidae sp.	1
	Simuliidae sp.	15
Group D – Very Pollution Tolerant	*Naididae sp.*	4
Group E – Most Pollution Tolerant	-	-

The section of stream kick sampled for GR-5 was generally homogenous in terms of depth and lacked pools for adequate salmonid holding habitat and poor eel habitat. Marginal vegetation provided refugia and shading to areas of cobble substrata which were considered moderate salmonid nursery habitat. While riffle-glide sequences over gravel and cobble provided accelerated flow, the semi-compacted nature of substrata and degree of siltation mean that potential spawning gravel was relatively immobile and laden with finer sediments. Therefore, potential salmonid and lamprey spawning habitats were considered moderate. A lack of defined areas of loose, fine sediment with organic matter limited potential habitat for Lamprey *sp.* ammocoetes.

4.1.2.6 GR Survey Site 6 (GR-6)

Survey site GR-6 located along Freshford Lots stream was identified as an additional watercourse along the proposed grid connection crossing (IG Ref.: S 40420 62677). However, this kick-sample site was a highly inaccessible culvert, with a steep concrete wall featuring storm drains along the left-hand bank (BL3), and a steep right-hand bank with boulder outcrops, overgrown with Bramble thicket (*Rubus fruticosus agg.)*. Properties of the stream at sample point GR-6 are shown in Table 4-26 and a representative photograph of the survey location is shown in Plate 4-18.

Table 4-26 Properties of the stream at inaccessible sample point GR-6 (IG Ref.: S 40420 62677)

Properties	Record			
Average Depth (m)	0.1			
Average Bank Width (m)	0.7			
Wet Width (m)	0.5			
Bank Height (m)	LHB	4	RHB	4
Flow	Low flow with moderate velocity			
Colour	No discernible colour			
Clarity	Clear			
Dominant Substrates	Streambed artificially reinforced with concrete (95%) with boulder outcrops (5%)			
Substratum Condition	Compacted			

Plate 4-18 Representative picture of inaccessible Sampling Point – GR-6 (IG Ref.: S 40420 62677)

Prior to extensive modifications, including channel straightening and concrete streambed reinforcement, this would have been a historically **Eroding/Upland (FW1)** stretch of stream. Flow was low, with moderate velocity. Land use from the left-hand bank was almost exclusively tarmac road (**buildings and artificial surfaces (BL3)**), while land use extending from the right-hand bank included bramble **scrub (WS1)** and mosaic **improved agricultural and amenity grassland (GA1, GA2).** Riparian vegetation present was scarce and limited to Common Nettle (*Urtica dioica*), Dock (*Rumex sp.*) and Ivy (*Hedera Hibernica*) along the concrete wall. The shallow depth, concrete rendered stream bed and general homogeneity of the initially identified sample point GR-6 displayed a lack of spawning, nursery or holding habitat for salmonid and lamprey species.

In the interest of health and safety, a more accessible kick-sample site was identified 125m downstream of the initial sample site. (IG Ref.: S 40495 62773). Properties of the stream at the accessible sample point GR-6 are shown in Table 4-27 and a representative photograph of the survey location is shown in Plate 4-19.

Table 4-27 Properties of the stream at accessible sample point for GR-6 (IG Ref.: IG Ref.: S 40495 62773)

Properties	Record			
Average Depth (m)	0.15			
Average Bank Width (m)	1.2			
Wet Width (m)	1			
Bank Height (m)	LHB	4	RHB	4
Flow	Low flow with moderate velocity			
Colour	No perceptible colouration			
Clarity	Very clear			

Dominant Substrates	Boulder (> 128mm): 10% Cobble (>32–128mm): 30% Gravel (8-32mm): 20% Fine gravel (2-8mm): 30% Silt (<0.25mm): 10%
Substratum Condition	Semi-compacted

Plate 4-19 Representative picture of accessible Sampling Point – GR-6 (IG Ref.: IG Ref.: S 40495 62773)

This section of the watercourse was in low flow, with moderate velocity. Water had high clarity, no colouration and a slight degree of siltation when the streambed was disturbed. Substrate, of which gravels were the dominant kind, was semi-compacted.

This section of stream was entrenched within steep sided, vegetated banks composed of earth and rock outcrops. Land use extending back from both the right and left-hand banks included Bracken (*Rubus fruticosus agg.*) **scrub (WS1)** and mixed **treelines (WL2)** composed of native hazel (*Corylus avellana*) and holly (*Ilex aquifolium*) trees, and non-native Beech (*Fagus sylvatica*) and sycamore (*Acer pseudoplatanus*) trees. Varied canopy layers provided adequate shading to the watercourse. Tree trunks were covered with mosses (*Hypnum* and *Isothecium spp.).* Riparian zone vegetation included Hart's-tongue Fern (*Asplenium scolopendrium*), Lesser Celandine (*Ficaria verna*), Ivy (*Hedera Hibernica*) and Bracken (*Pteridium aquilinum*). *Fontinalis spp.* were the dominant emergent macrophyte.

Diversity of macroinvertebrates was moderate while the density of macro-invertebrates was moderate-high. The Q rating assigned to GR-6 was low **Q4 –Good,** on the basis that 88% of species recorded (115 individuals across six taxa in Groups C and D) were 'pollution tolerant', with *Simuliidae sp.* making up 46% of the total sample. *Baetis rhodani* and *Gammarus sp.* were also common. While 'pollution sensitive' species were recorded, they made up only 12% of the sample (16 individuals across four taxa in Groups A and B). Results of kick sampling are summarised in Table 4-28.

Table 4-28 Results of macroinvertebrates sample at GR-6 (IG Ref.: IG Ref.: S 40495 62773)

Indicator Group	Taxon	Abundance
Group A – Very Pollution Sensitive	*Brachyptera sp.*	6
	Chloroperlidae sp.	1
	Heptagenia sp.	7
Group B – Moderately Pollution Sensitive	*Leuctra sp.*	2
Group C – Pollution Tolerant	*Baetis rhodani*	30
	Gammarus sp.	20
	Pediciidae sp.	1
	Polycentropodidae sp.	3
	Simuliidae sp.	60
Group D – Very Pollution Tolerant	*Glossiphonidae sp.*	1
Group E – Most Pollution Tolerant	-	-

While the accessible kick-sampling site downstream of the culvert had a variety of substrate, including gravel of suitable size for spawning, stream depth was shallow, channel width was narrow and potential salmonid and lamprey spawning habitat was therefore poor. Absence of pools in combination with shallow depth saw a lack of any salmonid holding habitat and a lack of suitable eel habitat. The presence of more coarse, larger substrates and areas with water velocity difference (i.e. areas of accelerating flow in mid-channel riffles alongside marginal areas with slower water velocity) provided moderate salmonid nursery habitat. A lack of silty, covered areas provided poor habitat for *Lamprey sp.* ammocoetes.

4.1.2.7 GR Survey Site 7 (GR-7)

Survey site GR-7 was located on a section of Freshford Lots stream, an **Eroding/Upland (FW1)** tributary of the Nuenna River within the wider Nore catchment (IG Ref.: S 40418 63087). Properties of the stream at sample point GR-7 are shown in Table 4-29 and a representative photograph of the survey location is shown in Plate 4-20.

Table 4-29 Properties of the stream at sample point GR-7

Properties	Record			
Average Depth (m)	0.15			
Average Bank Width (m)	0.7			
Wet Width (m)	0.6			
Bank Height (m)	LHB	1.2	RHB	1.7
Flow	Moderate flow with moderate velocity			
Colour	Slightly yellow			
Clarity	Clear			
Dominant Substrates	Boulder (> 128mm): 5% Cobble (>32–128mm): 30% Gravel (8-32mm): 25% Fine gravel (2-8mm): 30% Silt (<0.25mm): 10%			
Substratum Condition	Semi-compacted			

Plate 4-20 Representative picture of Sampling Point GR-7

This section of the watercourse was in moderate flow, with moderate velocity. Water was clear when undisturbed with a slight yellow colouration, which may be attributed to a moderate degree of siltation observed in the watercourse during the kick-sampling process. Substrate, of which gravel was the dominant kind, was semi-compacted. Entry to the stream and sample area was limited to a section of riffle ~20m from the road, due to fallen trees and steep, unstable earthen banks into an over-deepened, laterally confined watercourse further downstream.

Improved agricultural grassland (GA1), predominated by Perennial Rye-Grass (*Lolium perenne)* extended beyond the left-hand bank, while land use extending from the right-hand bank was primarily built land with **artificial surfaces** in the form of tarmac road **(BL3).**

Riparian vegetation on the riverbanks and tops included Bracken (*Pteridium aquilinum*), Lesser Celandine (*Ficaria verna),* Ivy *(Hedera Hibernica),* Bramble *(Rubus fruticosus agg.),* Cow Parsley *(Anthriscus sylvestris),* Common Nettle (*Urtica dioica*) and Dock (*Rumex sp.).* A Hawthorn hedgerow (*Crataegus monogyna*) along with Bramble scrub provided adequate shading to the watercourse along the right-hand channel margin. Submergent macrophytes were absent from the channel.

The diversity of macroinvertebrates was moderate while the density of macro-invertebrates was high. The Q rating assigned to Gr-7 was **Q3-4 –Moderate,** on the basis that 96% of the species recorded in the sample were 'pollution tolerant' or 'very pollution tolerant' (138 individuals across seven taxa) with fewer 'pollution sensitive' species recorded (six individuals across three taxa in Groups A and B). The results of the kick sampling are summarised in Table 4-30.

Table 4-30 Results of macroinvertebrates sample at GR-7

Indicator Group	Taxon	Abundance
Group A – Very Pollution Sensitive	*Perla sp.*	2
	Heptagenia sp.	3
Group B – Moderately Pollution Sensitive	*Glossomatidae sp.*	1
Group C – Pollution Tolerant	*Baetis rhodani*	30

	Chironomidae spp.	30
	Ephemerellidae sp.	5
	Gammarus sp.	30
	Polycentropodidae sp.	2
	Simuliidae sp.	40
Group D – Very Pollution Tolerant	*Erpobdella sp.*	1
Group E – Most Pollution Tolerant	-	-

While bankside vegetation provided suitable coverage and refugia to fish species, the shallow depth and narrow margins of this stream made it a poor salmonid and lamprey spawning habitat. Downstream barriers in the form of fallen trees may also prove to be barriers to upstream migration of spawning fish species, particularly lamprey. A lack of lateral pools or deeper water saw an absence of any salmonid holding habitat or suitable adult eel habitat. The semi-compacted nature of substrata, of which coarser cobble and gravel were the dominant type. A lack of depth variation and marginal silt beds provided poor habitat for lamprey *sp.* ammocoetes and smaller eels.

4.1.2.8 GR Survey Site 8 (GR-8)

Survey site GR-8 was located on a channelised, **Depositing/Lowland (FW2)** section of Monabrika stream, a tributary of the Nuenna River within the wider Nore catchment (IG Ref.: S 40636 64467). Properties of the stream at sample point GR-8 are shown in Table 4-31 and a representative photograph of the survey location is shown in Plate 4-21.

Table 4-31 Properties of the stream at sample point GR-8

Properties	Record			
Average Depth (m)	0.25			
Average Bank Width (m)	2			
Wet Width (m)	2			
Bank height (m)	LHB	0.4	RHB	0.6
Flow	Low flow with slow velocity			
Colour	No perceptible colouration			
Clarity	Clear			
Dominant Substrates	Cobble (>32–128mm): 20% Gravel (8-32mm): 40% Fine gravel (2-8mm): 30% Sand (0.25–2mm): 5% Silt (<0.25mm): 5%			
Substratum Condition	Loose			

Plate 4-21 Representative picture of Sampling point GR-8

This section of the watercourse was in low flow, with slow velocity. Water had no colouration and streambed channel substrate was loosely compacted, with a moderate degree of siltation evident when disturbed.

The land-use immediately extending from both right and left stream banks was laid-**stone walls and other stonework (BL1)** on which Wall Screw-moss (*Tortula muralis*) and Ivy (*Hedera Hibernica*) were growing. Beyond the lateral channel confinement of the stone walls, left-hand land use was heavily urbanised, with **residential buildings and tarmac road (BL3)**, while right-hand land use was **improved amenity grassland (GA2)**. There was evidence of poaching downstream of the kick-sampling location, at the entry point to the stream on the left hand-bank.

Mid-point and marginal gravel bars formed from natural depositional processes were vegetated with Perennial Rye-Grass (*Lolium perenne*), Bracken (*Pteridium aquilinum)*, Lesser Celandine (*Ficaria verna*), Short-fruited Willowherb (*Epilobium obscurum*), Common Nettle (*Urtica dioica*) and Broad-leaved Dock (*Rumex obtusifolius*). Riparian vegetation, including pruned Alder *(Alnus glutinosa)* and an ornamental Cherry Laurel hedgerow (*Prunus Laurocerasus*) provided negligible shading to channel margins. Submerged macrophytes were sparse and dominated by Water-starwort (*Callitriche sp.).*

The kick-sample was taken across areas of riffle and glide, downstream of a culverted section of stream which passed beneath the road. Several salmonid alevins were identified in the kick-sample and upon their discovery, were immediately returned to the section of stream in which sampling took place.

The diversity and density of macroinvertebrates was high, with much of the sample (87%, comprised of 89 individuals from eight taxa across Groups C and D) being 'pollution tolerant' species. 13% of the sample (comprised of 13 individuals from six taxa) fell within pollution sensitive groups A and B. The Q rating assigned to sample location GR-8 was **Q3–4—Moderate,** on the basis that 'pollution sensitive' Group A and B taxa were present in low numbers, relative to pollution tolerant species in Groups C and D, with *Baetis rhodani* and *Gammarus* being the dominant species in this sample. The results of the kick sampling are summarised in Table 4-32.

Table 4-32 Results of macroinvertebrates sample at GR-8

Indicator Group	Taxon	Abundance
Group A – Very Pollution Sensitive	*Brachyptera sp.*	1
	Chloroperlidae sp.	1
	Perla sp.	2
	Rhithrogena sp.	2
Group B – Moderately Pollution Sensitive	*Limnephilidae sp.*	3
	Sericostomatidae	4
Group C – Pollution Tolerant	*Baetis rhodani*	30
	Gammarus sp.	25
	Hydropsyche sp.	5
	Simuliidae sp.	15
Group D – Very Pollution Tolerant	*Diacranota sp.*	1
	Eiseniella sp.	1
	Erpobdella sp.	1
	Naididae spp.	11
Group E – Most Pollution Tolerant	-	-

Although this stretch of stream lacked any marginal features or an adequate riparian zone to provide a source of refugia and shading to fish species, defined areas of riffle and glide alongside marginal areas of slower flow provided a water velocity difference for the sheltering and feeding habitats of salmonid fry and parr species. The narrow confined and shallow nature of the stream at this point provided poor salmonid spawning habitat. Substrate size/variability, including the presence of gravel bars, provided moderate salmonid nursery habitat, potentially limited by the moderate degree of siltation in the watercourse. Salmonid alevins were observed within the kick sample at this site (Plate 4-22). Salmonid holding, as well as general eel habitat suitability were negligible due to lack of any depth variation, pools or marginal sheltering features. While substrata present is loose, a lack of fine, organic sediment deposits meant there was poor habitat for lamprey *sp.* ammocoetes.

Plate 4-22 Salmonid alevins were observed at survey location GR-8.

4.1.2.9 GR Survey Site 9 (GR-9)

Survey site GR-9 was located on the Nuenna River, a tributary of the River Nore (IG Ref.: S 40702 64839). Properties of the river at sample point GR-9 are shown in Table 4-33 and a representative photograph of the survey location is shown in Plate 4-23.

Table 4-33 Properties of the stream at sample point GR-9

Properties	Record			
Average Depth (m)	0.5			
Average Bank Width (m)	8m			
Wet Width (m)	8m			
Bank Height (m)	LHB	0.5	RHB	1
Flow	Moderate flow with high velocity			
Colour	No perceptible colouration			
Clarity	Clear			
Dominant Substrates	Boulder (> 128mm): 15% Cobble (>32–128mm): 40% Gravel (8-32mm): 30% Fine gravel (2-8mm): 10% Sand (0.25–2mm): 5%			
Substratum Condition	Loose			

Plate 4-23 Representative picture of Sampling point GR-9

This **Depositing/Lowland section of river (FW2)** was in moderate flow, with high velocity. Water was clear with no colouration but had a slight degree of siltation upon disturbance of loosely packed riverbed substrate, of which cobble was the dominant substrate form. The section of channel at which the kick-sample was taken was straight, with a low, sloping left-hand bank and an earthen embanked right-hand bank.

Land use extending from the left and right-hand banks was **improved agricultural grassland (GA1)**, predominated by Perennial Rye-Grass (*Lolium perenne)*, and **improved amenity grassland (GA2)** with residential buildings **(buildings and artificial surfaces (BL3))**, respectively. Riparian vegetation on the

riverbank top and face included Lesser Celandine (*Ficaria verna*), Bracken (*Pteridium aquilinum*), Bramble (*Rubus fruticosus agg.*), Ivy (*Hedera Hibernica*), Winter Heliotrope (*Petasites pyrenaicus*), Common Nettle (*Urtica dioica*) and Broad-leaved Dock (*Rumex obtusifolius*). Submerged and emergent macrophytes coverage was low and predominately composed of Floating Sweet-grass (*Glyceria fluitans*). Moderate channel shading was provided by Sycamore trees (*Acer pseudoplatanus)* along the right-hand riverbank. Horse chestnut (*Aesculus hippocastanum*) saplings were also identified along the riverbank margin.

Kick-sampling was carried out in areas of riffle and glide ~10m downstream of a major bridge structure >10–25m of the riverbank length, with one in-channel abutment and a concrete apron. The presence of a pool-riffle-glide complex at sample site GR-9 provided a variation in depth across the channel. While shading provided by interspersed riparian vegetation was low, deep pools running adjacent to the right-hand bank provided good salmonid holding habitat. Pools located below sycamore trees with in-channel root structures provided suitably shaded holding habitat for adult eels.

Macroinvertebrate diversity and density were moderate and high, respectively. The Q rating assigned to sample location GR-9 was a high **Q4—Good**, on the basis that at least one taxon of 'very pollution sensitive' species were represented in reasonable numbers. Group A made up 14% of the sample (20 individuals across four taxa), with Group C making up 84% of the sample (122 individuals across four taxa, of which *Baetis rhodani* were the most dominant species). A single taxon from Group B and Group were recorded once, with taxa from the 'most pollution tolerant' group E absent. The results of the kick-sample are summarised in Table 4-34.

Table 4-34 Results of macroinvertebrates sample at GR-9

Indicator Group	Taxon	Abundance
Group A – Very Pollution Sensitive	*Brachyptera sp.*	1
	Ecdyonurus sp.	1
	Perla sp.	8
	Rhithrogena sp.	10
Group B – Moderately Pollution Sensitive	*Leuctra sp.*	2
Group C – Pollution Tolerant	*Baetis rhodani*	50
	Gammarus sp.	20
	Ephemerellidae sp.	50
	Hydropsyche sp.	2
Group D – Very Pollution Tolerant	*Naididae sp.*	1
Group E – Most Pollution Tolerant	-	-

Accelerated, turbulent flow over areas of mobile, relatively clean cobble and gravel substrates provided good salmonid and lamprey spawning habitat, while areas with suitable substrate and an increased water velocity difference (i.e. riffle/glide habitat running adjacent to areas of slower flow) provided good nursery habitat for sheltering and feeding juvenile salmonids. Areas of slower flow with organic matter-rich marginal silt and sand deposits suitable for Lamprey *sp.* ammocoete habitat were absent from the stretch of watercourse.

4.1.2.10 GR Survey Site 10 (GR-10)

Survey site GR-10 was identified following initial field visits as an additional watercourse along the proposed grid connection crossing (IG Ref.: S 40689 65355). Properties of the stream at sample point GR-10 are shown in Table 4-35 and a representative photograph of the survey location is shown in Plate 4-24.

Table 4-35 Properties of the stream at sample point GR-10

Properties	Record
Average Depth (m)	0.1

Average Bank Width (m)	2m			
Wet Width (m)	2m			
Bank Height (m)	LHB	1.7	RHB	1.8
Flow	Low flow with moderate velocity			
Colour	No perceptible colouration			
Clarity	Slightly turbid			
Dominant Substrates	Concrete in stream bed Cobble (>32–128mm): 20% Gravel (8-32mm): 30% Fine gravel (2-8mm): 30% Sand (0.25–2mm): 5% Silt (<0.25mm): 15%			
Substratum Condition	Compacted			

Plate 4-24 Representative picture of Sampling point GR-10

This section of highly modified **Eroding/Upland River (FW1)** was in low flow, with moderate velocity. Water was moderately turbid with no colouration but a heavy degree of siltation overlaying otherwise compacted channel substrate. The channel itself has been straightened, with high earthen embankments on both banks and sections of streambed reinforced with concrete.

Land use extending from the left-hand bank beyond the immediate riparian buffer of **scrub (WS1)** primarily a mixed deciduous **treeline (WL2)** of Common Beech (*Fagus sylvatica*) and Hawthorn (*Crataegus monogyna*), with scattered coniferous trees **(scattered trees and parkland (WD5))** and **amenity grassland (GA2)** in the form of a residential lawn. Land use extending from the right-hand bank was a derelict industrial site **(buildings and artificial surfaces (BL3))** with artificial surfaces. Tipped debris in the form of plastic waste was littered in the stream channel and banks.

Riparian vegetation on the riverbank top and face included lords-and-ladies (*Arum maculatum*), Lesser Celandine (*Ficaria verna*), Common Toadflax (*Linaria vulgaris*), Bracken (*Pteridium aquilinum*), Bramble (*Rubus fruticosus agg.*), Ivy (*Hedera Hibernica*) and Hart's-tongue Fern (*Asplenium scolopendrium*). Cypress pine trees (*Callitris sp.,)* present provided excessive shading to the watercourse. Submerged and emergent macrophytes were absent.

Kick-sampling was carried out in areas of riffle and glide ~50m downstream of a minor bridge structure <10m of the stream bank length, with no in-channel supports. Macroinvertebrate diversity and density were low and moderate, respectively. The Q rating assigned to sample location GR-10 was **Q3–Poor**, on the basis that Group C were the dominant indicator group in this sample (88%, comprising of 45 individuals from four separate 'Pollution Tolerant' taxa) and Group A– 'very pollution sensitive' and Group B– 'moderately pollution sensitive' taxa were absent and recorded only once, respectively. The results of the kick-sample are summarised in Table 4-36.

Table 4-36 Results of macroinvertebrates sample at GR-10

Indicator Group	Taxon	Abundance
Group A – Very Pollution Sensitive	-	-
Group B – Moderately Pollution Sensitive	*Baetidae sp. (excluding Baetis rhodani)*	1
Group C – Pollution Tolerant	*Baetis rhodani*	20
	Gammarus sp.	15
	Hydropsyche sp.	
	Simuliidae spp.	10
Group D – Very Pollution Tolerant	*Naididae spp.*	5
Group E – Most Pollution Tolerant	-	-

Excessive shading as a result of coniferous plantation tunnelling decreased the salmonid carrying capacity of this stretch of highly modified stream, with the presence of rendered concrete in the streambed substrate reduced available spawning substrate for both salmonid and lamprey species. Cobble and gravel present was compacted and overlain with silt deposits, making for clogged and immobile spawning substrate. Therefore, the straightened, narrow and shallow profile of this stream made for poor fish species spawning and nursery habitat. Lack of depth variability and pools made for a lack of salmonid holding and adult eel habitat. A lack of marginal features over silt beds, such as overhanging riparian vegetation or naturally undercut banks, made for poor lamprey *sp.* ammocoete habitat.

4.1.2.11 GR Survey Site 11 (GR-11)

Survey site GR-11 was located on the Lismaine, a tributary of the River Nore (IG Ref.: S 42185 67535). Properties of the stream at sample point GR-11 are shown in Table 4-37 and a representative photograph of the survey location is shown in Plate 4-25.

Table 4-37 Properties of the stream at sample point GR-11

Properties	Record			
Average Depth (m)	0.15			
Average Bank Width (m)	2			
Wet Width (m)	2			
Bank Height (m)	LHB	1.8	RHB	2
Flow	Low flow with moderate velocity			
Colour	Slightly yellow			
Clarity	Slighty turbid			
Dominant Substrates	Boulder (> 128mm): 5% Cobble (>32–128mm): 20% Gravel (8-32mm): 35% Silt (<0.25mm): 40% (silt layer overlaying substrate)			
Substratum Condition	Compacted			

Plate 4-25 Representative picture of Sampling point GR-11

This section of **depositing/ lowland river (FW2)** was in low flow, with moderate velocity. Water was slightly turbid and yellow in colour, which may be attributed to the heavy degree of siltation. The watercourse channel is laterally confined by high, steep earthen banks.

Land use extending beyond the immediate riparian buffer was primarily **improved agricultural grassland (GA1)** used for pasture on the left and right-hand banks, respectively. Perennial Rye-Grass (*Lolium perenne*) was the dominant grass species. Riparian vegetation on the riverbank top and face included Common Nettle (*Urtica dioica),* Lesser Celandine (*Ficaria verna*), thistle (*Cirsium spp.*), Bracken (*Pteridium aquilinum*), Bramble (*Rubus fruticosus agg.*), Broad-leaved Dock (*Rumex obtusifolius*), Ivy (*Hedera Hibernica*), Early Dog-violet (*Viola reichenbachiana*) and thallose liverwort species such as *Conocephalum conicum.* Wych Elm (*Ulmus glabra*) trees present provided a low level of shading to the watercourse. Submerged and emergent macrophytes were absent. The watercourse was littered with organic detritus.

Kick-sampling was carried out in areas of glide ~50m downstream of a minor bridge structure which was <10m of the stream bank length, with no in-channel supports. A minnow was caught during the kick-sampling process and was immediately returned to the stream without harm.

The diversity and density of macroinvertebrates was high. Although individuals identified in the Group D taxa made up 40%of the sample, the Q rating assigned to GR-11 was high **Q3-4–Moderate,** on the basis that 21% of the sample (comprising of 28 individuals within 5 taxa) were 'very pollution sensitive', with two taxa (*Heptagenia sp., Rhithrogena sp.)* present in reasonable numbers. A further 5% of the sample was made up of 'moderately pollution sensitive' species. Taxa in Group C were common, with the exception of *Baetis rhodani and Gammarus sp.* which were numerous. The results of the kick sampling are summarised in Table 4-38

Table 4-38 Results of macroinvertebrates sample at GR-11

Indicator Group	Taxon	Abundance
Group A – Very Pollution Sensitive	*Brachyptera sp.*	1
	Chloroperlidae sp.	1
	Ecydyonurus sp.	1
	Heptagenia sp.	15

	Rhithrogena sp.	10
Group B – Moderately Pollution Sensitive	*Anabolia sp.*	1
	Halesus sp.	1
	Lecutra sp.	5
Group C – Pollution Tolerant	*Baetis Rhodani*	10
	Gammarus sp.	40
	Simuliidae spp.	1
	Tipula sp.	*1*
Group D – Very Pollution Tolerant	*Naididae spp.*	*3*
	Asellus sp.	*40*
	Glossiphonidae sp.	*1*
Group E – Most Pollution Tolerant	-	-

The stream at kick-sample site GR-11 was narrow and shallow, with compacted and silt laden cobble and gravel substrate providing poor lamprey and salmonid spawning habitat. Marginal areas of moderate flow velocity with adequate shading provided by overhanging tree canopy and high banks provided moderate salmonid nursery habitat. Salmonid holding and eel habitat was poor due to shallow water and lack of pools featuring large boulders to provide solitary refugia. Marginal silt deposits provided moderate nursery silts for lamprey *sp.* ammocoetes.

4.1.2.12 GR Survey Site 12 (GR-12)

Survey site GR-12 was located on Lisdowney stream (IG Ref.: S 43638 68636). Properties of the stream at sample point GR-12 are shown in Table 4-39 and a representative photograph of the survey location is shown in Plate 4-26.

Table 4-39 Properties of the stream at sample point GR-12

Properties	Record
Average Depth (m)	0.5
Average Bank Width (m)	4
Wet Width (m)	4
Bank Height (m)	LHB 1.5 RHB 1.2
Flow	High flow with high velocity
Colour	No perceptible colouration
Clarity	Very clear
Dominant Substrates	Boulder (> 128mm): 15% Cobble (>32–128mm): 40% Gravel (8-32mm): 20% Fine gravel (2-8mm): 20% Sand (0.25–2mm): ~2.5% Silt (<0.25mm): ~2.5%
Substratum Condition	Compacted

Plate 4-26 Representative picture of Sampling Point GR-12

This section of the watercourse was classified as **Eroding/Upland River (FW1)** with high flow and velocity. Despite a slight degree of siltation during the kick-sampling process, plumes of silt quickly cleared, and the river was determined to have very high clarity when undisturbed. This stretch of watercourse had no colouration. Both banks have been reinforced, with laid stone reinforcing banks of soil (BL1) and artificial earth embankment (BL2) along the left and right-hand banks, respectively. The channel is therefore confined laterally and may have reduced floodplain connectivity.

Land use on the right-hand bank was composed of **improved agricultural grassland (GA1)**, with a small section of scrub and shrub (WS1), including Bramble (*Rubus fruticosus agg.*) and Bracken (*Pteridium aquilinum*), with a **stone wall** extending from the bridge along the field boundary **(BL1)**. Land use extending from the left-hand bank included **improved amenity grassland (GA2)** in the form of a residential lawn dominated by Perennial Rye-Grass (*Lolium perenne*). Riparian vegetation on the riverbank top and face included Common Nettle (*Urtica dioica),* Lesser Celandine (*Ficaria verna*) and *Festuca spp.,* including Red Fescue (*Festuca rubra agg.*) and Meadow Fescue (*Festuca pratensis).* Alder

Macroinvertebrate density was high, with increased species density, particularly of Group C taxa (60%, of the sample, comprising 87 individuals). The Q rating assigned to sample location GR-12 was **Q4 – Good,** on the basis that at least two taxa were well represented from Group A, with few to numerous individuals present within Group B taxa. ~33% of the sample was composed of 'very' or 'moderately pollution sensitive' species. Individuals in group C were numerous, with no single taxa dominant, while only one group D taxon was present. Group E taxa were absent. The results of the kick sampling are summarised in Table 4-40.

Table 4-40 Results of macroinvertebrates sample at GR-12

Indicator Group	Taxon	Abundance
Group A – Very Pollution Sensitive	*Early instar plecoptera spp.*	3
	Ecdyonurus sp.	10
	Isoperla sp.	5
Group B – Moderately Pollution Sensitive	*Early instar cased caddisfly spp.*	5
	Glossomatidae sp.	20
	Leuctra sp.	4
	Sericostomatidae sp.	1
Group C – Pollution Tolerant	*Baetis rhodani*	20
	Ceratopogonidae spp.	1
	Chironomidae spp.	20
	Gammarus sp.	20

	Hydracarina sp.	1
	Hydropsyche sp.	3
	Orectochilus sp.	2
	Simuliidae spp.	20
Group D – Very Pollution Tolerant	*Naididae spp.*	10
Group E – Most Pollution Tolerant	-	-

Kick-sampling was predominantly carried out in sections of glide, immediately downstream of an intermediate bridge structure >10m of the bank length, with no in-channel supports. While stream depth and substrate were highly variable across the pool-riffle-glide complexes present at kick-sample site GR-12, substrata were compacted and thus provided only moderate salmonid and lamprey spawning and salmonid nursery habitat. Deeper areas of pool featuring larger boulders provided good holding habitat for older salmonids and adult eels. Marginal silt beds provided good nursery habitat for Lamprey *sp.* ammocoetes.

4.1.2.13 GR Survey Site 13 (GR-13)

This sample site was located along a **depositing/lowland (FW2)** section of the mainstem River Nore (IG Ref.: S 44080 71492). Properties of the stream at sample point GR-13 are shown in Table 4-41 and a representative photograph of the survey location is shown in Plate 4-27.

Table 4-41 Properties of the stream at sample point GR-13

Properties	Record			
Average Depth (m)	0.8 - 1			
Average Bank Width (m)	20			
Wet Width (m)	20			
Bank height (m)	LHB	0.6	RHB	1
Flow	Moderate flow and slow velocity			
Colour	Very slight brown colouration			
Clarity	Clear			
Dominant Substrates	Cobble: 60% Gravel and Fine Gravel: 25% Sand and silt: 15%			
Substratum Condition	Loose			

Plate 4-27 Representative picture of Sampling Point – GR-13

Land use along the banks of the River Nore at this survey location composed of **improved agricultural grassland (GA1)** as well as **wet grassland (GS4).** Alder (*Alnus glutinosa*) and willow (*Salix spp.*) trees were present on the left-hand bank growing from the bank top and bank face and trailing into the channel margin on the left-hand bank and providing some shading to the channel margin. Bur reed (*Sparganium spp.*), bullrush () and reed canary grass (Phalaris arundinaceae) dominated fringe communities were present in patches along both bank margins and provided some refuge habitat to juvenile fish species. Instream submerged macrophyte cover was low however there was a high cover of green algae in patches upstream and downstream of survey location GR-13.

General fish habitat assessment was limited by the River Nores width and depth causing visibility issues across the whole channel. Salmonid and lamprey spawning habitat was considered to be poor due to the lack of suitable conditions for spawning i.e. predominant cobble substrate, shallow well oxygenated water with clean small fine gravels. Salmonid nursery habitat was considered moderate due to the presence of some suitable habitat but also poor shading across the width of the channel and the size of the channel and depth of pools providing good habitat for predators. Some juvenile salmonids were observed at the right-hand bank sheltering behind and area of marginal vegetation. Lamprey nursery habitat was considered to be moderate due to the presence of fine sediment deposits along the bank margins and overall slow flow of the watercourse. Holding habitat for salmonids and habitat for European eel was considered to be good due to the presence of deep pools and trees overhanging the bankside providing refuges within the channel margins and shading.

Due to water depth and unsuitable conditions for survey no Q-Value was recorded at the GR-13 survey location. However, a survey was completed downstream of this location upstream of the Ballyragget bridge at IG Ref.: S 44494 70847 (Plate 4-28). While the majority of the species recorded in the sample were pollution tolerant (66%, comprising 39 individuals), individuals that were 'very' and 'moderately pollution sensitive' species were also present. At least one Group A taxon was recorded in reasonable numbers, with seven individuals recorded for *Perla sp.* Group A taxon (~12% of the sample). The Q rating assigned to the sample location was **Q4 – Good,** based on high diversity and increased density of species (few Group B taxa, numerous Group C taxa, few Group D taxa and absent Group E taxa). The results of the kick sampling are summarised in Table 4-42.

Table 4-42 Results of macroinvertebrates sample downstream of WC-13

Indicator Group	Taxon	Abundance
Group A – Very Pollution Sensitive	*Perla sp.*	7
	Ecdyonurus sp.	4
	Rhithrogena sp.	4
Group B – Moderately Pollution Sensitive	*Early instar cased caddisfly sp.*	1
	Limnephilidae sp.	1
Group C – Pollution Tolerant	*Hydropsyche sp.*	4
	Gammarus sp.	1
	Simuliidae sp.	10
	Baetis rhodani	20
	Chironomidae spp.	4
Group D – Very Pollution Tolerant	*Asellus sp.*	1
	Naididae spp.	2
Group E – Most Pollution Tolerant	-	-

Plate 4-28 Survey location downstream of GR-13 and upstream of the Ballyragget bridge at IG Ref.: S 44494 70847.

Additional Survey Recordings in the vicinity of Survey Location WF-1

Otter (*Lutra lutra*) prints were observed on fine sediment/ sandy deposits at the right-hand bank approx. 60m upstream of survey location GR-13.

A kingfisher was seen flying upstream along the River Nore during the survey.

4.2 eDNA Results.

Environmental DNA (eDNA) surveys were undertaken on watercourses at 4 locations within the proposed wind farm. Surveys were taken at the following 4 locations: Irish Grid Refs: S 39438 53752, S 39388 52279, S 39348 53815 and S 38826 54684. Survey locations were chosen to give the best chance of detecting eDNA of target species and to aid in determining approximate area of presence of such species if positive results were garnered.

Freshwater Pearl Mussel (*Margaritifera margaritifera*) (FWPM), White-clawed crayfish (*Austropotamobius pallipes*) (WCC) and Crayfish plague (*Aphanomyces astaci*) (CP) were tested for at each location. There were no positive results for FWPM or WCC at any survey location indicating an absence of these species within the areas surveyed and areas upstream of these survey areas. However, there was a strong positive result for CP at three of the survey locations.

All eDNA results can be found in Appendix III.

5. DISCUSSION

5.1 Proposed Wind Farm Aquatic Baseline Assessment

The watercourses surveyed within the proposed wind farm consist of a number of **Eroding/ upland rivers (FW1)** and **Depositing/ lowland rivers (FW2)**. All watercourses had a predominantly cobble and gravel substrate with a number of surveyed watercourses impacted to different degrees by siltation. Siltation in some watercourses were considered heavy with the likely cause being surrounding agricultural land use and runoff of sediments to watercourses. Watercourses within the proposed wind farm study area typically had historically modified banks and demonstrated historical modifications. Recent watercourse modifications were also present showing alterations to banks, alterations to river bed material and diversion of the Tullaroan stream watercourse at one point. At the time of survey macrophyte growths were minimal within surveyed stretches of watercourses however at the most downstream survey location south of the proposed wind farm luxuriant green algal growths were present. Additionally at the time of survey the Bregagh [Kilkenny] watercourse was dry with no flowing water.

Kick sampling (Q-Value Assessment) conducted at each of the survey locations revealed that water quality throughout the proposed wind farm study area was on average **Q3 Poor** with 4 of the 5 surveyed locations awarded a **Q3 Poor** status. One of the survey locations was awarded a Q-value of **Q3-4 Moderate**. Pollution tolerant aquatic macroinvertebrates dominated all samples taken with very pollution sensitive taxa absent from all but one survey location. Therefore, at present, watercourses within the proposed wind farm study area are not satisfying the objectives of the Water Framework Directive (WFD) which is to achieve at least Q4 Good Status by 2027 at the latest.

Watercourses within the proposed wind farm study area contained a number of fish species with brown trout (*Salmo trutta*) present at all survey locations. Atlantic salmon (*Salmo salar*) was present at 3 of the survey locations and only on the Tullaroan stream watercourse, being absent from any of its tributaries which were surveyed. European eel was recorded at one location on the Foylatalure watercourse, a tributary of the Tullaroan stream watercourse.

Salmonid spawning, nursery and holding habitat suitability varied across the proposed wind farm survey locations. On the surveys carried out on the Tullaroan stream watercourse spawning habitat ranged from Poor-moderate to Moderate – good, nursery habitat ranged from poor-moderate to moderate to good and holding habitat ranged from moderate to good. The area with the best salmonid habitat featured the least bank alterations, the cleanest gravels with the lowest degree of siltation, and the highest Q-value recorded during the surveys. On the surveys undertaken on the tributaries of the Tullaroan stream watercourse spawning and nursery habitat was poor. Holding habitat ranged from poor to moderate. These tributaries were consistently silted and had substrate which was at least moderately compacted. Holding habitat on the Foylatalure was deemed moderate due to the presence of a number of deeper pools.

Lamprey spawning and nursery habitat suitability ranged from poor to poor-moderate at all survey locations except WF-4 on the Tullaroan stream watercourse which had good spawning suitability and moderate nursery suitability. This location had the cleanest gravels of all sites surveyed, suitable sized gravels for spawning, little compaction of substrate and some areas of finer sediment for nursery habitat. No lamprey species (*lampetra spp.*) were recorded during the surveys.

European eel (*Anguilla anguilla*) habitat suitability ranged from poor to moderate with three of the five survey locations having moderate suitability to support European eel. These sites with moderate potential contained deeper pools, overhangs, undercut banks and tree roots and some courser substrate. One European eel was recorded during the surveys and was utilising a pool lying underneath an overhanging bank.

There were no positive results for FWPM (Freshwater pearl mussel) or WCC (White-clawed crayfish) at any survey location indicating an absence of these species within the areas surveyed and areas upstream of these survey areas. However, there was a strong positive result for CP (Crayfish Plague) at three of the survey locations. CP does not survive well in the natural environment for extended periods of time without a suitable host (O.I.D.É., 2009). This likely indicates that there was a recent introduction or there are frequent reintroductions of CP into the watercourses in which surveys were undertaken as without WCC the water mould CP would not persist in the environment for long periods of time.

No otter (*Lutra lutra*) holts were located upstream or downstream within the vicinity of any survey location. Otter spraint and tracks were recorded under the bridge upstream of survey point WF-1. No other otter signs (spraint, prints, anal jelly, couches) were recorded in the vicinity of survey locations. However, it is likely that otter populations are utilising the watercourses in which surveys were undertaken. In addition, the proposed wind farm is located upstream of the Lower River Suir SAC and the proposed grid route passes through the River Barrow and River Nore SAC, both of which are designated for the QI species Otter.

5.2 Proposed Grid Route Aquatic Baseline Assessment

The watercourses surveyed along the proposed grid route consist of a number of **Eroding/ upland rivers (FW1)** and **Depositing/ lowland rivers (FW2)**, characterised by predominantly cobble, gravel and boulder channel substrates (in order of dominance). Similar to the sites surveyed within the Proposed Wind Farm site, watercourses within the Proposed Grid Route displayed varying degrees of siltation, from slight to heavy, most likely as a result of agricultural land use surrounding the surveyed sites.

Historical modifications of the receiving watercourses within the proposed grid route included earthen embankments at survey site GR-3, a high, steep-sided bridge culvert with concrete channel bed reinforcement at survey site GR-6, and channel straightening, concrete streambed reinforcement and earthen embankments at survey site GR-10.

Instream macrophytic growth was sparse – absent, with mats of *Fontinalis sp.* present at survey sites 1, 2, 3 and 6, and *Cladophora sp.* which grew extensively across the concrete bridge apron at survey site GR-3. Riparian zone vegetation was dense and consistent across the survey sites, and commonly included Bracken (*Pteridium aquilinum*), Lesser Celandine (*Ficaria verna*), Ivy (*Hedera Hibernica*), Cow Parsley (*Anthriscus sylvestris*), Common Nettle (*Urtica dioica*), Dock (*Rumex sp.*), Creeping Buttercup (*Ranunculus repens*), Bramble (*Rubus fruticosus agg.)* and Hart's-tongue Fern (*Asplenium scolopendrium*). Tree lines bordered watercourses were varied, consisting of Hazel (*Corylus avellana*) and Holly (*Ilex aquifolium*) trees, Beech (*Fagus sylvatica*), Sycamore (*Acer pseudoplatanus*) and Hawthorn (*Crataegus monogyna*).

Results for Q-Value assessment conducted at each of the Proposed Grid Route Survey Locations saw Q-values range from **Q3- Poor** (GR-4, GR-10) to **Q4 Good** (GR-2, GR-3, GR-6, GR-9, GR-12, GR-13), with some sites assessed as being **Q3-4- Moderate** (GR-1, GR-5, GR-7, GR-8, GR-11). Group A '*Very Pollution Sensitive'* Taxa were present at all survey sites except GR-4 and GR-10. Therefore, at present, while six of the watercourses surveyed were assigned scores of Q4 Good, over half (seven) of the thirteen watercourses surveyed along the proposed grid route are not satisfying the objectives of the Water Framework Directive (WFD) which is to achieve at least Q4 Good Status by 2027 at the latest.

Incidentals of note during kick-sampling include the unintentional catching of a Brook Lamprey (*Lampetra planeri*) at survey site GR-1, salmonid alevins present at GR-8 and the identification of a dead salmonid parr at survey site GR-2.

While watercourses within the site surveyed often displayed gravels of adequate size and mobility for spawning, the salmonid carrying capacity of several watercourses within the Proposed Grid Route was limited by a high degree of siltation, resulting from excessive bank erosion, bank reprofiling and

surrounding agricultural land use (which dominated the landscape surrounding the Proposed Grid Route). Survey sites such as GR-4, 7 and 11 were laterally confined and/or shallow with excessively modified banks and barriers to upstream migration, providing overall poor salmonid spawning, nursery and holding habitats. Survey sites GR-1, GR-9 and GR-12 provided overall moderate – good salmonid spawning, nursery and holding habitat, with clean, mobile cobble and gravel substrate, accelerating flow and depth variation across the channel. Marginal silt beds with adequate cover for Lamprey *sp.* ammocoetes were overall classified as moderate across the Proposed Grid Route Survey sites, while good European eel habitat was identified at survey sites GR-12 and GR-13 in the form of deep pools with marginal sheltering features.

No otter (*Lutra lutra*) holts were located upstream or downstream within the vicinity of any survey location. Otter prints were recorded approx. 60m upstream of survey location GR-13 along the right-hand bank. No other otter signs (spraint, prints, anal jelly, couches) were recorded in the vicinity of survey locations. However, it is likely that otter populations are utilising the watercourses in which surveys were undertaken. In addition, the proposed grid route passes through the River Barrow and River Nore SAC, which is designated for the QI species Otter.

6. CONCLUSIONS

6.1 Proposed Wind Farm Aquatic Baseline Assessment Conclusions

Both **eroding/ upland rivers (FW1)** and **depositing/ lowland rivers (FW2)** were present within and in the vicinity of the proposed wind farm. Watercourses were historically modified and displayed issues with excess siltation. Within the proposed wind farm there were sections of watercourse on the Tullaroan Steam that had been recently altered with bank alterations, riverbed alterations and river course diversion noted. Q-values recorded within and in the vicinity of the proposed wind farm were predominantly **Q3 Poor** with one sample location assigned **Q3-4 Moderate**. At present, watercourses within the proposed wind farm study area are not satisfying the objectives of the Water Framework Directive (WFD) which is to achieve at least Q4 Good Status by 2027. Salmonid, lamprey and European eel habitat was predominantly poor and moderate across the study area for the proposed wind farm with one location displaying good habitat for salmonid spawning, nursery and holding as well as good spawning habitat for lamprey. Atlantic salmon was found within surveys on the Tullaroan stream which flows through the proposed wind farm while brown trout was found at all survey locations, lamprey were not found, and European eel was present in one survey location. There was no positive eDNA results for freshwater pearl mussel or white-clawed crayfish at any survey location. There were however strong positive results for crayfish plague. No otter holts were recorded during surveys however otter spraint and prints were recorded showing use of the area by otter. A kingfisher was observed flying upstream on the Tullaroan Stream watercourse however no kingfisher burrows were noted within the vicinity of any survey point.

6.2 Proposed Grid Route Aquatic Baseline Assessment Conclusions

Both **eroding/ upland rivers (FW1)** and **depositing/ lowland rivers (FW2)** were present along the proposed grid route. Watercourses were historically modified and commonly displayed issues with excess siltation. Q-values recorded within and in the vicinity of the proposed wind farm ranged from **Q3 Poor** to **Q4 Good**. Seven of the watercourses sampled received **Q3-4 Moderate** and **Q3 Poor** and at present, these watercourses along the proposed grid route are not satisfying the objectives of the Water Framework Directive (WFD) which is to achieve at least Q4 Good Status by 2027. Six of the watercourses along the proposed grid route achieved a **Q4 Good** status and are therefore currently meeting the objectives of the Water Framework Directive (WFD) to achieve at least Q4 Good Status by 2027 at the latest. Salmonid, lamprey and European eel habitat ranged from poor to moderate to good along the proposed grid route. A number of locations (e.g. GR-1, GR-9, GR-12) displaying moderate to good habitat for salmonid spawning, nursery and holding as well as moderate to good spawning and nursery habitat for lamprey and locations GR-12 and GR-13 provided good habitat for European eel. A dead salmonid parr was found at sample location GR-2, salmonid alevins were recorded at sample site GR-8 and a brook lamprey was recorded at sample location GR-1. No otter holts were recorded during surveys however otter prints were recorded 60m upstream of sample location GR-13 showing use of the area by otter. A kingfisher was observed flying upstream on the River Nore however no kingfisher burrows were noted within the vicinity of any survey point.

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APPENDIX I

ELECTROFISHING SPECIES RECORDS AT ALL PROPOSED WIND FARM SURVEY LOCATIONS

Appendix I: Electrofishing species records at all proposed wind farm survey locations						
Survey Location	Fish Species					
	Anguilla anguilla	*Salmo trutta*	*Salmo salar*	*Barbatula barbatula*	*Phoxinus phoxinus*	*Gasterosteus aculeatus*
WF-1	No	Yes	Yes	Yes	No	No
WF-2	No	Yes	No	Yes	Yes	No
WF-3	Yes	Yes	No	No	Yes	Yes
WF-4	No	Yes	Yes	No	Yes	Yes
WF-5	No	Yes	Yes	No	No	No
WF-6	N/A	N/A	N/A	N/A	N/A	N/A

APPENDIX II

Q-VALUES AT ALL SURVEY LOCATIONS

Appendix II: Q-Values at all Survey Locations (Proposed Wind Farm and Propose Grid Route)	
Survey Location	Q-Value and WFD Status
Proposed Wind Farm	
WF-1	Q3 Poor Status
WF-2	Q3 Poor Status
WF-3	Q3 Poor Status
WF-4	Q3-4 Moderate Status
WF-5	Q3 Poor Status
WF-6	N/A
Proposed Grid Route	
GR-1	Q3-4 Moderate Status
GR-2	Q4 Good Status
GR-3	Q4 Good Status
GR-4	Q3 Poor Status
GR-5	Q3-4 Moderate Status
GR-6	Q4 Good Status
GR-7	Q3-4 Moderate Status
GR-8	Q3-4 Moderate Status
GR-9	Q4 Good Status
GR-10	Q3 Poor Status
GR-11	Q3-4 Moderate Status
GR-12	Q4 Good Status
GR-13	Q4 Good Status

APPENDIX III

PROPOSED WIND FARM eDNA RESULTS

SureScreen Scientifics

Folio No: E19275
Report No: 1
Client: MKO
Contact: Aran von der Geest Moroney

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: 02/10/2023
Date results reported: 11/10/2023
Matters affecting result: None

TARGET SPECIES: Crayfish plague *(Aphanomyces astaci)*

Lab ID	Site Name	OS Reference	SIC	DC	IC	Result	Positive Replicates
FK1515	Kilsalagh WF site 2	S 39438 53752	Pass	Pass	Pass	Negative	0/12
FK1516	Kilsalagh WF site 4	S 39388 52279	Pass	Pass	Pass	Positive	12/12
FK1517	Kilsalagh WF site 3	S 39348 53815	Pass	Pass	Pass	Positive	12/12
FK1518	Kilsalagh WF site 1	S 38826 54684	Pass	Pass	Pass	Positive	12/12

SureScreen Scientifics

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

Lab ID	Site Name	OS Reference	SIC	DC	IC	Result	Positive Replicates
FK1515	Kilsalagh WF site 2	S 39438 53752	Pass	Pass	Pass	Negative	0/12
FK1516	Kilsalagh WF site 4	S 39388 52279	Pass	Pass	Pass	Negative	0/12
FK1517	Kilsalagh WF site 3	S 39348 53815	Pass	Pass	Pass	Negative	0/12
FK1518	Kilsalagh WF site 1	S 38826 54684	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
FK1515	Kilsalagh WF site 2	S 39438 53752	Pass	Pass	Pass	Negative	0/12
FK1516	Kilsalagh WF site 4	S 39388 52279	Pass	Pass	Pass	Negative	0/12
FK1517	Kilsalagh WF site 3	S 39348 53815	Pass	Pass	Pass	Negative	0/12
FK1518	Kilsalagh WF site 1	S 38826 54684	Pass	Pass	Pass	Negative	0/12

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

Reported by: **Chelsea Warner** Approved by: **Lauryn Jewkes**

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.