FEARNA STORAGE

Fearna Pumped Storage Hydro Scheme
EIA Report

Appendix 11.2 – SAR Aquatic Ecology Surveys

February 2025

Quality Information

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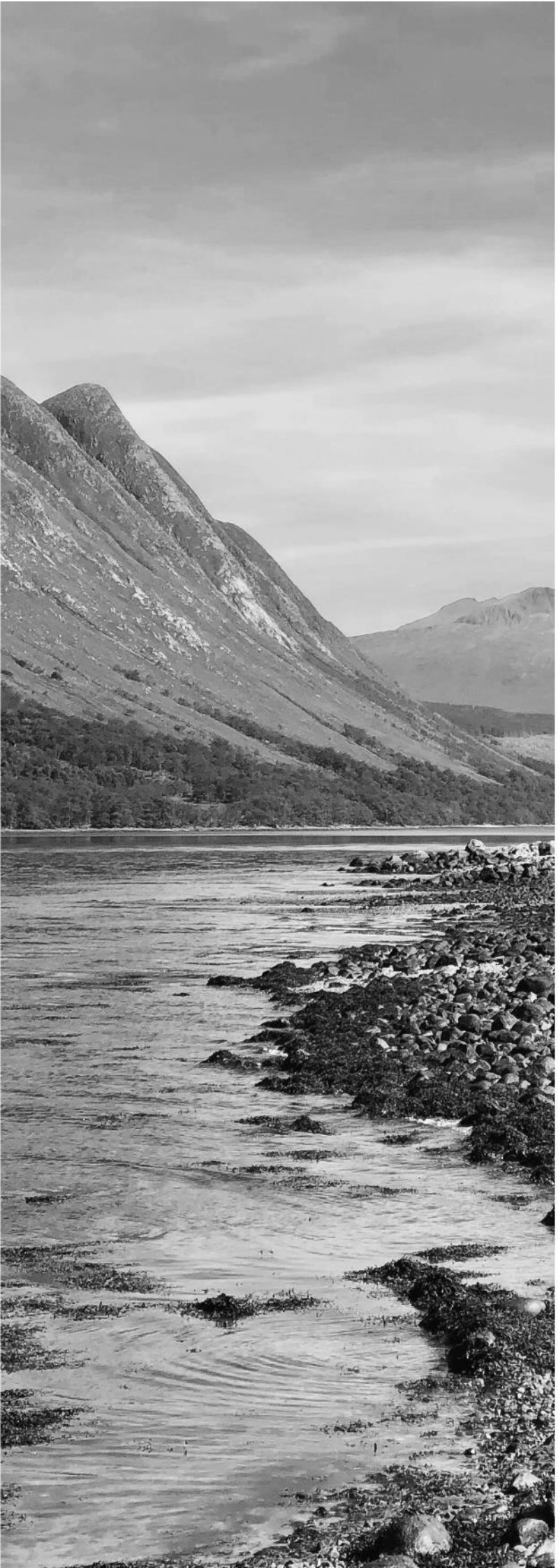

APPENDIX 11.2 – FEARNA SOUTHERN ACCESS ROUTE (SAR) AQUATIC ECOLOGY SURVEYS

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Quality Assurance

This report has been prepared according to Gavia Environmental Quality Management Process. Gavia Environmental employs consultant scientists who are members of appropriate professional institutions and adhere to professional codes of conduct.

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Executive Summary

Gavia Environmental Ltd. was commissioned by Fearna PSH Ltd. to undertake an Aquatic Ecology Assessment to determine the status of fish habitat, fish and macroinvertebrate populations and water quality along the watercourses situated at 13 crossing points along the proposed Southern Access Route (SAR) of the Fearna Pumped Storage Hydro Scheme (Proposed Development - Grid Reference NH055030).

The objectives of this study were to conduct a macroinvertebrate, fish habitat and fish population assessment using electrofishing methods in order to assess the status of the macroinvertebrate and fish populations in the watercourses along the proposed SAR during the pre-construction period.

Close to 70% of the survey areas showed *Productive: Good* fish habitat with the remaining habitats being close to 23% *Productive: Moderate and 7% Unproductive: Bedrock*. The presence of Atlantic salmon was confirmed at eight sites with brown trout being found across seven sites which included four watercourses that are set to be crossed by the proposed SAR (i.e, CP8, CP9. CP11 & CP12).

The fish population assessment found *Excellent* density indices of Atlantic salmon at both the *fry* and *parr* stage and an *Excellent* density of brown trout at the *fry* stage. For Atlantic salmon, *Moderate*, *Excellent* and *Good* population indices were found across the Greenfield burn, Allt Choire a' Bhalachain and River Kingie. From the combination of the electrofishing results, fish habitat assessments and historical data concerning salmon presence and impassable migration barriers, it is possible that salmon could be using the watercourses at crossing points 1, 2, 4, 5, 6, 7, 12 and 13. It should also be noted that the presence of two *Critically Endangered* European eels further confirm the importance of the river habitat and the water quality downstream of crossing point 12.

The macroinvertebrate population assessment has confirmed the good quality of the watercourses with low levels of organics at the same survey locations, however, a lower density of species was identified within each of the watercourses than expected for a freshwater highland environment.

Overall, the value of the in-situ water quality remains within the range of unpolluted freshwater system, however, a range of pH levels were recorded across each of the watercourses including those outside of the ideal range for salmonids at crossing points 7, 8, 9, 10 and 11. From these initial findings, it would suggest that the elevated pH levels found along these watercourses are not the result excessive run-off from the existing access track. However, a full baseline sampling protocol is recommended to determine the baseline water quality values over a longer period to account for seasonal variation.

1 Introduction

Gavia Environmental Ltd. was commissioned by Fearna PSH Ltd. to undertake an aquatic ecology assessment to determine the status of fish habitat, fish and macroinvertebrate populations and water quality on watercourses situated at 13 crossing points along a proposed access track (hereafter 'the proposed Southern Access Route (SAR)') for the Fearna Pumped Storage Hydro Scheme (the Proposed Development - Grid Reference NH055030). The proposed SAR runs east to west and is located south of Loch Garry and the adjacent River Garry. The route will also cross the River Kingie and Gearr Garry which are tributaries within the Garry catchment. The proposed SAR track will be approximately 24 km long and will use and upgrade an existing forestry track which features existing bridges and culverts along the watercourse crossing points. A new bridge crossing will be constructed across the Gearr Garry at (NH 08816 01510), with upgrades made to some of the existing crossing points.

1.1 Study Objectives

The objectives of this study were to conduct:

- a fish habitat assessment up to 100 m upstream and downstream of each of the crossing points along the SAR;
- a fish population assessment on watercourses potentially affected by the SAR using existing data held by the Ness District Salmon Fisheries Board (NDSFB);
- a macroinvertebrate population assessment upstream and downstream of crossing points along the SAR and
- a water quality assessment upstream and downstream of crossing points along the SAR.

2 Project Personnel

The project personnel are listed below in **Table 1.**

Table 1: Project Personnel.

Personnel	*Role*
Matthew Askin BSc (Hons), CSci FGS	Technical Director (Project Director)
Joris Philip BSc, MSc, MFSBI	Freshwater Ecologist - Environmental Consultant (Project Manager)
Donald Morrison BSc (Hons), MIFM	Freshwater Ecologist – Principal Environmental Consultant
Michael Conner BSc (Hons)	Ecologist – Graduate Environmental Consultant

3 Methodology

3.1 Desk Study

A desktop study was carried out at the start of the commission and ahead of the field survey. Information sources used for this study are described below:

- Google Earth (http://earth.google.co.uk) - aerial imagery was obtained and used to inform the field survey;
- Ordnance Survey (OS) Map – 1:50 km OS site mapping was obtained and used to inform the field survey;

- SEPA (http://www.sepa.org.uk) - the SEPA Water Classification Hub was referred to and information on the classification status of the affected watercourses was noted;
- Marine Scotland (https://marinescotland.atkinsgeospatial.com/nmpi/) – interactive map describing various parameters including barriers to fish migration and salmon presence; and
- NatureScotSitelink (https://sitelink.nature.scot/home) – A search was performed looking for sites with relevant qualifying interests with the potential to be impacted by works.

3.2 Study Area

The proposed SAR is located between the White Bridge of Glen Garry (228356, 801354) to ~450 m east of Quoich Dam (207560, 802386). The proposed SAR will utilise an existing forestry track, crossing several watercourses with existing water crossing features (i.e., bridges / culverts). While smaller watercourses may be present along the proposed SAR, the survey locations were selected based on named watercourses appearing on 1:50,000 mapping and the watercourses being directly crossed by the proposed SAR.

The survey extent for each of the 13 water crossing points included up to 100 m upstream and downstream of each of the crossing points. A fish habitat assessment was carried out within these survey extents. Macroinvertebrate sampling and water quality monitoring was conducted immediately upstream and downstream of each of the crossing points. These crossing point locations are shown in **Appendix A – Figures 11.2.2.0-11.2.2.13**.

Table 2: Survey locations with access route crossing points (CP) and upstream and downstream Survey boundaries and Fish Population Assessment Survey Locations.

Survey Location	Easting	Northing	Watercourse Name & Survey Extent
CP1	**224986**	**800803**	**Allt Bolinn crossing point**
CP1 Upstream Boundary	225005	800706	Allt Bolinn upstream boundary
CP1 Downstream Boundary	225064	800860	Allt Bolinn downstream boundary
CP2	**223887**	**800454**	**Dubh Uisge crossing point**
CP2 Upstream Boundary	223816	800400	Dubh Uisge upstream boundary
CP2 Downstream Boundary	223951	800525	Dubh Uisge downstream boundary
CP3	**222981**	**800257**	**Allt Ladaidh crossing point**
CP3 Upstream Boundary	223019	800157	Allt Ladaidh upstream boundary
CP3 Downstream Boundary	222923	800336	Allt Ladaidh downstream boundary

Survey Location	Easting	Northing	Watercourse Name & Survey Extent
CP4	**220548**	**799744**	**Allt na Plaide crossing point**
CP4 Upstream Boundary	220595	799651	Allt na Plaide upstream boundary
CP4 Downstream Boundary	220486	799828	Allt na Plaide downstream boundary
CP5	**220187**	**799576**	**Allt nan Corp crossing point**
CP5 Upstream Boundary	220246	799498	Allt nan Corp upstream boundary
CP5 Downstream Boundary	220207	799682	Allt nan Corp downstream boundary
CP6	**219648**	**799427**	**Allt Giubhais crossing point**
CP6 Upstream Boundary	219637	799346	Allt Giubhais upstream boundary
CP6 Downstream Boundary	219593	799516	Allt Giubhais downstream boundary
CP7	**218941**	**799419**	**Allt na Gearr Leacainn crossing point**
CP7 Upstream Boundary	218901	799314	Allt na Gearr Leacainn upstream boundary
CP7 Downstream Boundary	218956	799501	Allt na Gearr Leacainn downstream boundary
CP8	**218745**	**799279**	**Greenfield Burn crossing point**
CP8 Upstream Boundary	218749	799185	Greenfield Burn upstream boundary
CP8 Downstream Boundary	218690	799373	Greenfield Burn downstream boundary
CP9	**215855**	**798856**	**Allt Garaich Ghualaich crossing point**
CP9 Upstream Boundary	215763	798828	Allt Garaich Ghualaich upstream boundary
CP9 Downstream Boundary	215944	798921	Allt Garaich Ghualaich downstream boundary
CP10	**214056**	**799396**	**Allt Fionn-dhail crossing point**
CP10 Upstream Boundary	213998	799316	Allt Fionn-dhail upstream boundary

Survey Location	Easting	Northing	Watercourse Name & Survey Extent
CP10 Downstream Boundary	214019	799483	Allt Fionn-dhail downstream boundary
CP11	**212796**	**799982**	**Allt Choire a' Bhalachain crossing point**
CP11 Upstream Boundary	212719	799915	Allt Choire a' Bhalachain upstream boundary
CP11 Downstream Boundary	212891	800023	Allt Choire a' Bhalachain downstream boundary
CP12	**209050**	**799822**	**River Kingie crossing point**
CP12 Upstream Boundary	209115	799905	River Kingie upstream boundary
CP12 Downstream Boundary	209008	799719	River Kingie downstream boundary
CP13	**208816**	**801511**	**Gearr Garry crossing point**
CP13 Upstream Boundary	208725	801546	Gearr Garry upstream boundary
CP13 Downstream Boundary	208900	801445	Gearr Garry downstream boundary
Fish Population Assessment Survey Locations			
Greenfield Burn 1	220046	800832	Approx. 2 km downstream of CP7
Greenfield Burn 2	219992	800730	Approx. 1.9 km downstream CP7
Allt Garaidh Ghualaich	217016	800496	Approx. 2.2 km downstream of CP9
Allt Fionn-dhail	214623	800038	Approx. 1.1 km downstream of CP10
Allt Choire a' Bhalachain 1	213353	800453	Approx. 800 m downstream of CP11
Allt Choire a' Bhalachain 2	213411	800457	Approx. 850 m downstream of CP11
River Kingie 1	207037	798789	Approx. 3.1 km downstream of CP12
River Kingie 2	207422	798863	Approx. 2.4 km downstream of CP12
River Kingie 3	204104	797789	Approx. 6 km downstream of CP12

***CP = Crossing Point*

3.3 Fish Habitat Assessment Methodology

Fish habitat assessments were undertaken at up to 100 m upstream and downstream of each of the aforementioned crossing points (CP1-CP13) along the SAR. The upper and lower extents of the assessment areas are listed in **Table 2** above. The fish habitat assessment was conducted using an adapted version of SEPA hydropower guidelines on assessing habitat suitability for juvenile salmonids. This guidance has been recommended by the Marine Directorate on similar pumped storage hydro scheme projects.

Using the SEPA approach, habitat types are classified under four main categories: Bedrock channels, Lamprey habitat, Productive habitat and Obstructions to migration. This method was adapted to sub-divide Productive habitat into *Productive: Good* and *Productive: Moderate*. A category for '*Unproductive*' was also added and sub-divided into *Unproductive: Bedrock* and *Unproductive: Other*. Habitat characteristics such as bankside cover, flow types, depths and riparian habitats were collected on a SFCC habitat form to help inform these assessments at each survey location. These amendments to the method allowed for a more informed assessment of the fish habitat present and allowed scope for habitat categories not included under the SEPA method to be recorded e.g. man-made concrete channels or peat laden ditches.

Predominant habitats were recorded within specific sections. It is important to note that not all habitat features (productive or unproductive) are necessarily continuous within a section of watercourse; they may often be isolated and too small to map, in this case a target note was recorded or a longer section with a constant succession of impassable features (waterfall or underground channel) were immediately characterised as *Unproductive: Other* until a section with productive habitat was found. Where spawning gravels were present and accessible, an assessment of their quality in terms of stability, compaction and siltation was made. In addition, the bankside structure and surrounding land use was also recorded.

3.4 Fish Population Assessment Methodology

Assessment of the species composition, abundance and age class structure of fish populations are conducted in line with the Scottish Fisheries Coordination Centre guidelines on undertaking and managing electrofishing operations (SFCC, 2007) and British Standards (BS 14011 - Sampling of fish with electricity & BS 14962 Guidance on the scope and selection of fish sampling methods). Historical electrofishing data was gathered from the Ness District Salmon Fishery Board, detailing the assessment criteria outlined above. The historical reports contained data which was recorded between 19/07/23 – 31/08/23 with one report covering Allt Fion Dhail, which was carried out on the 10/10/18. All of which fall within the optimal time period for sampling juvenile salmonids. The survey team comprised of three experienced surveyors from the Ness District Salmon Fishery Board. The surveys were undertaken using backpack Electrofishing kits (models: LR24 & WFC911) which were battery powered and set up to drive a single anode. Smooth DC current was applied as this is generally accepted as the least damaging to fish during this type of survey.

Fish population assessments using electrofishing is undertaken within the optimal time of the year corresponding to the biology of the targeted species. Juvenile Salmonids usually emerge from *redds* (spawning ground) early in the spring and take from 5 to 10 weeks (variable according to resource availabilities and water temperature) to reach the *fry* stage and a sufficient size to be safely captured and identified to the species level. Furthermore, water temperature must be within the optimal range for electrofishing (10 – 15°C). Under the SFCC protocol, surveyors should perform a maximum of four electrofishing runs per site. Draft guidelines from the European Inland Fisheries Advisory Commission (EIFAC) state that *"Sites must be surveyed at least three times except and unless the second catch is very much smaller than the first and the field estimates of population size indicate (a) that the population size exceeds 200, and (b) that the probability of capture of an individual fish is greater than 0.6. Under these circumstances a third fishing need not be carried out"*. However, it is usual that additional electrofishing runs are performed to increase the reliability of the estimate.

3.5 Macroinvertebrate Population Assessment

Macroinvertebrates samples were collected immediately upstream and downstream of the crossing points (CP) listed in **Table 2**. Sampling was conducted using the standard SEPA and Environment Agency kick sampling method.

A three-minute kick sample was conducted in riffled areas, moving within the river to account for differences in substrate and habitat types. During each kick sample the net was held down-stream of the surveyor, with its bottom edge in contact with the substrate. The surveyor kicked and dislodged the substrate, moving slowly backwards, and in an upstream direction. Invertebrates dislodged from the substrate were washed downstream and trapped in the net. This was followed by a one-minute manual search in which substrate too large to dislodge during the initial three-minute sample were over-turned and examined. To account for surface macroinvertebrate presence a further one-minute sweep was conducted in the shallow margins and across the surface of the river.

The macroinvertebrate sample was collected using a standard Freshwater Biological Association Pond net (i.e., mesh diameter 1.0 x 1.0 mm); which was disinfected with Virkon S prior to and after use. Invertebrates and substrate trapped in the pond net or collected during the manual search were stored in a labelled sample container (i.e., with a paper sample identification label also added to the sample container for security) for later extraction.

3.6 Water Quality Assessment Methodology

Water quality monitoring assessments were conducted immediately upstream and downstream of the crossing points (CP) listed in **Table 2**. In-situ monitoring was carried out using the Aquaread Water Quality Monitoring device (Aquaread AP-2000 Portable Multiparameter water quality meter).

3.7 Data Analysis and Statistics

3.7.1 Fish Habitat Assessment

Observations and target notes were recorded to identify optimal habitat (i.e., including channel width, channel depth, flow type, substrate composition, instream and bankside cover, riparian canopy cover, fish spawning ground potential; riparian land uses, and associated limiting factors. From this, further analysis was undertaken, and evaluations were made for suitable spawning potential and fish habitat classification along the watercourse. Each survey location was then given a rating for fish habitat quality (**Table 3**).

Table 3: Adapted SEPA Fish Habitat Classification.

Fish Habitat	Conditions	
Productive Habitat (Good)	Salmonid Spawning Habitat	Stable gravel up to 30 cm deep that is not compacted or contains excessive silt. Substrate size predominantly pebbles and cobbles (i.e., lower size limit).
	Salmonid Fry	○ Atlantic salmon: Shallow (i.e., <0.2 m) and fast flowing water indicative of riffle and run with a substrate dominated by pebbles and cobbles (i.e., lower size limit). ○ Brown trout: Slow to medium flowing shallow water with a substrate dominated by pebbles (i.e., upper size limit), cobbles (i.e., lower size limit), often concentrated at stream margins.
	Salmonid Parr	○ Atlantic salmon: Riffle and run habitat that is generally faster and deeper than fry habitat (i.e., 0.2 - 0.4 m). Substrate size range comprise from

Fish Habitat	Conditions
	pebbles (i.e., upper size limit), cobbles (i.e., lower size limit) to boulder. ○ Brown trout: Variety of substrate sizes (i.e., from pebble to boulder); undercut banks, tree roots; deeper and slower water.
Productive Habitat (Moderate)	Suitable habitat characteristics (i.e., mentioned in the above section 'Productive Habitat (Good)' but with the presence of unsuitable elements (i.e., lack of bankside cover, high variation of water flow, bedrock, silt, and algae).
Unproductive Habitat (Bedrock Channels)	Habitat primarily consists of adverse conditions (i.e., dominated by bedrock).
Unproductive Habitat (Other)	Habitat primarily consists of adverse conditions with the presence of limited suitable elements.
Obstructions to Migration	Potentially impassable waterfalls, weirs, bridge sills.
Lamprey Habitat	Optimal: Stable fine sediment or sand; ≥15 cm deep with low water velocity and the presence of organic detritus as well as macrophytes. Sub-optimal: Shallow sediment (i.e., <15 cm deep), unequal and interspersed among coarser substrates.

3.7.2 Population Estimate

Population estimates were calculated by the Ness District Salmon Fishery Board using analysis of depletion catches with a maximum likelihood estimation procedure. The maximum likelihood estimator of Carle and Strub (1978) is a development of the Zippin (1958) method. It has the advantage of being able to produce population estimates and confidence intervals under situations where the Zippin method fails (i.e., when the probability of catch varies from run to run, or when the population size is small which was the case in the study). However, despite being more robust than the Zippin method, it is still susceptible to the same violations mentioned above as the Zippin method is, and the confidence intervals of the data should be considered when the data are interpreted. A minimum population estimate was utilised instead where data was only collected from one electrofishing run which has been accompanied by the SFCC Classification.

3.7.3 SFCC Classification Scheme

The SFCC developed a national river classification scheme for Scottish rivers (Godfrey, 2005). The following classification is based on data collected in the Moray Firth Region and therefore applicable in the catchment (**Tables 4-7**). The SFCC single-run classification methodology produces a result with a lower level of precision than that required to inform a full Environmental Impact Assessment (EIA), where baseline information on fish populations prior to the development will need to be collected, often for a number of years. When providing information for EIAs the SFCC recommends that fully-quantitative sampling is performed (as above). However, SFCC classifications are also provided in this report as a useful analysis in a regional context.

Table 4: SFCC Classification Scheme - N individual/100 m² in stream <4 m wide.

Species/Age-class	A	B	C	D	E	F
Brown trout fry 0+	39.0+	21.0 - <39.0	14.3 - <21.0	5.9 - <14.3	<5.9	0
Brown trout parr >0+	18.1+	13.7 - <18.1	9.1 - <13.7	3.9 - <9.1	<3.9	0
Atlantic salmon fry 0+	86.8+	35.8 - <86.8	22.6 - <35.8	8.6 - <22.6	<8.6	0
Atlantic salmon parr >0+	30.9+	18.9 - <30.9	11.7 - <18.9	5.3 - <11.7	<5.3	0
Description	***Excellent***	***Good***	***Moderate***	***Poor***	***Very Poor***	***Absent***

Table 5: SFCC Classification Scheme - N individual/100 m² in stream 4-6 m wide.

Species/Age-class	A	B	C	D	E	F
Brown trout fry 0+	26.4+	10.4 - <26.4	7.0 - <10.4	2.9 - <7.0	<2.9	0
Brown trout parr >0+	13.3+	7.2 - <13.3	5.2 - <7.2	2.3 - <5.2	<2.3	0
Atlantic salmon fry 0+	77.3+	42.6 - <77.3	27.5 - <42.6	7.7 - <27.5	<7.7	0
Atlantic salmon parr >0+	25.3+	18.4 - <25.3	10.8 - <18.4	3.7 - <10.8	<3.7	0
Description	***Excellent***	***Good***	***Moderate***	***Poor***	***Very Poor***	***Absent***

Table 6: SFCC Classification Scheme - N individual/100 m² in stream 6-9 m wide.

Species/Age-class	A	B	C	D	E	F
Brown trout fry 0+	9.3+	6.0 - <9.3	4.5 - <6.0	3.1 - <4.5	<3.1	0
Brown trout parr >0+	6.1+	4.0 - <6.1	2.3 - <4.0	1.3 - <2.3	<1.3	0
Atlantic salmon fry 0+	40.4+	26.8 - <40.4	18.7 - <26.8	11.2 - <18.7	<11.2	0
Atlantic salmon parr >0+	22.8+	12.4 - <22.8	9.2 - <12.4	4.9 - <9.2	<4.9	0
Description	***Excellent***	***Good***	***Moderate***	***Poor***	***Very Poor***	***Absent***

Table 7: SFCC Classification Scheme - N individual/100 m² in stream >9 m wide.

Species/Age-class	A	B	C	D	E	F
Brown trout fry 0+	5.4+	3.3 - <5.4	1.6 - <3.3	1.2 - <1.6	<1.2	0
Brown trout parr >0+	2.7+	1.9 - <2.7	1.7 - <1.9	1.0 - <1.7	<1.0	0
Atlantic salmon fry 0+	40.4+	26.8 - <40.4	18.7 - <26.8	11.2 - <18.7	<11.2	0
Atlantic salmon parr >0+	22.8+	12.4 - <22.8	9.2 - <12.4	4.9 - <9.2	<4.9	0
Description	***Excellent***	***Good***	***Moderate***	***Poor***	***Very Poor***	***Absent***

3.7.4 Macroinvertebrate Population Assessment

Analysis of macroinvertebrate population was conducted by Gavia Environmental Ltd. approved third-party contractors. Macroinvertebrate samples were classed to species level where it was appropriate to do so. The following scores were calculated for each sample (Interpretation of the Taxonomic level and the scores for BMWP, PSI and CCI are provided in **Table 8 & 9**):

- BMWP - Biological Monitoring Working Party Score
- NTAXA (TL1 and TL2) - Count of BMWP family taxa in the sample
- ASPT (TL1 and TL2) - Average score per (BMWP/WHPT) taxon
- LIFE (TL5 and TL2) - Lotic-Invertebrate index for Flow Evaluation
- PSI (TL5 and TL3) - Proportion of Sediment-sensitive Invertebrates
- E-PSI (FAM and TL5) - Empirically Weighted Proportion of Sediment-sensitive Invertebrates Index
- CCI (TL5) - Community Conservation Index (TL5 only)
- WHPT (TL2) - Whalley-Hawkes-Paisley-Trigg index

Table 8: Macroinvertebrate Taxonomic Level

Code	Description
TL1	Taxonomic Level 1 - The 78 "BMWP family" level taxa in RIVPACS IV
TL2	Taxonomic Level 2 - The 112 "WHPT family" level taxa in RIVPACS IV
TL3	Taxonomic Level 3 - 'All Families'
TL5	Taxonomic Level 5 - The 417 "WFD Species" level taxa in RIVPACS IV (including component members of species groups)

Table 9: Key and Score interpretation for Macroinvertebrate Analysis.

BMWP Score Category Interpretation		PSI Score Category Interpretation	
0 – 10	Very Poor	0 - 20	Heavily Sedimented
11 – 40	Poor	21 - 40	Sedimented
41 – 70	Moderate	41 - 60	Moderately Sedimented
71 – 100	Good	61 - 80	Slightly Sedimented
> 100	Very Good	81 - 100	Minimally Sedimented
CCI Score Category Interpretation			
0 - 5	Low Conservation Value		
>5 - 10	Moderate Conservation Value		
>10 - 15	Fairly High Conservation Value		
>15 - 20	High Conservation Value		
>20	Very High Conservation Value		

3.8 Limitations

Due to seasonal restrictions on the timing of electrofishing surveys, fish population data for the affected watercourses was instead obtained from NDSFB. All of the data sets bar one were of a semi-quantitative nature, meaning that only a single electrofishing run was carried out at each site, rather than multiple runs which allow for fully quantitative population estimation to be made. One run electrofishing data allows for a minimum density estimate to be made. The data from single electrofishing runs also allows the results to be placed in a regional context which is useful for analysis. The results also allow for the presence of any important ecological features (IEF) to be detected for consideration in the Ecological Impact Assessment (EcIA). It is recommended that fully quantitative electrofishing surveys are caried out as part of any future fish monitoring plan prepared in relation to the Proposed Development / the Proposed SAR.

No macroinvertebrate or water quality samples were collected at CP13 due to surveyors not being able to safely access the river on the day of sampling. It is recommended that this watercourse is captured in any baseline monitoring plan prepared in relation to the Proposed Development / the Proposed SAR.

Macroinvertebrate kick sampling locations were limited to areas immediately upstream and downstream of the crossing points. Due to the habitat conditions at the crossing points, which were typically located on steep gradients featuring bedrock riverbed and larger boulders and cobbles with a lack of smaller instream substrates, it was challenging for surveyors to collect a sufficient macroinvertebrate sample. As a result, some species typical of upland watercourses may have been absent from the findings (see section 5.0 for further discussion on the results).

4 Results

4.1 Desk Study

4.1.1 Watercourse and Waterbody Classifications

Loch Garry is a lake (ID: 100190), in the River Ness catchment of the Scotland River basin district. It is 6.9 square kilometres in area. The water body has been designated as a heavily modified water body on account of physical alterations that cannot be addressed without a significant impact on water storage for hydroelectricity generation. SEPA data from 2022 reveals that the waterbody was classified as High for fish barriers, fish and macroinvertebrates (CPET), however, it noted only a Good macroinvertebrate (acid) and good water quality classification. The overall ecological potential of the waterbody was Good.

River Garry - Loch Garry to Loch Poulary is a river (ID: 20255), in the River Ness catchment of the Scotland River basin district. The main stem is approximately 4.6 kilometres in length. This section of river has been classed as high for fish barriers, fish, macroinvertebrates, Good for water quality and has an overall status of Good Ecological Potential.

River Garry - Loch Poulary to Loch Quoich is a river (ID: 20256), in the River Ness catchment of the Scotland River basin district. The main stem is approximately 7.3 kilometres in length. The water body has been designated as a heavily modified water body on account of physical alterations that cannot be addressed without a significant impact on water storage for hydroelectricity generation. This section of river is classed as Poor for Fish, Fish Ecology and has an overall status of Poor Ecological Potential.

Allt Ladaidh is a river (ID: 20298), in the River Ness catchment of the Scotland River basin district. The main stem is approximately 9.0 kilometres in length. This section of river was classed as High for fish barriers and macroinvertebrates, Good for water quality and Moderate for fish ecology. Overall, this section is classed as Moderate for Ecological Potential.

Greenfield Burn is a river (ID: 20299), in the River Ness catchment of the Scotland River basin district. The main stem is approximately 7.1 kilometres in length. This section of river is classed as High for fish barrier and macroinvertebrate, Moderate fish ecology. Good water quality and is classed as Moderate for overall Ecological Potential.

Allt Lon Glas Bheinn is a river (ID: 20300), in the River Ness catchment of the Scotland River basin district. The main stem is approximately 10.3 kilometres in length. This section of river is classed as High for fish barriers and macroinvertebrates, Poor fish ecology, Good water quality and has an overall Poor Ecological Potential.

Allt Choire a Bhalachain is a river (ID: 20301), in the River Ness catchment of the Scotland River basin district. The main stem is approximately 9.2 kilometres in length. This section of river is classed as High for fish barrier and macroinvertebrates, Moderate fish ecology, Good water quality and an overall Moderate Ecological Potential.

River Kingie is a river (ID: 20302), in the River Ness catchment of the Scotland River basin district. The main stem is approximately 23.6 kilometres in length. This section of river is classed as High for fish barrier and macroinvertebrates, Moderate fish ecology, Good water quality and has an overall Moderate Ecological status.

Loch Quoich is a lake (ID: 100186), in the River Ness catchment of the Scotland River basin district. It is 17.5 square kilometres in area. The water body has been designated as a heavily modified water body on account of physical alterations that cannot be addressed without a significant impact on water storage for hydroelectricity generation. This lake is classed as Poor for Fish barrier and fish, Good for Macroinvertebrates and Water quality. Overall, this lake is classed as Good Ecological Potential.

4.1.2 Obstacles to Migration

Six obstacles to fish migration were found along the watercourses that will be crossed as part of the proposed SAR.

Allt Ladaidh – One impassable natural waterfall (OBJECTID:1177) located downstream of crossing point 3 along the proposed SAR at NH 23339 01192.

Greenfield Burn – One impassable natural waterfall (OBJECTID:3685) located downstream of crossing point 8 along the proposed SAR at NH 19912 00386.

Allt Lon Glas Bheinn – One impassable natural waterfall (OBJECTID:2425) located downstream of crossing point 9 along the proposed SAR at NH 17058 00413.

Allt Choire a Bhalachain – 1 impassable natural waterfall (OBJECTID:3687) located downstream of crossing point 11 along the proposed SAR at NH 13150 00273.

River Garry - Loch Poulary to Loch Quoich – 1 passable artificial barrier (OBJECTID:4260) located upstream of crossing point 12 along the proposed SAR at NH 10911 01016. It should be noted that this point was impassable until 2004.

Gearr Garry – 1 impassable artificial barrier (OBJECTID:2672) located at the hydro power dam upstream of crossing point 12 along the proposed SAR at NH 07055 02289.

4.1.3 Marine Scotland data

Historic data shows salmon presence within Loch Garry and the adjacent tributaries; however, no salmon presence was noted beyond the impassible barriers mentioned in Section 4.1.2. It should be noted that data from Marine Scotland (OBJECTID:338893.0, Ross_code:1) documents salmon presence in the River Kingie at crossing point 12, downstream from the passable artificial barrier.

4.1.4 Protected Areas

No designated sites with relevance to aquatic ecology were recorded on Naturescot sitelink, within 7.5km. The closest relevant designated site is the River Moriston SAC (NatureScot Site Code: 8361) which is located approximately 7.5 km north of Loch Garry which is recognised for its Atlantic salmon and freshwater pearl mussel populations.

The proposed SAR does run parallel to the West Inverness-shire Lochs Special Protected Area and SSSI (NatureScot Site Code: 9187; 9189) which is designated for its breeding Black-throated divers and common scooters. However, as this route is approximately 800m away from the site boundary, there are likely to be no interference with these constraints.

The eastern edge of the proposed SAR ends within the Quoich Spillway SSSI (NatureScot Site Code: 1321) which is designated for its Moine metasedimentary rocks.

4.2 Fish Habitat Assessment

A total of 13 crossing point locations and 26 defined sections were surveyed along the proposed SAR, with the results for each section is shown in **Table 10** below. Area and percentage of fish habitat classification is shown in **Table 11**. A survey took place at each of the crossing points of the proposed SAR (CP1-13) including up to 100 m upstream and downstream of the crossing point. Almost 70% of the areas covered revealed *Productive (Good)* habitat with just over 20% being classed as *Productive (Moderate).* The remaining area was comprised of steep bedrock channels and documented as *Unproductive (Bedrock)*. Three impassible natural barriers, in the form of waterfalls, were identified during the survey. All of which were located upstream of crossing point 5. Although near 70% of the surveyed areas were categorised as *Productive (Good)*, no areas were documented as suitable spawning habitat. It should be noted that this area calculation could be heavily skewed due to the relatively large difference in the watercourse widths between the Gear Garry and the other 12 watercourses. The average depths across all of the watercourses varied between 21 - >50 cm with the depth remaining below 50 cm across crossing points 4

– 7. The flow types across each of the watercourses were similar with fast flowing water being the consistent factor, resulting in run, riffle and torrent being the main contributing flow types, most likely attributed to the majority of the watercourses draining north down the hillside The substrate composition across crossing points 1 – 7 was largely consistent, with gravels, pebbles and cobbles making up the majority. From crossing point 8 onwards, larger substrate such as cobble and boulder made up a larger percentage of the substrate composition along with exposed bedrock. Bankside cover was predominantly draping or overhanging boughs and bare.

Table 10: Fish Habitat Classification of each crossing location.

Survey Location	Upstream (100 m)	Downstream (100 m)
CP1	**Productive: Moderate**	**Productive: Moderate**
CP2	**Productive: Moderate**	**Productive: Moderate**
CP3	**Productive: Moderate**	**Productive: Moderate**
CP4	**Productive: Good**	**Productive Moderate**
CP5	**Productive: Moderate**	**Productive: Moderate**
CP6	**Productive: Moderate**	**Productive: Moderate**
CP7	**Productive: Moderate**	**Productive: Moderate**
CP8	**Unproductive Bedrock**	**Unproductive Bedrock (20 m)**
		Productive: Moderate (80 m)
CP9	**Productive: Moderate**	**Unproductive Bedrock**
CP10	**Unproductive Bedrock**	**Unproductive Bedrock**
CP11	**Productive: Moderate**	**Unproductive Bedrock**
CP12	**Productive: Moderate**	**Productive: Moderate**
CP13	**Productive: Good**	**Productive: Good**

Table 11: Area and Percentage of Fish Habitat Classification.

Classification	Area (m^2)	Percentage	Length (m)	Percentage
Productive: Good	6,028.68**	70.38 %**	300	11.538
Productive: Moderate	1,939.88	22.64 %	1,780	68.462
Unproductive: Bedrock	597.89	6.98 %	520	20
Unproductive: Other	0	0 %	0	0 %
Total	**8,566**	**100 %**	**2,600**	**100 %**

****Note that Productive: Good habitat is biased by the considerable width of the Gear Garry watercourse at the crossing point, which increases the area surveyed compared with other watercourses. Length is expressed as a percentage for comparison.**

4.3 Fish Population Assessment

Atlantic salmon and brown trout population estimates are shown in **Table 12** below. While Semi-quantitative sampling was carried out over the majority of the sites, meaning only one electrofishing run was conducted, fully quantitative sampling was carried out across two of the sites, Allt Fionn-dhail and Kingie 2. However, only one fish was caught across all three runs of Allt Fionn-dhail, as such, only a minimum population estimate is given below.

It should be noted that common minnow (*Phoxinus Phoxinus*) were found during the electrofishing surveys along the River Kingie 3, Allt Choire a' Bhalachain and Greenfield. Two European eels (*Anguilla anguilla*) were also caught during the survey at River Kingie 2, which was a long straight stretch of river approximately 500 m downstream of Lochan nan Sgud. The area designated as Greenfield Burn 1 showed the highest classification for Atlantic salmon fry, parr and brown trout fry populations. This location was also deemed *Poor* for brown trout parr; however, this is the highest classification reached by any of the locations that were surveyed. This survey location was located approximately 1800 m downstream of crossing point 8 and approximately 350 m downstream from the waterfall deemed as an impassable natural barrier. Greenfield 2 was located approximately 120 m downstream of the previous survey location and was also deemed *Excellent* for salmon fry and parr populations, however, the population classification dropped to *Good* for brown trout fry with no parr being recorded. The River Kingie surveys, while returning a *Poor* classification for brown trout, revealed an *Excellent* and *Good* classification for salmon fry and parr respectively. The River Kingie 2 survey location was the closest of the three surveys, within the River Kingie, to crossing point 12 at approximately 2.4 km downstream. The surveys returned *Poor* to *Absent* population classifications for both salmon and brown trout across Allt Garaidh Ghualaich, Allt Fionn-dhail and Allt Choire a' Bhalachain 1. It should be noted that while Allt Choire a' Bhalachain 1 returned *Poor* and *Very Poor* scores for salmon and brown trout fry respectively, Allt Choire a' Bhalachain 2 returned *Good* scores for both salmon and brown trout fry.

Table 12: Salmonid Minimum Population Estimates and SFCC Regional Classification.

Survey Location	NGR	Survey Technique and Sample Area	Minimum Population Estimate (per 100 m²)				*SFCC Regional Classification*			
			Brown trout *fry*	Brown trout *parr*	Salmon *fry*	Salmon *parr*	Brown trout *fry*	Brown trout *parr*	Salmon *fry*	Salmon *parr*
Greenfield Burn 1	NH 20046 00832	Semi Quantitative (~100m²)	15.597	1.2	92.382	44.391	***Excellent***	***Poor***	***Excellent***	***Excellent***
Greenfield Burn 2	NH 19992 00730	Semi Quantitative (~100m²)	9.193	0	67.412	41.367	***Good***	***Absent***	***Excellent***	***Excellent***
Allt Garaidh Ghualaich	NH 17016 00496	Semi Quantitative (~100m²)	13.252	7.068	0	2.650	***Poor***	***Poor***	***Absent***	***Very Poor***
Allt Fionn-dhail	NH 14623 00038	Fully Quantitative (~100m²)	0.962	0	0	0	***Very Poor***	***Absent***	***Absent***	***Absent***
Allt Choire a' Bhalachain 1	NH 13353 00453	Semi Quantitative (~100m²)	3.032	1.011	18.193	0	***Very Poor***	***Very Poor***	***Poor***	***Absent***
Allt Choire a' Bhalachain 2	NH 13411 00457	Semi Quantitative (~100m²)	7.006	0	36.781	4.379	***Good***	***Absent***	***Good***	***Very Poor***
River Kingie 1	NN 07037 98789	Semi Quantitative (~100m²)	0	0	9.553	12.493	***Absent***	***Absent***	***Very Poor***	***Good***
River Kingie 3	NN 04104 97789	Semi Quantitative (~100m²)	0	0.802	16.032	6.413	***Absent***	***Very Poor***	***Poor***	***Poor***

Table 13: Salmonid Density Population Estimate and SFCC Regional Classification.

Survey Location	**NGR**	**Survey Technique and Sample Area**	**Density Population Estimate (per 100 m^2)**				***SFCC Regional Classification***			
			Zippin				SFCC (based on the first run result only)			
			Brown trout *fry*	Brown trout *parr*	Salmon *fry*	Salmon *parr*	Brown trout *fry*	Brown trout *parr*	Salmon *fry*	Salmon *parr*
River Kingie 2	NN 07422 98863	Fully Quantitative (~100m^2)	316.893	1.122	53.703	14.745	***Poor***	***Poor***	***Excellent***	***Good***
			Carle & Strub							
			Brown trout *fry*	Brown trout *parr*	Salmon *fry*	Salmon *parr*				
			60.25	1.03	53.556	14.419				

4.4 Macroinvertebrate Population Assessment

The macroinvertebrate population score indices are presented in **Table 14** below. Only one survey location, downstream from crossing point 7, had a *Good* BMWP score with the remaining crossing points showing a range between 15 (*Poor*) and 61 (*Moderate*), upstream from crossing point 9 and downstream from crossing point 6 respectively. PSI (TL5) analysis categorised all survey locations as *Unsedimented* except for downstream of crossing point 1 which was categorised as *Slightly Sedimented*. PSI (FAM/TL3) indicates a slightly lower index score across most of the survey locations with the lowest scores now indicating Sedimented categorisations downstream of crossing point 1 and upstream of crossing point 2. Downstream of crossing point 6 and 8 also show *Moderately Sedimented* categorisations. Two locations show *Very High* Conservation Value according to the CCI scores with downstream of crossing point 5 slightly exceeding the >20 threshold and upstream of crossing point 12 significantly exceeding the threshold with a score of 49. A full list of species is present in **Appendix B**.

Table 14: Results of the Macroinvertebrate Population Assessment: Indices Scores.

Biotic Index	Autumn																						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
	CU 01	**CD01**	**CU02**	**CD02**	**CU 03**	**CD 03**	**CU 04**	**CD04**	**CU05**	**CD 05**	**CU 06**	**CD06**	**CU 07**	**CD 07**	**CU 08**	**CD 08**	**CU 09**	**CD 09**	**CU 10**	**CD 10**	**CU11**	**CD 11**	**CU 12**
	np	*np*	*np*	*np*	*np*	*np*	*np*	*np*	*np*	*np*	*np*	*np*	*np*	*np*	*np*	*np*	*np*	*np*	*np*	*np*	*np*	*np*	*np*
BMWP (TL1)	50	26	26	43	52	21	51	48	30	44	35	61	47	96	54	32	15	39	17	56	21	35	50
NTAXA (TL1)	6	4	4	6	6	3	6	6	6	5	5	8	5	14	7	6	2	7	2	7	4	5	5
ASPT (TL1)	8.33	6.50	6.50	7.17	8.67	7.00	8.50	8.00	5.00	8.80	7.00	7.63	9.40	6.86	7.71	5.33	7.50	5.57	8.50	8.00	5.25	7.00	10.00
LIFE (TL5)	7.50	7.33	8.20	8.40	8.83	9.00	8.40	8.43	7.50	8.38	8.67	8.73	9.00	8.71	9.00	8.25	8.50	8.25	8.67	8.14	7.67	8.33	7.00
LIFE (FAM) (TL2)	7.00	7.00	7.33	7.40	8.33	9.00	7.50	7.33	6.40	7.80	7.50	7.50	8.40	7.46	8.14	6.80	8.50	7.40	7.50	7.43	7.00	7.00	8.40
PSI (TL5)	87.50	50.00	66.67	83.33	100.00	100.00	93.33	92.31	55.56	93.33	100.00	90.91	100.00	100.00	100.00	100.00	100.00	100.00	100.00	92.86	75.00	100.00	100.00
PSI (FAM) (TL3)	75.00	33.33	33.33	62.50	88.89	100.00	81.82	63.64	50.00	87.50	83.33	60.00	90.00	81.82	85.71	57.14	100.00	83.33	100.00	90.00	75.00	80.00	100.00
E-PSI (TL5))	95.64	62.11	86.41	88.79	100.00	100.00	97.77	98.12	94.37	98.00	100.00	95.49	100.00	100.00	100.00	100.00	100.00	100.00	100.00	98.12	94.34	100.00	100.00
E-PSI (FAM)	100.00	66.89	66.89	66.89	100.00	100.00	100.00	80.57	80.00	100.00	100.00	82.17	100.00	93.77	100.00	75.63	100.00	100.00	100.00	100.00	80.65	100.00	100.00
CCI (TL5)	8.00	10.00	17.00	12.50	7.20	12.00	14.00	15.00	22.50	12.86	13.00	13.64	14.29	12.92	7.50	16.25	1.00	1.25	7.00	13.33	1.50	15.00	49.00
WHPT (TL2)	48.6	33.4	34.6	46.1	57.2	24.7	55.5	48.6	33.4	44.7	39.5	67.5	50.2	111.5	61.4	38	14.3	48.5	18.7	56.9	23.7	38.6	46.4
NTAXA (TL2)	6	4	4	6	6	3	6	6	6	5	5	8	5	14	7	6	2	8	2	7	4	5	5
ASPT (TL2)	8.10	8.35	8.65	7.68	9.53	8.23	9.25	8.10	5.57	8.94	7.90	8.44	10.04	7.96	8.77	6.33	7.15	6.06	9.35	8.13	5.93	7.72	9.28

4.5 Water Quality Assessment

The water quality parameters are summarised in **Table 15** below. The temperature ranged from 4.4◦C, upstream of crossing point 3, to 6.1◦C, downstream of crossing point 11. The Oxidation Reduction Potential (ORP) varied greatly across each of the crossing points with a range of 77.2 mV, downstream of crossing point 11, to 232.0 mV, upstream of crossing point 5. The pH ranged from 6 at upstream of CP4 to 8.57 at downstream of CP9. The dissolved oxygen concentration was at total saturation and consistent throughout the majority of the survey locations, only dropping below 100% upstream and downstream of CP1 and CP2, and downstream of CP11. The electrical conductivity was relatively consistent across the majority of sample locations with an average of 38.54 ± 14.81 µs/cm. Large spikes were seen downstream of CP11, CP10 and CP9 at 94.0, 60.0 and 59.0, respectively. This was consistent with the pattern of TDS values which were also consistent across each sample location with the exceptions of downstream of CP11, CP10 and CP9 which showed spikes in total dissolved solid levels.

Table 15: Water Quality Monitoring results.

Sampling Location	Temperature (◦C)	ORP (mV)	pH	DO (%)	DO ($mg.l^{-1}$)	EC ($us.cm^{-1}$)	TDS ($mg.l^{-1}$)
CD1	5.40	164.50	7.38	97.00	11.64	31.00	21.00
CU1	5.65	164.50	7.12	95.90	11.47	28.00	19.00
CD2	5.30	176.80	6.86	99.20	11.97	28.00	18.00
CU2	5.30	147.90	7.01	99.70	12.02	28.00	18.00
CD3	4.50	155.70	7.26	101.30	12.45	32.00	20.00
CU3	4.40	120.00	7.48	101.00	12.50	31.00	18.00
CD4	5.20	213.60	6.71	101.60	12.30	38.00	26.00
CU4	5.20	228.00	6.00	101.10	12.23	40.00	26.00
CD5	4.90	201.00	7.00	102.00	12.43	48.00	30.00
CU5	4.80	232.00	6.27	101.40	12.39	34.00	22.00
CD6	5.40	128.00	7.95	100.90	12.16	31.00	20.00
CU6	5.30	131.30	7.90	100.90	12.20	28.00	18.00
CD7	5.60	120.00	8.05	100.90	12.17	31.00	20.00
CU7	5.50	89.10	8.49	100.80	12.20	33.00	21.00
CD8	5.33	99.10	8.10	101.20	12.31	41.00	26.00
CU8	5.35	105.10	8.27	101.10	12.32	32.00	20.00
CD9	5.10	99.10	8.57	101.10	12.26	59.00	38.00
CU9	5.00	88.90	8.37	101.10	12.36	40.00	26.00
CD10	6.00	117.40	8.03	100.90	12.06	60.00	36.00
CU10	5.70	131.40	7.98	101.20	12.17	30.00	19.00

Sampling Location	Temperature (◦C)	ORP (mV)	pH	DO (%)	DO ($mg.l^{-1}$)	EC ($us.cm^{-1}$)	TDS ($mg.l^{-1}$)
CD11	6.10	77.20	7.76	99.70	11.78	94.00	65.00
CU11	5.90	79.80	8.53	100.90	12.00	43.00	29.00
CD12	5.10	131.50	7.60	101.40	12.40	35.00	22.00
CU12	5.20	102.90	7.95	101.40	12.37	30.00	18.00

5 Discussion

5.1 Water Quality Assessment

The water quality assessment results did not reveal any water parameters that would be unexpected across Scottish Highland watercourses with the value of the *in-situ* water quality remaining within the range of an unpolluted freshwater system. The only large spikes in the results that differed greatly between watercourses was the spike in TDS and electrical conductivity at downstream of CP11, CP10 and CP9 which were likely correlated. Typical TDS values in freshwater environments can range up to 500 ppm, therefore the values recorded are unlikely to be detrimental to the aquatic fauna (Moran, 2018). The dissolved oxygen remained above 95.9 % across all of the watercourses and although temperature ranged from 4.4 – 6.1 ◦C, it is important to note that as temperature rises the capacity of the water to hold oxygen reduces. The pH range observed throughout the Survey Locations ranged between pH 6 upstream of CP4 and 8.57 downstream of CP9. It should be noted that both upstream and downstream of CP7, 8, 9, as well as downstream of CP10 and upstream of CP11 had pH scores above 8 which is outside of the optimal pH level for salmonids (i.e., pH 6.5 – 8.0) (Staurnes et al., 1996). Although indicative, water quality results are only relevant for the watercourses on the days of sampling. From these initial findings, it would not appear that the elevated pH upstream and downstream of the access track is a result of run-off and excessive use. However, a full baseline sampling protocol would need to be implemented to determine baseline water quality values over a longer period to account for variation.

5.2 Fish Habitat Assessment

A fish habitat assessment was conducted along each of the watercourses that due to be crossed as part of the proposed SAR in order to forecast the presence of suitable habitat for Atlantic salmon. While 70% of the total habitat area surveyed returned *Productive: Good,* this was biased towards the results from the River Garry at crossing point 13 due to the greater width in comparison to the other burns and smaller watercourses. Almost 23% of the surveyed habitats were assessed as *Productive: Moderate*, including crossing points 1–7, however, none of the watercourses were marked as suitable for spawning due to the lack of suitable substrate. Historical records show salmon presence across Loch Garry and into the watercourses but only up until the impassable waterfalls mentioned previously. The exception is crossing point 12 where salmon have been recorded throughout the River Kingie which was confirmed with the presence of salmon caught during the electrofishing survey. Overall, all of the crossing points showed some evidence of productive habitat across each of the crossing points with the exception of crossing points 8 and 10 which show unproductive bedrock both upstream and downstream of the crossing points. However, it should be noted that downstream of crossing point 8 has at least 80 m of *Productive: Moderate* habitat which could be utilised by resident fish species.

5.3 Fish Population Assessment

Atlantic salmon were recorded within the watercourses downstream of crossing points, 8, 11 and 12. While the Greenfield Burn, downstream from crossing point 8, showed the greatest minimum population for both Atlantic salmon and brown trout, the results from these electrofishing surveys are only applicable beyond the natural waterfall which will act as a barrier to migration and dispersal further upstream. Crossing point 10 revealed *Unproductive: Bedrock* habitat during the fish habitat assessment and the confirmation of an absence of salmon or brown trout found during the electrofishing suggests that this watercourse is not readily utilised by fish. A *Good* classification was assessed along the watercourse at crossing point 11, however, this was achieved with electrofishing results downstream of the impassible natural waterfall which would impede migration of salmon further upstream. The fish habitat assessment also revealed that 100 m downstream of the crossing point is classed as *Unproductive Bedrock*, an unsuitable habitat for salmon. Crossing point 12 which crosses the River Kingie found salmon at three locations

downstream of the crossing point and brown trout at two locations. The results at the second electrofishing location. River Kingie 2, showed an *Excellent* classification for salmon fry and a *Good* classification for salmon parr. This is in line with the historic data from Marine Scotland which shows salmon presence throughout the River Kingie and past the passable barrier at the River Garry dam. While not specifically targeted, two European eels were found during the electrofishing survey at the River Kingie 2 location.

5.4 Macroinvertebrate Population Assessment

In total 59 different taxa were identified across the watercourses surveyed. On average 8 different taxa were identified within each survey location with the highest being 21 individual taxa recorded downstream of crossing point 7. The most abundant species was *Amphinemura sulcicollis* which is known to be most commonly found in fast flowing reaches of stony streams and is classified as highly sensitive to organic enrichment, which suggests low organic component levels across the watercourses (Baars and Kelly-Quinn, 2006). There was no species of nature conservation interest according to JNCC's main Conservation Designations for UK Taxa spreadsheet containing the taxa's Global, GB and England red data (JNCC, 2023). The red listing includes listing based on pre-1994, 1994 and 2001 IUCN guidelines. All overall WHPT indices are far lower than what would be expected for common upland Scottish watercourses. The relatively low diversity in taxa expected of upland Scottish watercourses excluded commonly associated taxa such as *Sphaeriidae*, *Hydraenidae, Hydroophilidae* and smaller *Dipteran* larvae. Due to the lower-than-expected invertebrate diversity, the CCI scores may have been skewed, e.g. the sampling locations upstream of CP5 and CP12 returned low numbers of taxa but high CCI scores resulting in a *Very High Conservation Value*. RiverWood Ecology Ltd who carried out the analysis were *'not confident that these data are a true representation of macroinvertebrate communities of the sites sampled*. However, given the large substrate size, compaction and relatively high flow rate expected of the torrent and run/riffle flow types recorded on steeper gradients, the habitat suitability and sampling areas may have been sub-optimal for the diverse taxa typically associated with other upland watercourses which show a broader range of flow types, substrate composition and instream cover.

6 Conclusion

Based on the survey results, there are no significant constraints regarding macroinvertebrate species within the watercourses directly adjacent to the crossing points.

From the combination of the electrofishing results, fish habitat assessments and historic data concerning salmon presence and impassable migration barriers, it is possible that salmon could be using the watercourses at crossing points 1, 2, 4, 5, 6, 7, 12 and 13. With crossing point 12 on the River Kingie having both historic salmon presence data upstream of the crossing point and confirmed electrofishing data to support salmon presence downstream.

It should also be noted that the presence of *Critically Endangered* European eels further confirm the importance of the river habitat and the water quality downstream of crossing point 12. This species is a UK Biodiversity Action Plan priority species which is particularly susceptible to chemical pollution in waterways.

The remaining crossing points lack salmon presence data in the form of current electrofishing results or historic data or have confirmed impassable barriers which would impede salmon dispersal and movement upstream towards the proposed crossing points. Water quality also shows pH scores outside of the optimal pH level for Salmonids as well as elevated TDS levels across these remaining watercourses which would further suggest a lack of ideal habitat conditions (Staurnes *et al.*, 1996). It should be noted that while this does not exclude salmon presence completely from these watercourses, the data suggests that it is unlikely.

7 References

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8 Appendices

Appendix A Figures [See Separate Document]

Figures List

Figure 11.2.1.0 – The Proposed Southern Access Route (SAR)

Figure 11.2.2.0 – Fish Habitat Assessment Overview

Figure 11.2.2.1 – 11.2.2.13 – Fish Habitat Assessment

Figure 11.2.3.1 – Fish Population Assessment Brown Trout Fry

Figure 11.2.3.2 – Fish Population Assessment Brown Trout Parr

Figure 11.2.3.3 – Fish Population Assessment Brown Salmon Fry

Figure 11.2.3.4 – Fish Population Assessment Brown Salmon Parr

Appendix B Macroinvertebrate Population Taxa List

		TAXA LIST	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
			CU01	CD01	CU02	CD02	CU03	CD03	CU04	CD04	CU05	CD05	CU06	CD06	CU07	CD07	CU08	CD08	CU09	CD09	CU10	CD10	CU11	CD11	CU12
			np	*np*	*np*	*np*	*np*	*np*	*np*	*np*	*np*	*np*	*np*	*np*	*np*	*np*	*np*	*np*	*np*	*np*	*np*	*np*	*np*	*np*	*np*
Order	**Family**	**Taxa Name**	**Abundance**	**Abundance**	**Abundance**	**Abundance**	**Abundance**	**Abundance**	**Abundance**	**Abundance**	**Abundance**	**Abundance**	**Abundance**	**Abundance**	**Abundance**	**Abundance**	**Abundance**	**Abundance**	**Abundance**	**Abundance**	**Abundance**	**Abundance**	**Abundance**	**Abundance**	**Abundance**
COLEOPTERA	DYTISCIDAE	Agabus sp.									1														
COLEOPTERA	ELMIDAE	Elmis aenea												1											
COLEOPTERA	ELMIDAE	Limnius volckmari																1							
COLEOPTERA	ELMIDAE	Oulimnius sp.		3							1														
COLEOPTERA	SCIRTIDAE	Elodes sp.														1									
COLEOPTERA	SCIRTIDAE	Odeles marginata																1							
DIPTERA	CHIRONOMIDAE	Tanypodinae																		2					
DIPTERA	MUSCIDAE	Limnophora sp.																		1					
DIPTERA	PEDICIIDAE	Dicranota sp.														4									
DIPTERA	PEDICIIDAE	Pedicia sp.														1									
DIPTERA	TIPULIDAE	Tipula sp.									1														
EPHEMEROPTERA	BAETIDAE	Baetis sp.															1								
EPHEMEROPTERA	HEPTAGENIIDAE	Ecdyonurus sp.					1	1				1	2		1		2		1			1	3		
EPHEMEROPTERA	HEPTAGENIIDAE	Ecdyonurus venosus											4	1		2									
EPHEMEROPTERA	HEPTAGENIIDAE	Electrogena lateralis								1		1		1	1										
EPHEMEROPTERA	HEPTAGENIIDAE	Electrogena sp.																							1
EPHEMEROPTERA	HEPTAGENIIDAE	Heptageniidae						1					1		1										
EPHEMEROPTERA	HEPTAGENIIDAE	Rhithrogena semicolorata					2							2	12	2									
EPHEMEROPTERA	HEPTAGENIIDAE	Rhithrogena sp.						2							3	9	14								
EPHEMEROPTERA	LEPTOPHLEBIIDAE	Paraleptophlebia sp.																						1	2
EPHEMEROPTERA	LEPTOPHLEBIIDAE	Paraleptophlebia submarginata	1																					1	
HIRUDINEA	GLOSSIPHONIIDAE	Helobdella stagnalis																					1		
LEPIDOPTERA	CRAMBIDAE	Crambidae									1														
MEGALOPTERA	SIALIDAE	Sialis fuliginosa								2				1		2		1							
ODONATA	COENAGRIONIDAE	Pyrrhosoma nymphula	5																						
ODONATA	CORDULEGASTRIDAE	Cordulegaster boltonii		6	4	4								1											
OLIGOCHAETA	LUMBRICIDAE	Eiseniella tetraedra				1		2								1		1						1	
OLIGOCHAETA	N/A	Oligochaeta		1	1			3			1		1							3			1		
PLECOPTERA	CHLOROPERLIDAE	Chloroperla tripunctata													1	4									

PLECOPTERA	LEUCTRIDAE	Leuctra sp.	8	1		1			2					8	1	7	6	5				2		1	1
PLECOPTERA	NEMOURIDAE	Amphinemura sulcicollis	6	4	22	4			12	8		1	2	25	2	17	22	2				3			
PLECOPTERA	NEMOURIDAE	Nemoura avicularis	6	9	1				1	1	1	1										1			
PLECOPTERA	NEMOURIDAE	Nemouridae		5					1											1					
PLECOPTERA	NEMOURIDAE	Protonemura meyeri			5	1			5	10	1	4	2	1	2	7		1				5		2	
PLECOPTERA	NEMOURIDAE	Protonemura sp.					1					1				1	1								
PLECOPTERA	PERLIDAE	Dinocras cephalotes						1																	
PLECOPTERA	PERLIDAE	Perla carlukiana					1																		
PLECOPTERA	PERLODIDAE	Isoperla grammatica	1		5				8	8		6	4	14	1	6	1				1	1			
PLECOPTERA	PERLODIDAE	Perlodes mortoni					1							3	1	1					1				
PLECOPTERA	TAENIOPTERYGIDAE	Brachyptera putata																							3
PLECOPTERA	TAENIOPTERYGIDAE	Brachyptera sp.							1																
TRICHOPTERA	GOERIDAE	Goeridae																							1
TRICHOPTERA	GOERIDAE	Silo pallipes				1				1		1													
TRICHOPTERA	HYDROPSYCHIDAE	Hydropsyche instabilis															4								
TRICHOPTERA	HYDROPSYCHIDAE	Hydropsyche siltalai					1									2			5	1		4			
TRICHOPTERA	HYDROPSYCHIDAE	Hydropsyche sp.															2								
TRICHOPTERA	LIMNEPHILIDAE	Chaetopteryx villosa	1																						
TRICHOPTERA	LIMNEPHILIDAE	Limnephilidae							1		1					1									
TRICHOPTERA	LIMNEPHILIDAE	Micropterna sequax				1																			
TRICHOPTERA	LIMNEPHILIDAE	Potamophylax latipennis				3																			
TRICHOPTERA	LIMNEPHILIDAE	Potamophylax sp.				1			1	1	1											1			
TRICHOPTERA	ODONTOCERIDAE	Odontocerum albicorne					1																		
TRICHOPTERA	PHILOPOTAMIDAE	Philopotamus montanus														2	1								
TRICHOPTERA	POLYCENTROPODIDAE	Plectrocnemia conspersa										2	1	2		1									
TRICHOPTERA	POLYCENTROPODIDAE	Plectrocnemia sp.														1									
TRICHOPTERA	POLYCENTROPODIDAE	Polycentropodidae																			1				
TRICHOPTERA	POLYCENTROPODIDAE	Polycentropus flavomaculatus																		1	2	2	5	2	
TRICHOPTERA	RHYACOPHILIDAE	Rhyacophila dorsalis							3							2				1					
TRICHOPTERA	SERICOSTOMATIDAE	Sericostoma personatum																		1					
		Total No. of Taxa	7	7	6	9	7	6	10	8	9	9	8	12	11	21	10	7	2	8	4	9	4	6	5
		Total Abundance	28	29	38	17	8	10	35	32	9	18	17	60	26	74	54	12	6	11	5	20	10	8	8
		Sample Comments	Preservation level: 60%.	Preservation level: 60%.	Preservation level: 60%.	Preservation level: 60%.	Preservation level: 60%.	Preservation level: 20%.	Preservation level: 60%.	Preservation level: 60%.	Preservation level: 60%.	Preservation level: 60%.	Preservation level: 60%.	Preservation level: 60%.	Preservation level: 60%.	Preservation level: 60%.	Preservation level: 60%.	Preservation level: 60%.	Preservation level: 60%.	Preservation level: 60%.	Preservation level: 60%.	Preservation level: 60%.	Preservation level: 60%.	Preservation level: 60%.	Preservation level: 60%.

Appendix C Freshwater Pearl Mussel Surveys (NDSFB)