BALLINA FLOOD RELIEF SCHEME EIAR

Chapter 9: Aquatic Biodiversity

MGW0290 RPS EI XX R EN 900
S4 P04
April 2025

Document status

Version	Purpose of document	Authored by	Reviewed by	Approved by	Review date
S4. P04	Final for Submission	LW	KM/PJG	PJG	April 2025

Approval for issue

PJG	4 April 2025

Prepared by:

RPS

Prepared for:

Mayo County Council

Dublin | Cork | Galway | Sligo | Kilkenny
rpsgroup.com

RPS Group Limited, registered in Ireland No. 91911
RPS Consulting Engineers Limited, registered in Ireland No. 161581
RPS Engineering Services Limited, registered in Ireland No. 99795
The Registered office of each of the above companies is West Pier Business Campus, Dun Laoghaire, Co. Dublin, A96 N6T7

Contents

Tables

Figures

Acronyms

Term	Meaning
AA	Appropriate Assessment
BOD	Biological Oxygen Demand
CEMP	Construction Environmental Management Plan
CIEEM	Chartered Institute of Ecology and Environmental Management
CL	Conservation Limit
CMS	Construction Method Statement
cSAC	Candidate Special Area of Conservation
cSPA	Candidate Special Protected Area
CWEF	Catchment-Wide Electro-Fishing
DCHG	Department of Culture, Heritage and the Gaeltacht
ECoW	Environmental Clerk of Works
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EPA	Environmental Protection Agency
EQR	Ecological Quality Ratio
EU	European Union
FGA	Filamentous Green Algae
FRV	Floating River Vegetation
GPS	Global Positioning System
GSI	Geological Survey of Ireland
IEF	Important Ecological Feature
IFI	Inland Fisheries Ireland
ITM	Irish Transverse Mercator
LHS	Left-hand side
MCC	Mayo County Council
NBAP	National Biodiversity Action Plan
NBDC	National Biodiversity Data Centre
NIEA	Northern Ireland Environment Agency
NPWS	National Parks and Wildlife Service
NRA	National Roads Authority
PPE	Personal protective equipment
QI	Qualifying Interest
RBMP	River Basin Management Plan
RHAT	River Hydromorphology Assessment Technique
RHS	Right-hand side
RMS	Root Mean Square
RS	River Station
RWB	River Water Body
SAC	Special Area of Conservation

Term	Meaning
SEL	Sound Exposure Level
SPA	Special Protected Area
SPR	Source-Pathway-Receptor
SWMP	Surface Water Management Plan
TII	Transport Infrastructure Ireland
TSS	Total suspended solids
WFD	Water Framework Directive
ZoI	Zone of Influence

9 AQUATIC BIODIVERSITY

9.1 Introduction

This chapter of the Environmental Impact Assessment Report (EIAR) identifies, describes, and presents an assessment of the likely significant effects on aquatic ecology of the Ballina Flood Relief Scheme (hereafter referred to as the 'Proposed Scheme'). Potential impacts are assessed for the construction and operational/ maintenance phases of the Proposed Scheme. The Proposed Scheme is described in **Chapter 5: Project Description** which sets out measures proposed on each watercourse. Other aspects related to biodiversity and aquatic ecology/the water environment are addressed in other chapters of the EIAR, namely:

- **Chapter 10 – Terrestrial Biodiversity:** Baseline descriptions and impact assessment related to the terrestrial aspects of biodiversity. This chapter also deals with habitats and species that rely on the aquatic environment.
- **Chapter 11 – Land, Soils, Geology and Hydrogeology:** Baseline descriptions and impact assessment relating to groundwater and hydrogeology.
- **Chapter 12 – Water:** Baseline descriptions and impact assessment relating to other aspects of the surface water environment such as Water Framework Directive considerations, hydrology and flood risk.

There are also clear linkages between the Environmental Impact Assessment (EIA) and Appropriate Assessment (AA) processes. This chapter should therefore be read in conjunction with the Stage 1 – AA Screening and Stage 2 – Natura Impact Statement (NIS) for the Proposed Scheme, which have been prepared with reference to European sites. These are included as part of the overall application for development consent.

These parallel but separate processes commonly overlap but also differ in key respects. While the EIA and AA must clearly be distinguished in terms of their respective scope and conclusions, the processes have been carried out concurrently and draw on common data and information. The key findings of the AA are reflected in the relevant section(s) of this chapter of the EIAR.

9.2 Methodology

9.2.1 Legislation, Policy and Guidance

The assessment of the likely significant effects of the Proposed Scheme on aquatic ecological features has taken account of the following legislation, policy and guidance documents; where relevant.

9.2.1.1 Legislation

EU Legislation

- EU Habitats Directive - Council Directive 92/43/EEC (1992), ensures the conservation of a wide range of rare, threatened or endemic animal and plant species and the conservation of characteristic habitat types.
- EU Water Framework Directive (2000/60/EC) (WFD) for the protection and improvement of water quality in all waters so that good ecological status is achieved within specified timelines.

National Legislation

- The Wildlife Act 1976, as amended, is the principal national legislation providing for the strict protection of wildlife and the control of some activities that may adversely affect wildlife. It aims to provide for the protection and conservation of wild fauna and flora, to conserve a representative sample of important ecosystems and protect species from injury, disturbance, and damage to breeding and resting sites (EC, 2000). Such species, where relevant, are considered as sensitive ecological receptors in this chapter.
- Part XAB of the Planning and Development Act, 2000 (S.I. No. 30 of 2000) as amended and the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477 of 2011), as

amended ('the Habitats Regulations'), transpose the EU Habitats Directive (see above) into Irish law. In Ireland, these sites are designated as European Sites and include Special areas of Conservation (SAC), established under the Habitats Directive and Special Protection Areas (SPA), established under the Birds Directive 2009/147/EC as well as candidate sites (cSAC and cSPA).

- European Communities (Water Policy) Regulations 2003 (S.I. No. 722 of 2003), as amended, give legal effect in Ireland to the WFD.
- European Communities Environmental Objectives (Surface Waters) Regulations (S.I. No. 272 of 2009), as amended (S.I. 77 of 2019), establishes the legally binding water quality objectives for all surface waters and outlines environmental quality standards for pollutants.
- European Communities (Quality of Salmonid Waters) Regulations (S.I. No. 293 of 1988) designating "*waters capable of supporting salmon (Salmo salar), trout (Salmo trutta), char (Salvelinus) and whitefish (Coregonus)*" as salmonid waters. This also sets out the quality standards that must be achieved in 'Salmonid Waters'.

9.2.1.2 Policy

- Mayo County Development Plan 2022-2028 (MCC, 2022).
- The 3rd National Biodiversity Action Plan (NDAP) 2017-2021 (DCHG, 2017) is a framework for the conservation and protection of biodiversity in Ireland and the 4th draft National Biodiversity Action Plan (DCHG, 2022), which will set the national biodiversity agenda for the period 2023-2027.
- The 2nd cycle River Basin Management Plan (RBMP) (DHLGH, 2018) and the Water Action Plan 2024: A River Basin Management Plan for Ireland (DEHLGH, 2024) set out the measures necessary to protect and restore water quality in Ireland. The overall aim is to ensure that Ireland's natural waters are sustainably managed and that freshwater resources are protected to maintain and improve Ireland's water environment.

9.2.1.3 Guidance

The methodology and associated impact assessment were conducted with regard to the general guidance on undertaking an EIA (EPA, 2022), plus the following topic-specific guidance:

- Chartered Institute of Ecology and Environmental Management (CIEEM): Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine (CIEEM, 2018)
- National Roads Authority (NRA) Guidelines for assessment of ecological impacts of national road schemes, Revision 2 (NRA, 2009)
- NRA Guidelines for assessment of ecological impacts of national road schemes, Revision 1 (NRA, 2003)
- Inland Fisheries Ireland (IFI) Guidelines on protection of fisheries during construction works in and adjacent to waters (IFI, 2016)

9.2.2 Zone of Influence

The downstream Zone of Influence (ZoI) was considered using expert judgement and taking into account existing watercourse morphology, size and flow types in terms of potential for downstream export of pollutants (primarily during construction phase). No fixed distance was applied for the downstream ZoI because site-specific conditions determine the potential for pollutant generation, downstream transport and any consequent effects. The upstream ZoI was included in relation of fish migration (where relevant) through the proposed works areas. This was defined as all accessible fluvial habitat upstream of the construction proposed on each watercourse in consideration of salmonid, lamprey and eel migration where this currently or potentially exists.

Overall, the aquatic habitats of the River Moy were investigated in detail covering the 800 m stretch within Ballina from the Salmon Weir to the pontoon on Bachelors Walk. This covers the reach that is subject to direct in-channel and bankside construction measures (e.g., flood defence walls). In terms of indirect

(downstream) effects, the Moy was observed over a total of 3 km between the Salmon Weir and the River Moy Harbour to the point at which Quignamanger Stream confluences beneath the estuarine River Moy.

Distribution of aquatic species / habitats and habitat quality of the River Moy and the Moy estuary were derived from a desk study which considered the entire catchment, primarily in relation to migrating fish species (salmonids, lamprey, eel) and their spawning /nursery and holding habitats. Tributaries (Tullyegan, Bunree, Quignamanger, Brusna/Glenree) were investigated at locations along their length focusing on areas that were: (i) accessible, e.g., upstream and downstream of existing culverts that require replacement and/or (ii) where measures such as walls, embankments and instream works are proposed. Tributaries were generally subject to walkover (subject to accessibility) between the most upstream location of proposed measures and the Moy confluence.

9.2.3 Sources of Information to Inform the Assessment

9.2.3.1.1 Desk Studies

A thorough desk-based search of available baseline information was undertaken to assist in the identification of key aquatic values and sensitivities. Verified online information and the published scientific literature (journals) were used to support the site-specific impact assessments. The following publicly available sources were utilised:

- Environmental Protection Agency (EPA) maps and data (https://gis.epa.ie/EPAMaps/)
- Water Framework Directive (WFD) maps and data (https://www.catchments.ie/)
- National Parks and Wildlife Service (NPWS) maps and data (https://www.npws.ie/maps-and-data)
- Geohive historical mapping (https://www.geohive.ie/)
- Geological Survey of Ireland (GSI) mapviewer (https://www.gsi.ie/en-ie/Pages/default.aspx)
- National Biodiversity Data Centre (NBDC) maps and data (https://biodiversityireland.ie/)
- Inland Fisheries Ireland (IFI) and WFD fish survey data (http://wfdfish.ie/)

9.2.3.1.2 Field Studies

Survey Schedule

Field studies were conducted on 21-22 July 2021; 11-12 July 2022 and 11-12 September 2023 covering reaches of watercourse where proposed works are proposed. The aim was to fully characterise baseline conditions of instream habitats and identify key aquatic receptors and Important Ecological Features (IEFs).

Locations of survey reference points were recorded (Irish Transverse Mercator (ITM)) using hand-held Global Positioning System (GPS). Photographs provide a record of representative views of each survey reach at select locations.

Types of survey(s) conducted at selected points on each watercourse are shown in **Table 9-1**. Specific survey site details are listed in **Appendix 9.1**, which includes stream order, EPA name and River Water Body (RWB) code, plus current EPA ecological status (2016-2021). Maps showing specific survey locations are in **Appendix 9.2**.

Table 9-1 Ecological Evaluation Criteria – Watercourses

Watercourse	Survey Date(s)	Locations	Survey Types
River Moy	21-22 July 2021 11-12 July 2022 11-12 Sept. 2023	Salmon Weir to the pontoon on Bachelors Walk with focus on proposed temporary instream works areas associated with flood defence wall construction	Fisheries habitat assessment; general habitat description; instream plant community description; juvenile lamprey presence/absence sampling; instream habitat survey (Ridgepool)
Brusna/Glenree	11-12 July 2022 11 Sept 2023	Select locations between R294/Shanaghy Heights junction and River Moy confluence with focus on	Q-value sample and analysis; fisheries habitat assessment; general habitat description; juvenile lamprey spot-

Watercourse	Survey Date(s)	Locations	Survey Types
		proposed flood defence wall/embankment areas. Instream habitat survey at Shanaghy Heights Bridge to determine baseline conditions of river bed / bank	checks; white clawed crayfish presence/absence sampling; instream habitat survey (Shanaghy Heights Bridge)
Tullyegan	11 July 2022	Select locations between Tullyegan / Raish townlands and River Moy confluence	Q-value sample and analysis; fisheries habitat assessment; general habitat description, white clawed crayfish presence/absence sampling
Bunree	11 July 2022	Select locations between Quignashee townland and River Moy confluence	Q-value sample and analysis; fisheries habitat assessment; general habitat description
Quignamanger	10 July 2022 11-12 Sept. 2023	Select locations between Quignalegan / Quignashee townlands and the River Moy confluence, with focus on the area at the corner of Cregg Rd and Quay Rd.	Q-value sample and analysis; fisheries habitat assessment; general habitat description; white clawed crayfish presence/absence sampling; water chemistry sampling and analysis

General Habitat Descriptions

Each channel was walked and accessed at select locations focusing on areas where scheme measures were proposed. River and stream habitats were visually assessed to characterise bankside and in-channel habitats. Site habitat characteristics recorded included: substrate and flow types, depth and width, aquatic plant community, shading, surrounding land-use and general morphological character. Habitat characteristics were assessed based broadly on criteria for river hydromorphology using the principles of the River Hydromorphology Assessment Technique (RHAT) (NIEA, 2014).

Biological Water Quality Assessment (Q value)

Biological water quality in Ireland is assessed using the Q-value metric. This system is based on field sampling and observations, which evaluates habitat quality and macroinvertebrate diversity and abundance to interpret WFD ecological status as set out in **Table 9-2**. The Q-value assists in the detailed characterisation of water and habitat quality given that water quality is a primary determinant of habitat quality for aquatic organisms.

Table 9-2: Ecological Evaluation Criteria – Watercourses

Q-value	EQR*	Quality Indication	Water Quality	Ecological Status
Q5	1.0	Unpolluted	Good	High
Q4-5	0.9	Unpolluted	Fair-to-Good	
Q4	0.8	Unpolluted	Fair	Good
Q3-4	0.7	Slightly Polluted	Doubtful-to-Fair	Moderate
Q3	0.6	Moderately Polluted	Doubtful	Poor
Q2-3	0.5	Moderately Polluted	Poor-to-Doubtful	
Q2	0.4	Seriously Polluted	Poor	Bad
Q1-2	0.3	Seriously Polluted	Bad-to-Poor	

** Ecological Quality Ratio*

Potentially affected watercourses were sampled in accordance with EPA protocols to determine Q-value and water quality implications. This involved taking 2-minute, travelling kick-samples in the fast flowing (riffle) area of each stream using a professional long-handled sampling net (250 mm width, mesh size 0.25mm). Stone washing was employed to ensure “clinging” species were adequately collected. Samples were identified on the bankside using a large white tray with a volume of water covering the contents to record relative abundance of aquatic macroinvertebrates (identified to species level where possible; family level at

minimum). The abundance of each group and sensitivity to pollution are then used to assign Q-value in accordance with published methods (Toner et al, 2005).

The Ecological Quality Ratio (EQR) represents the relationship between the values of the biological parameters observed for a given body of surface water and the values for these parameters in reference (pristine) conditions applicable to that body. The EQR classifies sites according to ecological quality status as required by river basin management planning under the WFD. It is expressed as a numerical value between 0 and 1, with high ecological status represented by values close to one and bad ecological status by values close to zero. This allows comparison of water quality status across the European Union since each member state has an EQR value for 'High'; 'Good', 'Moderate', 'Bad' and 'Poor', based on an intercalibration of boundaries between water quality categories (McGarrigle & Lucey, 2009). Under the WFD, all surface waters must be maintained or restored to at least Good Ecological Status (Q4) within specific timeframes as set out in the River Basin Management Plans (RBMPs) and high-status waters (Q4-5 and Q5) must not suffer deterioration.

Fisheries Habitat Assessments

Field-based fisheries habitat assessments were conducted at all sites, involving visual assessment of principal in-channel and bank-side habitats (e.g., substrates, flow type) and their specific suitability as spawning, nursery, holding and residential sites for fish including salmonids, lampreys, eel, and any other species that are likely to be present, e.g., as a result of estuarine influence.

White-clawed Crayfish Presence/Absence Survey

Instream habitat patches were manually searched for a time period of no less than 30 minutes targeting at least 50 habitat patches per survey area for presence of white clawed crayfish (*Austropotamobius pallipes*) using a variety of recognised techniques (Peay, 2003) including lifting and disturbing large flattish rocks and cobbles, hand searching of undercuts, hollows and crevices and pond sweeping among emergent aquatic macrophytes. Two sites on each of the Tullyegan and Brusna (Glenree) River were searched, and one site on the Quignamanger (TE1, TE3, BR2, BR5, QG1: Appendix 9.2). Bunree and the tidal River Moy were unsuitable for crayfish survey.

Juvenile Lamprey Spot-checks

Select spots in river margin areas with stable silt deposits were gently disturbed into a standard pond net to check presence or likely absence of juvenile lamprey (ammocoetes). Any juveniles detected were recorded (numbers) and returned to the silty marginal areas amongst emergent vegetation where they quickly re-burrow into the substrates. The method did not allow for differentiation between sea, river and brook lamprey species (*Petromyzon marinus, Lampetra fluviatilis* and *Lampetra planeri*, respectively) but determined habitat suitability and distribution of juvenile lampreys. All three species of larval lamprey have the same habitat requirements and would be equally affected with respect to any proposed instream works. The potential distribution of each species was inferred from previous juvenile lamprey surveys which showed broad distribution of *P. marinus* and *Lampetra* spp. throughout the Moy catchment (O'Connor, 2004).

Floating River Vegetation

Floating river vegetation (FRV) habitat is the common name for Habitat 3260: Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation. The habitat is listed on Annex I of the Habitats Directive and requires protection within designated European sites. The River Moy is not designated for FRV habitat, but its occurrence was recorded because FRV is often a component of salmonid waters. Within the freshwater and estuarine tidal reaches of the River Moy its presence contributes to cover for migrating fish, although boulders, deeper glides, turbulent riffles and turbidity also provide cover in the lower river reaches. FRV has a broad classification, covering rivers from upland bryophyte and macroalgal dominated stretches, to lowland depositing rivers with pondweeds and starworts (EC, 2013; (Hatton-Ellis, 2003). Many of the species named as components of FRV habitat are widespread and common in Irish rivers including, *Ranunculus* spp., *Myriophyllum* spp*., Callitriche* spp*., Berula erecta, Zannichellia palustris, Potamogeton* spp. and the aquatic moss *Fontinalis antipyretica.* FRV assessments were made from both banksides of the riverine Moy (with occasional in-channel wading, where depth allowed and with permission from IFI to enter angling waters). The presence/absence and broad coverage of indicator species were then used, where relevant, to assess distribution of FRV habitat in relation to proposed measures.

Water Sample Analysis

Water samples were taken on the lower Quignamanger Stream where Annex I Priority Habitat 7220: Petrifying springs with tufa formation (Cratoneurion) was previously identified (Denyer, 2021). The reason for this was to help establish whether there was any groundwater contribution within the proposed instream works area, i.e., a localised 'petrifying spring.' The hypothesis was that the tufa formation was being fed by spring risings well upstream in the catchment, with tufa deposits forming after the spring fed stream emerges from the existing culvert. If a 'spring' was present locally, causing tufa formation, then there would be expected to be a signature of such in the downstream water sample, i.e., change in general parameters (pH, conductivity), nutrient and/or calcium carbonate levels. Two samples were taken: one upstream and one downstream of identified tufa formation located between the existing culvert outlet on Creggs Road and the Quay Road culvert. The two samples were taken on 12 September 2023 in 1-litre HDPE bottles, collected within 30 minutes of each other. They were stored in cooler boxes with freezer packs in transit, refrigerated overnight before delivery the following morning to Southern Scientific Services Limited, an ISO accredited laboratory (Irish National Accreditation Board (INAB) registration No. 194T). The following parameters were tested:

- pH
- Conductivity (µS/cm @ 20 °C)
- Alkalinity (mg/l as $CaCO_3$)
- Total Hardness (mg/l $CaCO_3$)
- Total Oxidized Nitrogen (TON) as N (mg/l)
- Ortho-Phosphate as P (mg/l)

Temperature and Dissolved Oxygen (DO % and mg/l) were recorded *in-situ* using a hand-held calibrated meter (Oxyguard Handy Polaris). Expert knowledge was applied in the context of this base geology type, and physico-chemical parameters were interpreted with respect to legally binding environmental quality national standards (EQSs) under Surface Water Regulations (S.I. 77 of 2019) to support the achievement of high and good ecological status, as set out in **Table 9-3**.

Table 9-3: Boundary Values for Irish Rivers ([1]S.I. 77 of 2019)

Parameter	High Status	Good Status
Ortho P (MRP) (mg P/l)	≤ 0.025 (mean) and ≤ 0.045 (95%ile)	≤ 0.035 (mean) and ≤ 0.075 (95%ile)
Ammonia (mg N/l)	≤ 0.040 (mean) and ≤ 0.090 (95%ile)	≤ 0.065 (mean) and ≤ 0.140 (95%ile)
BOD (mg O_2/l)	≤ 1.3 (mean) or ≤ 2.2 (95%ile)	≤ 1.5 (mean) or ≤ 2.6 (95%ile)
Dissolved Oxygen (% saturation)	80 -120%	

9.2.4 Key Parameters for Assessment

The aquatic impact assessment relied on assessment of baseline parameters including, but not limited to:

- Biological water quality indicators (macroinvertebrate Q-value).
- Physicochemical conditions (primarily nutrients, oxygen, suspended solids, dissolved metals).
- Fisheries habitat quality evaluation using a combination of WFD fish data and physical habitat survey and assessment.

[1] S.I. No. 77/2019 - European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2019

- Protected aquatic species habitat evaluation (salmon, trout, lampreys, white clawed crayfish, eel) using a combination of NPWS, IFI and NBDC data along with site-specific physical habitat survey and assessment.
- Evaluation of general hydromorphological conditions supporting the biological quality elements.

9.2.5 Assessment Criteria and Significance

9.2.5.1 Ecological Valuation of Watercourses

The criteria used for assessment of ecological value of watercourses are adapted from NRA (now Transport Infrastructure Ireland (TII)) Guidelines (NRA, 2003), (NRA, 2009) involving careful consideration of fisheries value, instream habitats, general hydromorphological condition, biological water quality indicators, and consideration of contextual information at a geographic level.

Ecological value was assigned to the receiving watercourses on the basis of habitat/species sensitivity, conservation status and geographical context. Evaluation criteria used to classify sites is shown in **Table 9-4**. This is based on NRA guidelines that were originally published in 2003 which set out criteria that classify aquatic habitat value within the study area, with slight modifications from the revision of that document in 2009. Only criteria with direct relevance to aquatic habitats and fisheries within the study area have been retained in this table. Site-specific survey data and EPA biological monitoring data fed into the overall assessment of aquatic ecological value. All assessments were made in the context of national trends, guidelines and regulations and WFD criteria, as appropriate.

The impact assessment approach adopted for aquatic ecology is from the 2018 Chartered Institute of Ecology and Environmental Management Guidelines (CIEEM, 2018) whereby Important Ecological Features (IEFs) are identified. An IEF is defined as one that is greater than Category D (Local Importance – Higher Value) in terms of **Table 9-4**. The effects on identified aquatic receptors within those IEFs are then considered individually according to their sensitivity to site-specific measures of the Proposed Scheme.

Table 9-4: Ecological Evaluation – Sensitivity Criteria for Watercourses

Relevant Criteria	Category
International Importance: • Sites designated (or qualifying for designation) as an SAC. • Salmonid water designated pursuant to the European Communities (Quality of Salmonid Waters); Regulations, 1988, (S.I. No. 293 of 1988). • Major salmonid (salmon, trout or char) lake fisheries.	**A**
National Importance: • Sites or waters designated or proposed as a Natural Heritage Area (NHA) or Statutory Nature Reserve or National Park. • Undesignated sites containing significant numbers of resident or regularly occurring populations of Annex II species under the EU Habitats Directive. • Resident or regularly occurring populations (assessed to be important at the national level) of species protected under the Wildlife Acts; and/or; species listed on a Red Data list. • Major trout fishery rivers. • Waterbodies with major amenity fisheries value. • Commercially important coarse fisheries.	**B**
County Importance: • Small water bodies with known salmonid populations or with good potential salmonid habitat. • Undesignated sites containing any resident or regularly occurring populations of Annex II species under the EU Habitats Directive. • Large water bodies with some coarse fisheries value. • Sites containing habitats and species that are rare or are undergoing a decline in quality or extent at a national level.	**C**
Local Importance (Higher Value): • Small water bodies with some coarse fisheries value or some potential salmonid habitat.	**D**

Relevant Criteria	Category
• Any waterbody with unpolluted water (Q-value rating 4-5, Q5).	
Local Importance (Lower value):	**E**
• Water bodies with no current fisheries value and no significant potential fisheries value.	

(Adapted from NRA, 2003 and 2009)

9.2.5.2 Impact Significance and Duration Criteria

Pre-mitigation and residual ecological impacts were assessed using the source-pathway-receptor (S-P-R) framework and classified according to significance and duration criteria set out in **Table 9-5** and **Table 9-6**.

Significance level, duration and likelihood of direct, indirect and cumulative effects on IEFs were stated according to the meanings set out in EIA Guidelines (EPA, 2022). While there may be several possible effects on IEFs arising from a project, it is only necessary to examine in detail the likely significant effects. Impacts that are either unlikely to occur, or if they did occur are unlikely to be significant, are scoped out and not addressed by specific mitigation. If in doubt, the precautionary principle is applied, and the potential impact is duly assessed.

Mitigation is proposed along the S-P-R chain using avoidance, prevention and reduction as per EPA Guidelines (2022). Particular consideration was given to effects of the proposed development on: (i) integrity of European Sites; (ii) Conservation Objectives for any Annex I habitats and Annex II species and (iii) River Moy designated Salmonid Water.

Table 9-5: Ecological Impact Significance Criteria (from EPA, 2022)

Significance of Effects	Criteria
Neutral	No impact
Imperceptible	An impact capable of measurement but without noticeable consequences
Not Significant Effects	An impact which causes noticeable changes in the character of environment but without significant consequences
Slight Effects	An impact which causes noticeable changes in the character of the environment without affecting its sensitivities
Moderate Effects	An impact that alters the character of the environment in a manner that is consistent with existing and emerging trends
Significant Effects	An impact which, by its character, magnitude, duration, or intensity significantly alters a sensitive aspect of the environment
Very Significant Effects	An impact which, by its character, magnitude, duration, or intensity significantly alters most of a sensitive aspect of the environment
Profound Effects	An impact which obliterates sensitive characteristics

Table 9-6: Ecological Impact Duration Criteria (from EPA, 2022 and CIEEM, 2018)

Impact Duration	Criteria
Momentary Effects	Effects lasting from seconds to minutes
Brief Effects	Effects lasting less than a day
Temporary Effects	Effects lasting less than a year
Short-term Effects	Effects lasting one to seven years
Medium-term Effects	Effects lasting seven to fifteen years
Long-term Effects	Effects lasting fifteen to sixty years
Permanent Effects	Effects lasting over sixty years
Reversible Effects	Effects from which spontaneous recovery is possible within a reasonable timescale or which may be counteracted by mitigation.

Impact Duration	Criteria
Irreversible Effects	Effects from which recovery is not possible within a reasonable timescale or there is no reasonable chance of action being taken to reverse it.

9.2.6 Data Limitations

This Chapter of the EIAR has been prepared based upon the best available information in combination with regular site visits and in accordance with current best practice and relevant guidelines. The following difficulties were encountered, with notes as to whether they represent a limitation to the outcome of the assessment:

- Access to Bunree and Quignamanger watercourses imposed by the fact they are contained within existing culverts. This did not affect the collection of baseline information, nor the assessment of effects because streams could be accessed upstream and downstream of the existing and proposed culvert replacements.
- Freedom of access to the Ridgepool was restricted by the angling amenity value of the reach. This was overcome by booking a time with IFI to access the pool to conduct instream surveys. Marginal habitats of the Ridgepool, i.e., those subject to proposed instream works, could also be viewed from the bankside at low flow / low tide when they became largely dewatered.
- Permission was obtained from IFI staff to carry out instream survey to help identify potential sea lamprey habitats of the Ridgepool on 12th September 2023. There were no fishing bookings that day meaning no disruption to the angling amenity. Nest building activity has been observed in discrete areas of the Ridgepool on many occasions by IFI staff. Sea lamprey spawning typically occurs in mid-May to June and as late as mid-July. It was not possible to conduct instream habitat surveys in the Ridgepool during spawning season owing to angling amenity restrictions, high summer water levels and the fact that the proposed instream works footprint was not fully clarified until Q3 2023. That being said, the surveys carried out in September 2023 coincided with very low flows and low tide (82 percentile daily mean water level for the tidal Moy, with low tide level of 0.552 representing 95 percentile based on OPW data derived for the period 2007 to 2023). In addition, earlier survey of the Ridgepool marginal area was conducted on 22nd July 2021 during extreme low flow / low tide (95 percentile daily mean water level with low tide level at 99 percentile of water levels on the tidal Moy). Such conditions on both occasions were amenable to assessing the marginal and near margin habitats of the Ridgepool in relation to sea lamprey spawning and nursery habitat. On a precautionary basis, and to cover any uncertainty and natural variability in terms of low flow, wetted channel width that could support sea lamprey spawning in any year, stringent mitigations have been included for works in the Ridgepool that will avoid any likely or significant effects on this species.

9.2.7 Consultations

Meetings and follow up consultations were arranged with stakeholders at all phases of the project. Comments and queries from stakeholders informed design and are addressed throughout this report and summarised in **Table 9-7**.

Table 9-7: List of Stakeholder Consultations

Consultees	Feedback	Location where Comment Addressed
Department of Tourism, Culture, Arts, Gaeltacht, Sport and Media	• The Proposed Scheme is within or potentially directly or indirectly affecting the River Moy SAC, the Killala Bay/Moy Estuary SAC and the Killala Bay/Moy Estuary SPA. Any potential for change to hydrological conditions, and the impact of this on riverine and riparian habitats, should be clearly identified and considered.	**Section 9.4** (Description of likely significant effects) addresses potential effects to SAC and SPA areas.
	• Any watercourse or wetland impacted on should be surveyed for the presence of protected species and species	**Section 9.3.3** highlights surveys completed to

Chapter 9: Aquatic Biodiversity

Consultees	Feedback	Location where Comment Addressed
	listed on Annexes II and IV of the Habitats Directive, or Annex I of the Birds Directive. • IFI should be consulted regarding fish species and note publication *"Planning for watercourses in the urban environment."*	identify presence of protected species. IFI consultation addressed below.
Inland Fisheries Ireland (IFI) Onsite Meeting (12 July 2022) Ridgepool, River Moy.	Ridgepool (where the instream works are proposed) is one of Ireland's premier salmon angling pools. Any instream works on the Ridgepool has potential to be very disruptive to the angling amenity with potential for impacts on migration (salmon, lamprey) and spawning (lamprey) of SAC qualifying interest (QI) species. The issue of avoiding impact during the open angling season was discussed with respect to ensuring the Ridgepool will not be closed to angling. It was noted that presence of sheet piles and/or pile-driving going on through the summer would mean the Ridgepool would effectively be closed, and they could not accept bookings in advance. However - the angling season also coincides with the legal period for instream works - which is a conundrum. IFI suggested there could be room for exemption (under the Local Authorities Act) to allow works to occur outside of the legal instream works period, therefore making it possible to keep the Ridgepool open during spring/summer.	**Chapter 5: Project Description, Section 5.7.1** (construction phase timing restrictions)
Inland Fisheries Ireland Written Correspondence (23 January 2023)	• IFI requested that nature-based solution to flooding and surface water run-off management be prioritised. • There must be no discharge of silted waters, cement products, hydrocarbons or otherwise polluted waters into any surface watercourse as a result of the proposed works. • Biosecurity measures must be implemented and there must be no spread of invasive species as a result of the proposed works. • Fish passage for all species present including eel, which is a critically endangered species, must be protected or enhanced; • Timing restrictions apply for instream works (subject to each watercourse fisheries value including amenity (Moy).	**Section 9.5** and **Chapter 12: Water Section 12.5** (mitigation of water quality effects, implementation of biosecurity measures and ensuring fish passage) **Chapter 5: Project Description, Section 5.7.1** (construction phase timing restrictions)
Inland Fisheries Ireland Online Meeting (8 February 2023)	• Heaviest angling season from May to mid-Sept. IFI request no instream works when possible. • The salmon weir is a protected structure owned by IFI. • Potential for access from Pedestrian Bridge/Art Centre to be in place during construction works (not critical if only working during closed period). • IFI would like to see the historical fishing access to river (not currently used) to be maintained for future upgrade. • IFIs preference is no works in June, July and August as the Cathedral area is second in terms of importance (after Ridgepool).	**Chapter 5: Project Description, Section 5.7.9** (instream works)
Inland Fisheries Ireland (Ridgepool Fisheries Officers, Resident Ghillie) In-person meeting at Ridgepool (11/12 September 2023)	• IFI Resident Ghillie (c.25 years' experience at Ridgepool) and Fisheries Officers provided detail of observations over many years of sea lamprey ascending the Salmon Weir (sometimes in very large numbers) at the head of the Ridgepool, being predated upon by otter, mink and birds. • IFI Resident Ghillie and Fisheries Officers pointed out the areas in which sea lamprey nest building activity has been observed. The area was located c.30-35m downstream of the Salmon Weir in the mid-channel c.30m downstream of the weir in the vicinity of an obvious break in the fast water (standing wave, riffle-run formation). • IFI Fisheries Officers explained that Senior staff at IFI Ballina would need to be consulted about possible instream habitat enhancements that could potentially be accommodated	See **Appendix 9.6**: Ridgepool Instream Habitat Survey

Consultees	Feedback	Location where Comment Addressed
	whilst there were temporary instream works with plant and equipment on-site.	
Inland Fisheries Ireland Online meeting (29 Sept. 2023)	Ridgepool Temporary Works Review with IFI staff: • Update provided on access and instream works footprint in front of IFI office at the Ridgepool. • Construction works to commence in August and be in place for 2 no. seasons. The access ramp will be constructed and used from Y1 August through until May 31st. It will remain in place Y2 June and July when the pool will be open for angling (i.e., pause in construction works to accommodate peak angling season). The contractor will need to be out of the pool by June 1st to facilitate angling in June/July. Contractor can return in August and work through but vacate pool by following June again. • There are no instream works in the Cathedral Beat, hence no requirement for restrictions on works in this reach. • Agreement that there will be consultation with IFI during the contractor tender process. • Agreement that IFI provide proposal for instream habitat enhancement works to be included in EIAR and AA processes. • Agreement that there will be further detailed engineering assessments to narrow down the instream works area as much as possible on Ridgepool Road side of the river. A 5 m temporary works area along the river margin will be included for assessment in the EIAR as a worst-case scenario, but some of the works on that side can be achieved from the bank without an instream footprint. Any instream works footprint would utilise 1-tonne sandbag cofferdams in 50m sections at any one time.	**Chapter 5: Project Description, Section 5.7.1** (construction phase timing restrictions) and **Section 5.7.9** (instream works)
National Parks & Wildlife Service (NPWS) Written Correspondence (19 Apr 2023	• Salmon, Sea lamprey, and Brook lamprey are Qualifying Interests (QI) of the River Moy SAC. Consequently, the department considers that any potential effects on these species, such as changes to their habitats, should be considered as part of the Environmental Impact Assessment Report (EIAR) and Appropriate Assessment (AA) processes. • Consider what effect the proposed flood walls and embankments will have on the hydro-morphology of the river channels and whether such impacts will adversely affect the conservation objectives of Salmon, Sea lamprey, and Brook lamprey, with reference to the relevant attributes and targets for these species. • For Sea lamprey and Brook lamprey the Conservation Objectives for the attributes 'Extent and distribution of spawning habitat' and the 'Availability of juvenile habitat' are particularly relevant. Similarly, for Salmon the Conservation Objectives for the attributes 'Number and distribution of redds' and 'Salmon fry abundance' are particularly relevant where changes to flow regime, water depth, and substrate conditions may occur. • Both spawning and larval habitat for Sea Lamprey occur in sections of the River Moy in the wider area of Ballina town (NPWS, 2004). The potential for the proposed flood walls, along the River Moy in Ballina, to affect these areas of Sea lamprey habitat should be considered. This may require the use of hydraulic models to illustrate the potential impacts of any proposed flood walls and embankments on the distribution of suitable substrate within the channels. Consideration should be given to how any potential increase in winter flow, and any consequent increase in energy, through the main channel, would affect the distribution of	**Section 9.4** (Description of likely significant effects) addresses potential effects on salmon, sea lamprey and brook lamprey within each watercourse. **Section 9.4.5** (Operational phase effects) addresses hydromorphological impacts and possible effect on habitats of QI aquatic species through examination of hydraulic modelling (velocity, Froude number)

Consultees	Feedback	Location where Comment Addressed
	suitable lamprey spawning and larval habitat, which depends on the erosion and deposition of suitable substrate. Surveys to record suitable spawning habitat (and/or the occurrence of redds), and suitable larval habitat (and/or the occurrence of larval lamprey) should be considered within any areas where substrate conditions may be affected.	

9.3 Description of the Existing Environment

9.3.1 Overview

The Proposed Scheme spans the Ballina section of the River Moy and upper River Moy Estuary, plus four separate tributaries of the River Moy: Tullyegan Stream, Quignamanger Stream, Bunree Stream and the Brusna / Glenree River (**Figure 9-1**). The River Moy, Moy Estuary and Brusna/ Glenree River are covered by conservation designations (See **Section 9.3.2**).

Figure 9-1 Location of Affected Watercourses (SAC Channels in Orange)

The River Moy and its major tributaries upstream of Ballina comprise a catchment area of approximately 2,045 km^2 flowing through the urban centres of Tubbercurry, Kiltimagh, Swinford, Foxford, Enniscrone and Crossmolina, including Lough Conn and Lough Cullin. It is one of Ireland's most productive salmon rivers and is internationally recognised for angling.

9.3.2 Conservation Designations

The River Moy within the study area for the Proposed Scheme is covered by the following conservation designations:

- River Moy Special Area of Conservation (SAC 002298)
- Killala Bay/Moy Estuary Special Area of Conservation (SAC 000458)
- Killala Bay/Moy Estuary Special Protection Area (SPA 004036)
- River Moy Salmonid Water (under S.I. No. 293 of 1988)

Table 9-8 sets out the water dependent habitats and species that are relevant to this chapter, i.e., Qualifying Interests of European sites and fishes of salmonid waters. Note that this table only includes the strictly water dependent habitats/species relevant to the aquatic ecology chapter.

Mammals (otter, harbour seal) and terrestrial or riparian based habitats (e.g., alluvial vegetation habitats) are covered in **Chapter 10: Terrestrial Ecology**.

Table 9-8 Protected Water Dependent Habitats and Species

Designated Site	Protected Water Dependent Habitats / Species	Relevance to this Assessment (source)
River Moy Special Area of Conservation (SAC 002298)	White-clawed Crayfish (*Austropotamobius pallipes*)	**Yes** – potential to occur within ZoI (NPWS, 2016)
	Sea Lamprey (*Petromyzon marinus*)	**Yes** – occurs within ZoI (NPWS, 2016)
	Brook Lamprey (*Lampetra planeri*)	**Yes** – occurs within ZoI (NPWS, 2016)
	Atlantic Salmon (*Salmo salar*)	**Yes** – occurs within ZoI (NPWS, 2016)
Killala Bay/Moy Estuary Special Area of Conservation (SAC 000458)	Estuaries [1130]	**Yes** – occurs within ZoI (NPWS, 2012b)
	Mudflats and sandflats not covered by seawater at low tide [Habitat 1140]	**Yes** – occurs within ZoI (NPWS, 2012b)
	Atlantic salt meadows (Glauco-Puccinellietalia maritimae) [Habitat 1330]	**No** – does not occur within reasonable ZoI (NPWS, 2012a)
	Salicornia and other annuals colonising mud and sand [Habitat 1310]	**No** – does not occur within reasonable ZoI (NPWS, 2012a)
	Sea Lamprey (*Petromyzon marinus*)	**Yes** – occurs within ZoI (NPWS, 2016)
Killala Bay/Moy Estuary Special Protection Area (SPA 004036)	*Various bird species*	*See **Chapter 10: Terrestrial Biodiversity** which covers the EIA for birds*
	Wetlands (Habitat A999)	**Yes** – occurs on the Moy Estuary at and downstream of Quignamanger Stream confluence
River Moy Salmonid Water	Salmon (*Salmo salar),* trout (*Salmo trutta*)	**Yes** – River Moy supports salmon, sea and brown trout within the ZoI

9.3.3 Baseline Environment

9.3.3.1 Desk Studies

9.3.3.1.1 EPA Biological Water Quality Review

The WFD is enforced in Ireland under the European Union Environmental Objectives (Surface Waters) Regulations S.I. No. 272 of 2009, as amended. Q-value status, as reported by the EPA, is determined by the biological quality element: macroinvertebrate fauna. A target for Q4 and above is required for rivers sites to comply with good (Q4) or better (i.e., high status - Q4-5, Q5). **Table 9-9** shows most recent (2022) river monitoring results from relevant EPA river stations (RS) on the River Moy and the Brusna River tributary.

There is no EPA Q-value data for the smaller tributaries. **Figure 9-2** shows the location of most recent EPA Q-values (2022), plus current EPA waterbody status (2016-2021). See the Water Framework Directive (WFD) Assessment (Appendix 12-1) for additional detail on waterbody status.

Table 9-9 EPA River Q-value Monitoring 2022

EPA RS Code	EPA RWB Name	River Name	Station Name	Location in relation to proposed scheme	EPA 2022	Q-value Status (2022)	Waterbody status (2016-2021)
34M021050	Moy_120 (River)	Moy	1 km u/s Ardnaree Br (LHS)	Just upstream Ballina salmon weir	Q3-4	Moderate	Moderate
34M020850	Moy_110	Moy	Near Bunnafinglas	11km u/s Ballina salmon weir	Q4	Good	Good
34G010200	Glenree_030	Brusna	Bunree Bridge	1.6km d/s Shanaghy Heights Bridge (just u/s Moy confluence)	Q4-5	High	Good
34G010100	Glenree_030	Brusna	Ford u/s Rathkip	0.6km u/s Shanaghy Heights Bridge	Q4-5	High	Good

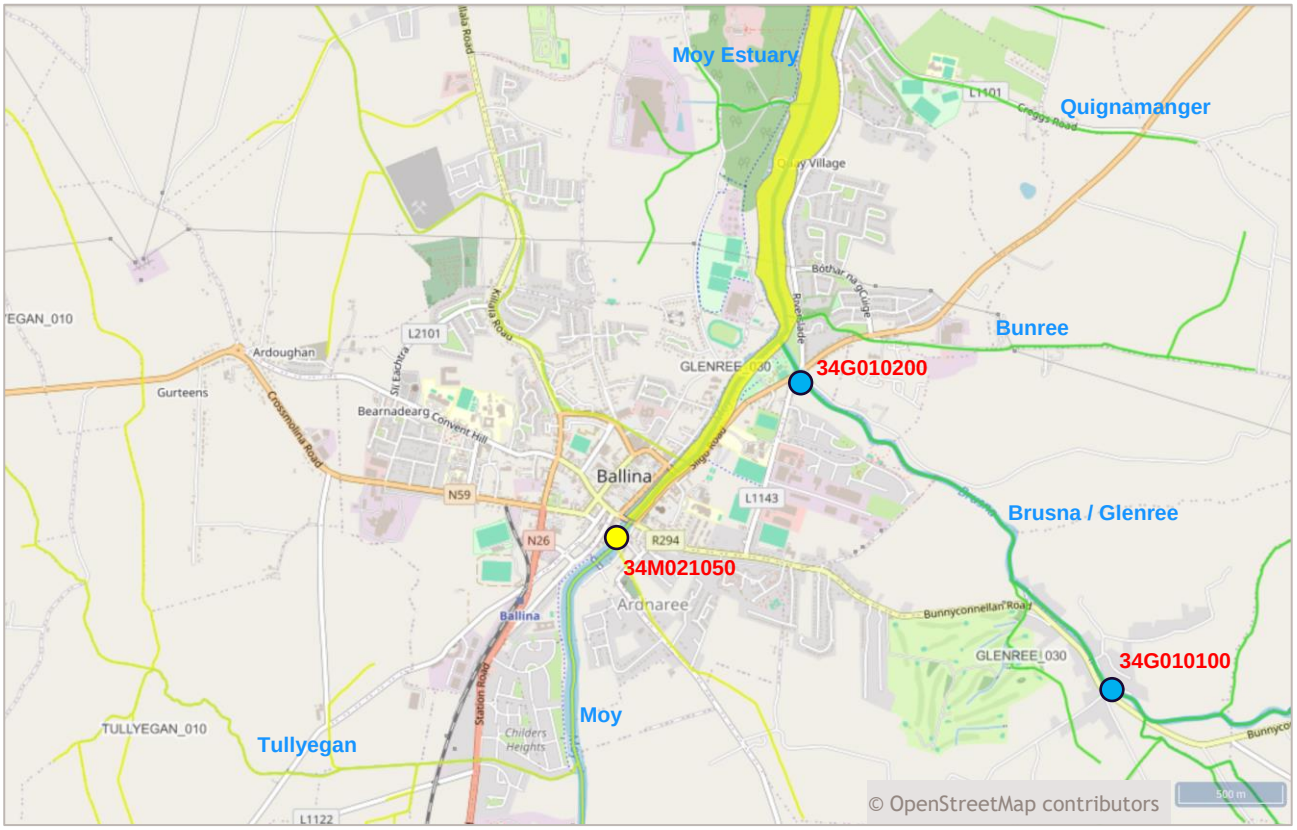

Figure 9-2 Location of EPA Q-Value Stations and Waterbodies

9.3.3.1.2 River Moy Fisheries Review

IFI undertook fisheries surveys in the Moy catchment on four occasions (2008, 2010, 2012 and 2016) as part of the WFD Fisheries Monitoring programme (Kelly *et al.,* 2009, 2010, 2013, 2017). The most recent survey targeted ten different River Moy sites within the same year (2016) and provide a good indication of the longitudinal utilisation of the channel by various fish species.

Six sites were located between Foxford and Ballina (8.7 km -14.5 km upstream of Ballina salmon weir) and four sites were on the upper Moy, northwest of Tobercurry. The four upper catchment sites were wadeable

and were dominated by juvenile salmon and brown trout ([2]0+ and 1+ and older fish) with smaller numbers of lamprey, stoneloach, minnow and 3-spined stickleback. The six lower catchment sites were surveyed by boat, with five of those sites recording only coarse fish species, mainly roach, with a few perch. One of the lower catchment sites had roach, perch and small numbers of 0+ and 1++ salmon (Kelly et al., 2017).

One WFD surveillance site was electric fished in 2012 on the River Moy at Ardnaree Bridge, located 1.3 km upstream of Ballina salmon weir. The 394 m survey reach was glide habitat over mud and silt substrates. Roach was the most abundant species, followed by salmon (0+, 1+ and older) (n = 27), juvenile lamprey, three-spined stickleback, brown trout, eels and minnow.

Three sites were electric fished in 2010: two between Foxford and Swinford (Bleanmore, Gweestion) and one in the upper catchment near Tobercurry (Cloonbaniff). The upper river site, Moy (Cloonbaniff), was dominated by minnow and salmon (n = 27) with brown trout, 3-spined stickleback and stone loach. The mid-river, Moy (Gweestion) site had an abundance of juvenile salmon (n = 317), with 93% of the catch being 1+ age class fish, indicating presence of excellent salmonid nursery habitat. Other species at Moy (Gweestion) were roach, brown trout, minnow, eels, sea trout and 3-spined stickleback. The most downstream reach surveyed in 2010 was the Moy (Bleanmore) site, which was dominated by roach followed by salmon, eels, perch, brown trout, minnow, 3-spined stickleback and pike.

The above IFI data, combined, shows the lower reaches of the Moy (downstream of Foxford) tend to be dominated by coarse fish species, mainly roach with perch and pike also present. Historically drained, sluggish, silty glide habitats that dominate these lower reaches are ideal for coarse fish. Conversely, the stony bottomed, faster flowing mid- and upper reaches of the Moy, and its lower order tributaries, are dominated by salmonids where the vast majority of spawning and nursery clearly occurs. Of relevance to the Proposed Scheme, this indicates is that, for anadromous salmonids (salmon, sea trout), the lower river reach in Ballina is primarily a migration route only.

The River Moy is recognised as one of the most important salmon rivers in Ireland, famous for the Ridgepool and Cathedral Beat within Ballina. The theoretical [3]Conservation Limit (CL) set for the Moy by the Standing Scientific Committee on Salmon (SSCS) is currently 16,736 fish annually (Millane et al. , 2023). Unlike many rivers in Ireland, The Moy exceeds its CL by a substantial margin, which allows for direct harvest of salmon on an annual basis by recreational anglers. The Moy has the highest salmon population in Ireland, with a forecasted return surplus for 2023 (numbers above CL) being 12,159, equating to 173% of CL. Fish counters located on the Ballina Salmon Weir provide a partial fish count each year. Counts for 2020-2022 are shown in **Table 9-10** (IFI 2021, 2022, 2023), demonstrating the bulk of returning fish are grilse (one sea winter salmon), with a healthy proportion of larger spring salmon (multi sea winter). Note that the majority of fish travelling upstream do so through the central “King’s gap” on the Salmon Weir at the head of Ridgepool without being counted, hence the counts provided in **Table 9-11** are only a proportion of the returning numbers. The King’s gap is not within the Proposed Scheme footprint and will not be obstructed during the construction or operational phases.

Table 9-10 River Moy Fish Counter Data 2020-2022

Year	2020	2021	2022
Spring Salmon	1,238	1,012	1,134
Grilse	8,151	8,869	7,868
Late Summer Salmon	1,962	973	2,452
Sea Trout	0	0	0

IFI Ballina further provided a breakdown of Moy salmon count data between 2012 and 2018 (**Table 9-11** and

[2] Salmonids are classified according to age which provides an indication of population structure based on spawning success trends: 0+ = young of the year (hatched in the preceding winter/spring); 1+ and older = juveniles hatched over one year or more previous.

[3] Conservation Limit (CL) = scientifically derived sustainable stock level, i.e., the number of returning salmon that would be required to maintain the carrying capacity of the system based on its accessible area of fluvial habitat.

Table 9-12; **Figure 9-3** and **Figure 9-4),** which demonstrate upstream and downstream salmon run timing past the Salmon Weir. The data shows an upward migration peak in July / August, with downstream migration (smolts) timing variable, but more common July to October.

Table 9-11 Upstream Salmon Movement by Month (Fish Numbers)

Upstream Salmon	2012	2013	2015	2016	2017	2018
April	4				12	
May	94	88	118		69	
June	771	1223	359		556	
July	3327	5757	3158	1482	2312	1146
August	2919	1762	1080	1813	3039	2415
September	711	232	1531	228	316	108
October	22		58	53	76	14

Table 9-12 Downstream Salmon Movement by Month (Fish Numbers)

Downstream Salmon	2012	2013	2015	2016	2017	2018
April	0					
May	11	33	1		14	
June	20	15	16		35	
July	36	36	30	24	48	114
August	15	81	34	13	33	82
September	123	29	61	21	2	13
October	61		31	30	24	21

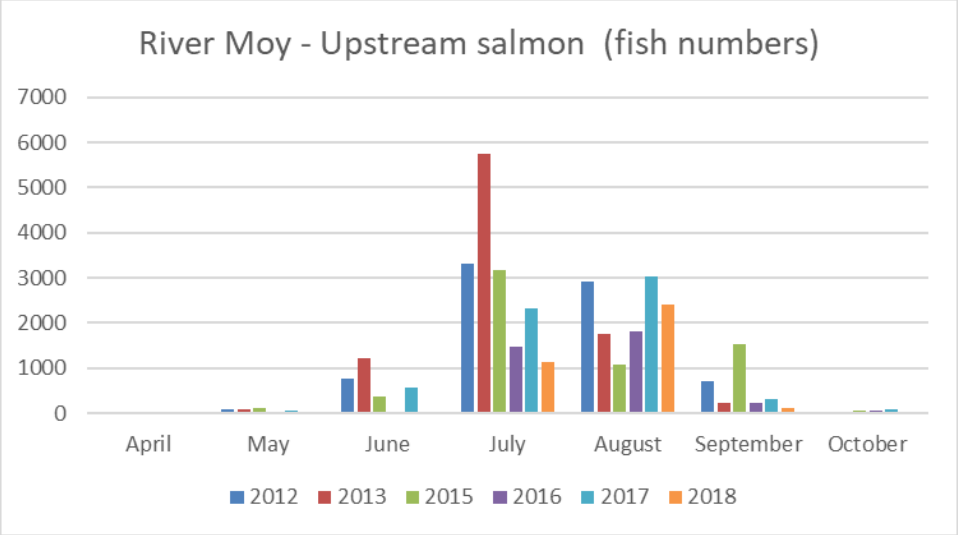

Figure 9-3 Upstream Salmon Movement by Month (Fish Numbers)

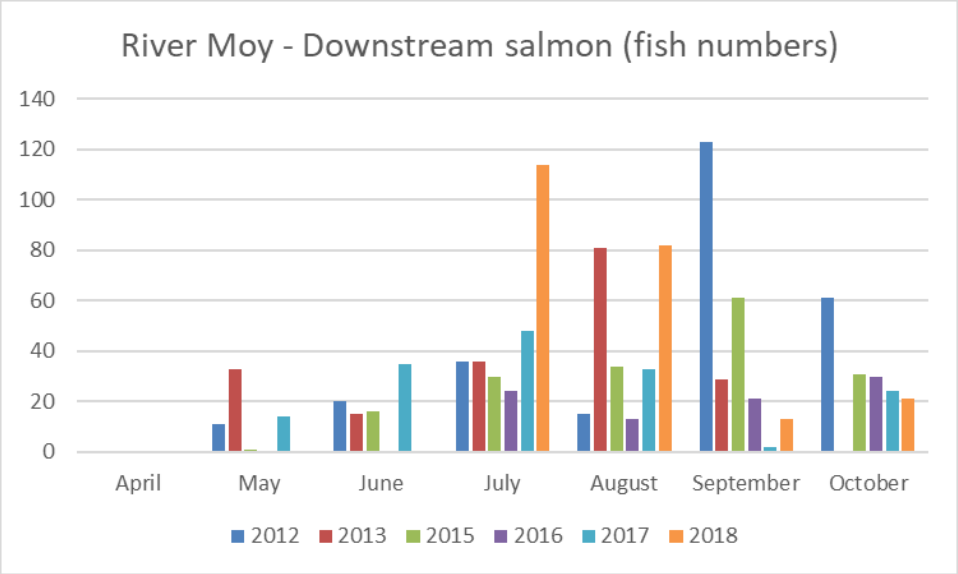

Figure 9-4 Downstream Salmon Movement by Month (Fish Numbers)

The abundant salmon population in the system is supported by good to high water quality combined with good quality spawning and nursery habitats throughout most of the upper catchment and in the upper tributaries. The river also benefits from the fact that most of its fluvial habitats are accessible to salmon despite the presence of the Salmon Weir in Ballina.

O'Connor (2004) carried out juvenile lamprey surveys covering 75 sites throughout the Moy catchment using electrical fishing methods. At least two species were confirmed: sea lamprey (*Petromyzon marinus*) and brook/river lamprey (*Lampetra* spp.) with *Lampetra* sp. comprised 84.9% of the lamprey abundance. Overall, juvenile lampreys were present at 62% of the 75 sites examined. Juvenile sea lampreys were quite widely recorded, constituting 18% of the total number of juveniles captured O'Connor, 2004 cited in (King, et al., 2008)) and were present at 24% of catchment sites. Sea lamprey larvae (ammocoetes) were generally confined to the Lower River Moy but were also present in some of the tributaries (e.g., River Deel upstream of Lough Conn) proving this migratory species can access at least parts of the upper catchment.

The sites electrofished within Ballina (and within the Proposed Scheme footprint) were positive only for larval sea lamprey, whilst further upstream between Ballina and Foxford, larvae of both sea lamprey and brook/river lamprey were present. The reach within Ballina and specifically the Ridgepool were identified as an area "*that may be of importance for sea lamprey spawning*." It is noted that mean minimum densities of lamprey recorded in the Moy catchment were significantly lower than those recorded in similar surveys of other large Irish rivers, e.g., Slaney and Munster Blackwater, which was attributed by the author to the impact of the Moy's extensive historical and ongoing arterial drainage schemes (O'Connor, 2004).

9.3.3.1.3 Brusna River Fisheries Review

IFI conduct Catchment-Wide Electro-Fishing (CWEF) on the Brusna River as part of fisheries conservation management. CWEF involves electrofishing a range of sites throughout the subject catchment within the period July-September (inclusive) of that year. Average salmon fry captured in the Brusna per 5 minutes fishing at a range of sites throughout the catchment were ~5.00, 14.16 and 14.74 for 2009, 2013 and 2014, respectively. The catchment was also surveyed in 2020, returning an abundance of 6.73 salmon fry/5min but that survey was not completed, and data was therefore not considered an accurate representation of the current density (Holmes, et al., 2022). On rivers like this where data on adult salmon returns are unavailable or limited, a threshold of 17 salmon fry/5min is required to open the river for angling on a catch and release basis. The Brusna currently fails this threshold, meaning it is closed to angling and also indicating that salmon stocks are not as abundant as they ought to be for such a system, with good salmonid habitat and good-to-high water quality throughout. The CL for the Brusna is currently 1,096 fish (Millane *et al*., 2023), but the low CWEF indicates the CL is not being met. The reason for low CWEF may be owing to hydromorphological (hydraulic) conditions as a result of historical and ongoing maintenance as part of the

Moy arterial drainage scheme (Channel C1/5). **Appendix 9.8** and **Section 9.4.5** examine Brusna hydraulic conditions (velocity, Froude number) in the vicinity of Shangahy Heights (Proposed Scheme), which demonstrates sub-optimal habitat for spawning because of historical channelisation.

A series of natural cascades and falls on the lower reaches of the Brusna River is clearly passable by (at least some) salmonids but appears to be a barrier to upstream migration by lampreys. Sea lamprey (*P. marinus*) and river/brook lamprey (*Lampetra* spp.) were present below the falls, but with no evidence upstream. Sea lampreys dominated the juvenile lamprey population of the lower Brusna (O'Connor 2004). A site located on the right-hand side bank, downstream of the N59, recorded 12 no. sea lamprey and 1 no. *Lampetra* spp. Overall, mean sea lamprey density on the lower Brusna (0.2/m^2) was similar to the River Moy main channel (0.28/m^2), while mean *Lampetra* spp. density (0.02/m^2) was much lower than that of the Moy (0.61/m^2).

9.3.3.2 Field Studies

Detailed field survey target notes are presented in **Appendix 9.3.** Representative site photographs set out in **Appendix 9.4**. Macroinvertebrate lists are presented in **Appendix 9.5**, showing Q-values arising from sampling in July 2021 and July 2022. A detailed survey of Ridgepool was conducted in September 2023 with results presented in **Appendix 9.6**. These appendices should be referred to in conjunction with the summary text below regarding each watercourse.

The following paragraphs provide a synopsis of aquatic habitat characteristics and important aquatic receptors of each relevant watercourse. Banks are referred to in terms of Left-Hand Side (LHS) or Right-Hand Side (RHS), which are the true left and true right banks facing downstream.

River Moy

The following description should be ready in conjunction with the detailed target note descriptions and photographs for field survey sites M1 to M15 (Appendices 9.3 and 9.4). The focus was on reaches of the River Moy in Ballina where measures are proposed under the scheme, particularly those requiring temporary instream construction works.

The River Moy from the footbridge upstream of the Salmon Weir to the Lower Bridge (N59) is currently highly modified owing to existing river walls and historical fisheries modifications, i.e., the Salmon Weir itself, plus flow modification structures: paired deflectors (Cathedral Beat) and "groyne" (Ridgepool). The location of the "groyne" can be viewed in **Appendix 9.6, Figure 3-4**).

The channel downstream of the Salmon Weir is tidally influenced. The Ridgepool forms the lower freshwater reach of the River Moy, and the Cathedral Pool forms the upper, freshwater dominated, estuarine reach of the River Moy.

The stretch downstream of the Lower Bridge (N59) can be classed as a laminar glide with slow flowing margins, especially along the LHS inside the floating dock at Bachelors Walk. Both banks form a berm inside the existing river walls downstream of the Lower Bridge, supported by a row of boulder rip-rap that is exposed at low tide. These marginal berms are largely terrestrial and support a diverse riparian swathe of marginal tall herb plant species pertaining to "tall herb swamp" (see description for Site M1, **Appendix 9.3**).

The main value of the stretch is in terms of the migration of salmon, sea trout, sea/river lamprey and eel, both seaward and landward. There are also likely to be resident and transitory species including, sea lamprey (juvenile "ammocoetes"), eel, juvenile flounder, trout, minnow, three-spined stickleback and possibly roach, which have been recorded in the channel upstream of the town by IFI in their WFD fish surveys (Kelly et al., 2009, 2010, 2013, 2017). Shoals of grey mullet were observed at low tide from between the floating pontoon on Bachelors Walk and the Upper Bridge (R294) in both July 2022 and September 2023. Lamprey ammoecoetes were common in the silty substrates at the river margins accessed from the pontoon (M15: 3 no. lamprey /5min search) and further upstream (M14: 5 no. lamprey /5min search) during targeted sampling in July 2022 and September 2023. These were very likely to be sea lamprey (*P. marinus*), given this was the only species of juvenile lamprey recorded along this reach in previous surveys (O'Connor 2004), i.e., LHS 500m downstream of the Lower Bridge. Larval brook and river lamprey (*Lampetra* spp.) cannot be ruled out as the nursery habitat is equally suitable for these species.

Regarding sea lamprey (*P. marinus*) which is a qualifying interest of both the freshwater and estuarine River Moy, nursery habitat is suitable, although patchy, for juvenile *P. marinus* along both river margins

downstream of the Lower Bridge. The first 25 m on the LHS downstream of the Lower Bridge has no suitable lamprey nursery habitat owing to entry of the Knockanelo culvert (M13). The next 100 m downstream is sub-optimal for lamprey nursery because boulder riprap lining the riverine side of the berm tends to reduce suitability of marginal habitat to juvenile lampreys, i.e., tends to reduce silt deposition, although there are small pockets of suitable sediment accumulation behind larger rocks in which larval lampreys were detected. From a point adjacent to Rope Walk Lane, juvenile lamprey habitat then improves with distance downstream of the Lower Bridge on the LHS. The best of the juvenile lamprey habitat is located approximately 125 m downstream of Lower Bridge, continuing downstream from there, i.e., in the reach that is not subject to potential instream works during river wall construction. It is noted that the larval lamprey habitat in this part of the lower Moy represents a tiny fraction of overall available nursery habitat in the catchment.

The Ridgepool (Salmon Weir to Upper Bridge) and Cathedral Pool (Upper to Lower Bridge) contain more turbulent and higher velocity central channel flows, mainly at low tide and at periods of low flow owing to the presence of rapids over the weir and intermittent paired deflectors in the Cathedral Pool. These reaches are still migration routes for anadromous fish (salmon, sea trout, sea / river lampreys). River margin habitats in these reaches are markedly different to those present downstream of the Lower Bridge, being more eroding than depositing type habitats.

The existing engineered walls and boulder deflectors generally do not favour lamprey ammocoetes in the Cathedral Pool and, indeed, none were located upon manual searching during July 2022. There was one patch of juvenile lamprey habitat confirmed in the Ridgepool on the LHS (in front of Ballina Manor) 40 m upstream of the Upper Bridge (12 September 2023). Two lamprey ammocoetes were captured within 15 min of searching amongst silty deposits around a patch of emergent *Sparganium erectum*. Another patch of potential juvenile lamprey habitat exists immediately upstream of the Upper Bridge on the RHS (Ridgepool Road). It is noted, however, that juvenile lamprey habitat in the Ridgepool is very sparse and spatially discrete owing to channel morphology and water levels. Both the LHS and RHS margins of the Cathedral Pool and the Ridgepool become very shallow / partially dewatered at low tide, meaning these areas are largely ephemeral habitat for fish. See **Appendix 9.6** for a further detailed analysis of Ridgepool instream habitats in relation to proposed temporary instream works areas.

The River Moy reach through Ballina contains marginal swathes of ephemeral FRV, predominantly *Potamogeton x zizzi, Potamogeton perfoliatus* and *Ranunculus* spp. with other FRV indicator species including *Fontinalis antipyretica* and *Myriophyllum spicatum*. The instream vegetation would provide good cover for juvenile and migrating fish (for species details see descriptions for Sites M1 – M15, **Appendix 9.3**). Considerable mats of pollution tolerant Filamentous Green Algae (FGA) (*Cladophora* and *Vaucheria* spp.) were noted during all site visits to the Moy (2021-2023) with filamentous brown diatom attached, i.e., indicating slight nutrient enrichment combined with the open, unshaded nature of the channel and summer water temperatures.

Quignamanger Stream

The following description should be ready in conjunction with the detailed target note descriptions and photographs for field survey sites QG1 to QG6 (**Appendices 9.3 and 9.4**). The upper reach (QG1) of the Quignamanger Stream has evidence of historical drainage, but has recovered reasonably natural morphology, flowing through a woodland area between sites QG1 and QG2. The stream has high alkalinity, evidenced by patches of calcareous concretion (QG2) and tufa formation. The stream is clearly spring fed, given the clarity of the water and volume, even during dry periods, in July 2022 and September 2023. Tufa formation (calcareous precipitate) was evident in patches along open reaches both upstream and downstream of the existing culvert system, as located by (Denyer, 2021) pertaining to Annex I Priority Habitat 7220 (hereafter *7220): Petrifying springs with tufa formation (Cratoneurion).

The current configuration of the culverted stream has resulted in the majority of flows being redirected to a diversion channel running under the road. The diversion culvert is fully culverted / piped downstream for over 1 km from a point located 20 m downstream of QG2 to where it emerges via a flap valve into an open, channelised reach upstream of QG5. Stormwater swales are present along Creggs Road (QG3, QG4), but there was no obvious connection with the culverted stream beneath. The stream emerges into the open area on the lower Creggs Road via the flap valve at ITM X, Y: 525774, 821146. Upstream of this point there is the dry channel with stream culvert opening located at ITM X, Y: 52577, 821133. There was no flow in the stream during site visits of July 2022 and September 2023.

The stream is deepened and channelised by vertical, stone / concrete walls on both banks along the exposed reach at the Creggs/Quay Road intersection. It forms glide/run flow and a series of small cascades where tufa formation was evident. Tufa deposits were also observed on masses of the pollution tolerant FGA (*Vaucheria* sp.) which was common along the stream bed, indicative of a degree of nutrient enrichment and concurring with Q3, "moderately polluted" and 'poor' status taken in kick-sampling (2022) at Site QG2 (**Appendix 9.5**).

Denyer (2021) recorded tufa cascades and frequent Priority Habitat *7220 positive indicator species in the lower Quignamanger at the Creggs/Quay Road junction, stating that the entire stream catchment from upstream of the existing culverted section is part of the same *7220 system. **Appendix 9.7** sets out results of water sampling in the lower Quignamanger conducted on 12 September 2023, showing no notable difference in water chemistry upstream and downstream of the obvious tufa cascades/deposits. This demonstrates no evidence of localised "springs" supporting the *7220 habitat here. Tufa deposits arise from the base-rich stream water forming calcium precipitates upon oxygenation over the small cascades. The existing stream walls are very stable, encasing the *7220 tufa habitat and tending to encourage turbulence over the low, narrowed cascades that create facilitate tufa deposition.

The channelised stream enters an existing low box-type culvert under Quay Road, merging to a 900 mm pipe that discharges to the River Moy below the high tide mark (QG6).

The Quignamanger Stream has low fisheries significance owing to extensive existing culverting that begins at the Moy confluence. Only approximately 50 m of the lower channel is likely accessible to any salmonids. The upper catchment reach (upstream of existing culverts) was positive for stickleback, but it is generally of low fisheries significance with little in the way of potential trout habitat owing to calcareous concretions and/or dominance of silty, unsuitable substrata (QG1, QG2).

Salmonid parr (salmon and/or trout) were observed foraging in the approximately 50 m open stretch of the lower Quignamanger (near the existing Quay Road culvert) in both May and September 2023. The channel here is not suitable for spawning, but salmonids (perhaps outwards migrating smolts) appear to be accessing the area from the River Moy and foraging as supplementary nursery habitat. Eels are likely to be present and because of the low gradient of the existing culvert system, there is potential for the species le to reach the upper catchment. The riparian area of the Creggs/Quay Road intersection reach is covered in a low scrub, forming an overflow area during periods of high flow / high tide on the Moy.

Bunree Stream

The following description should be ready in conjunction with the detailed target note descriptions and photographs for field survey sites BN1 to BN5 (**Appendix 9.3 and Appendix 9.4**). The upper reaches of the Bunree are very low volume with dry and damp patches alternating with stagnant small pools. The habitat is generally low-quality; drained and modified by either agriculture or realignment alongside the Behy Road. Kick-sampling at site BN3 in July 2022 returned a Q-value of Q3 ('poor' status) (see **Appendix 9.5**) which is significantly poorer than the EPA waterbody status (2016-2021) modelled rating of 'good' status in this stream. Impaired water quality, low stream volume and disturbed hydromorphology (drainage, realignment and culverting) means this stream has little, if any fisheries significance (perhaps stickleback at best). There is no salmonid or brook lamprey spawning or nursery habitat upstream of the existing culverts; low water volume coupled with poor water quality further militates against fisheries significance. The Bunree is predominantly culverted between BN4 and BN5 through the urban area, with a small, open channel section outflowing to the main channel of the tidal River Moy at BN5.

Brusna (Glenree) River

The following description should be ready in conjunction with the detailed target note descriptions and photographs for field survey sites BR1 – BR6 (**Appendices 9.3** and **Appendix 9.4**). The Brusna River (EPA name Glenree) is a moderately large river that flows westwards from the Ox Mountains to meet the tidal River Moy at Ballina. The potentially affected reaches are generally 10-12 m wide, forming a series of shallower riffle/runs (average ~30 cm deep) and deeper glides with occasional pools. Hydromorphology is reasonably natural despite the urban setting, although evidence of historical modifications exists in the form of overgrown boulder riprap along both banks. The river corridor is almost fully tree-lined providing good cover to fish and helping regulate instream temperature. A series of natural bedrock cascades and rapids, plus a weir occur upstream of the N59 bridge (BR6). These obstacles are passable by inward migrating salmonids but are a barrier to anadromous sea and river lampreys (O'Connor, 2004). Brook lamprey (non-migratory) was not recorded above the barriers and does not appear to be present in the reach subject to

proposed flood relief works. The habitats of this part of the Brusna (Glenree) are largely unsuitable for brook lamprey nursery, i.e. elevated water velocity and lacking in silt deposits. The reach where measures are proposed under this scheme is part of the River Moy SAC, with Atlantic salmon considered the only aquatic QI species potentially affected in the locality of proposed works on the Brusna (Glenree). . Physical habitat is conducive to white-clawed crayfish, but two 45-minute manual searches targeting 2 x 50 potential habitat patches (at BR2 and BR4) showed no evidence of the species. Within habitat of such good quality, crayfish should have been detected within that period if they were present in any numbers or at all.

The SAC also covers the riparian zone in the reach where new walls/ embankments are proposed. The RHS bank is predominantly reinforced with either existing walls or historical riprap boulder and more-or-less continuous shading from a broadleaf tree line. The LHS is also partially reinforced with boulder rip-rap but is more open, with managed grassland and mainly scattered clumps, lines or single specimen trees. Kick-sampling at Brusna River site BR2 returned a Q-value of Q4-5 ('high' status) (see **Appendix 9.5**), which concurred with EPA monitoring (2022 data) also recording high status. The habitats along the entire reach subject to proposed modifications are conducive to salmon and trout spawning and nursery, although historical channelisation has resulted in higher than ideal in-channel velocities during elevated flows (see **Section 9.4.5**). With high-status waters and tree-covered pools and glides providing cover for holding of resident and migrating fish, it comprises good to excellent salmonid habitat and high fisheries value.

Shanaghy Heights Bridge (BR3a) has existing, eroded concrete / conglomerate bed and bank protection extending 6 m upstream and downstream either side. The river reaches upstream and downstream of the bed/bank protection are very good salmonid habitats (spawning /nursery upstream, holding downstream). There is an obvious low flow channel eroded into the existing bed protection. Its conglomerate nature, along with deposited cobble/coarse sand and bryophytes creates fairly "natural" hydromorphology that would facilitate fish passage even during low flows. Existing concrete block and rip-rap bank protection is also eroded and slumping into the river.

A small tributary (Dovehill – Site DH1) enters the Brusna within the reach where the embankment is proposed. This is a minor tributary, highly modified by deep drainage and is culverted for a distance of approximately 100 m between the R294 road and the Brusna main channel. Upstream of the R294 it forms a stagnant glide over silty substrates and has no salmonid significance, but eel are possible and stickleback presence is likely.

Tullyegan Stream

The following description should be ready in conjunction with the detailed target note descriptions and photographs for field survey sites TE1 to TE4 (**Appendices 9.3** and **9.4**). The Tullyegan is a small tributary of the River Moy, highly modified throughout by historical, recent and clearly ongoing drainage as part of OPWs Moy drainage scheme (Channel C1/7). The catchment is mainly agricultural in the upper reaches (TE1, TE2, TE3), including some one-off rural housing. The downstream reach (TE4) nearer the Moy confluence flows through an urban area, enclosed by existing, high concrete flood defence walls. There is potential for trout and brook lamprey spawning and nursery throughout this stream, although impaired water quality and ongoing arterial drainage maintenance may depress fisheries value. Presence of eel and stickleback is likely. Even though there was habitat potential for white-clawed crayfish, a 45 min manual search targetting 50 habitat patches showed no evidence of the species. In habitat of this type, with an obvious calcareous nature, crayfish ought to have been detected if present, thus crayfish are considered very likely to be absent from the Tullyegan. However, eDNA data from studies by the Marine Institute, as part of the National Crayfish Plague Surveillance Program detected crayfish DNA in a sample taken upstream of Ballina (at the weir footbridge) during 2020. Note that a positive result for crayfish DNA does not delineate how far upstream the source animal / population occurs. There is evidence that DNA in river environments can travel considerable distances downstream providing positive results despite the source population being well upstream. For example, downstream eDNA detection distances have been reported as: 22.8km for rare frogs in a headwater stream catchment (Villacorta-Rath et al., 2021), 9km for *Unio tumidus*, a lake dwelling freshwater mussel (Deiner and Altermatt, 2014), 7km for freshwater crayfish in a stream catchment in south-west Germany (Chucholl et al, 2021). Therefore, a positive crayfish DNA sample above the salmon weir in Ballina could be detecting crayfish located well upstream of the Proposed Scheme. On the basis of focused manual searching surveys crayfish were deemed extremely unlikely within the Proposed Scheme study area, but as a precaution, the species was scoped in for Tullyegan Stream to avoid any doubt as to conclusions in the assessment. Kick-sampling at site TE3, just upstream of the proposed new flood walls, returned a Q-

value of Q3-4 ('moderate' status) (see **Appendix 9.5**) which concurs with EPA reported waterbody status (2016-2021) in this reach.

9.3.3.3 Aquatic Receptor Summary

Table 9-13 summarises aquatic receptors of potentially affected watercourses, categorizes ecological valuation and classifies the Important Ecological Factors (IEF)s that are considered in the impact assessment. Note that IEFs are those that are of Ecological Valuation Category A to D and are brought forward for impact assessment.

Table 9-13 Aquatic Receptor and IEF Summary

Watercourse	Fisheries Significance	Designations and QI Habitats / Species	Water Quality & ecological status	Ecological Evaluation	IEF scoped into assessment
River Moy	Main channel in downstream ZoI is principally a migration and holding channel for adult salmonids, lampreys and European eel. Spawning habitats for salmonids are largely upstream of Ballina. Sea lamprey have been reported nest building (spawning) in the Ridgepool. Silt at channel margins provide nursery habitat for juvenile lampreys (predominantly sea lamprey) downstream of the N59 Lower Bridge and in 2 no. discrete patches in the Ridgepool. LImited ephemeral (tidally influenced) salmonid nursery habitats in faster water of Ridge and Cathedral Pools.	Designated Salmonid Water River Moy SAC Killala Bay/Moy Estuary SAC Annex II Atlantic salmon (migration) Annex II Sea lamprey (migration route and nursery) Annex II Brook lamprey (possible)	EPA 2022 Q-value: Q4 Good status (compliant with WFD objectives)	A - International Importance	**Yes**
Quignamanger	Small stream, highly modified by culverting and urban development. No salmonid or lamprey habitats in the upper catchment. Salmon/trout parr appear to be foraging in the lower 50m of open channel at Cregg/Quay Road junction. Eel are potentially able to negotiate existing long culverts.	Lower reach supports priority habitat *7220, with areas of tufa formation common. QI Salmon (smolts) forage here from time-to-time.	2022 Q-value: Q3 [4]potential 'Poor' status (not compliant with WFD objectives)	C - County Importance	**Yes**
Bunree	Small stream, highly modified by culverting and urban development. No salmonid or lamprey habitats. Eel are unlikely to negotiate existing, long culvert through urban area with very little potential habitat for eel upstream of the culvert system in any case (limited flow, highly drained). The short, open reach near the Moy confluence may host foraging salmonids.	None - and does not support Conservation Objectives for downstream QIs	2022 Q-value: Q3 potential 'Poor' status (not compliant with WFD objectives)	D – Local Importance (Higher Value)	**Yes** (lower reach with connectivity to River Moy)
Brusna / Glenree	Excellent quality salmonid spawning, nursery and holding habitat with quite natural hydromorphology (recovered from historical drainage) and 'high' status water quality. Sea and brook lampreys recorded in lower reach near Moy confluence (downstream N59 bridge) but not upstream of the impassable waterfalls in the reach upstream of the N59. European eel likely present.	River Moy SAC Annex II Atlantic salmon (migration route and limited, patchy spawning / nursery) Annex II Brook lamprey (possible)	EPA 2022 Q-value: Q4-5 High status (compliant with WFD objectives)	A - International Importance	**Yes**
Tullyegan	Small stream, modified by drainage. Trout and brook lamprey spawning and nursery. Eel likely. Not suitable for salmon owing to small size.	None - and does not support Conservation Objectives for downstream QIs	2022 Q-value: Q3-4 potential 'Moderate' status (not compliant with WFD objectives)	D – Local Importance (Higher Value)	**Yes**

[4] Macroinvertebrate status reported as "potential", since ratings outside of the formal EPA river monitoring programme are not official status under the Water Framework Directive 2000/60/EC

9.3.4 Evolution of the Environment in the Absence of the Proposed Scheme

The Second (2018-2021) and Third Cycle (2022-2027) River Basin Management Plans will continue to be implemented with the intention of improving water quality even in the absence of the Proposed Scheme.

Flooding will continue to affect areas identified to be at risk in the absence of the scheme. This can have ongoing and intermittent, negative effects on water quality in the case that surface waters flood through urban areas, mobilising contaminants before draining back to the Moy and its tributaries.

Historical alterations to hydromorphology will continue to affect watercourses, specifically:

1. Bunree and Quignamanger, which have extensive sections of existing, undersized culverts.
2. Tullyegan, which has been extensively drained and deepened with existing flood defence walls in the lower reaches.
3. River Moy in Ballina, which has existing, engineered walls and instream structures (salmon weir, bridge piers) and fisheries alterations (rock deflectors and old mill race “groyne”) which modify flow.

Quay walls identified for repairs and refurbishment on the River Moy through Ballina, will continue to deteriorate, through obvious structural erosion and undermining, particularly evident in Ridgepool. This may lead to localised collapse causing temporary, uncontrolled influx of rubble, silt and sediment to the River Moy, as well as temporarily allowing uncontrolled flooding in the urban reach of the River Moy. This could directly impact on localised habitat and water quality of salmonid waters of the lower River Moy (smothering and short term, negative effects related to sediment input) and has potential to reduce the visual and angling amenity value of the Ridgepool and Cathedral Beat.

9.4 Description of the Likely Significant Effects

9.4.1 Relevant Characteristics of the Proposal

Table 9-14 summarises characteristics of the Proposed Scheme with potential for Source-Pathway-Receptor linkages that may affect aquatic receptors of Important Ecological Features. The linear length of each channel directly impinged upon by the measures provides context for scale and magnitude of potential effects.

Table 9-14 Relevant Characteristics of the Proposed Scheme – Aquatic Ecology

Watercourse	Proposed Measures relevant to Aquatic Ecology Assessment	Linear length of channel directly affected (m)
River Moy	**River Moy instream and bankside works (Ridgepool LHS and RHS; Salmon Weir RHS) (within SAC):** Temporary instream access ramp / haul route and sandbag cofferdam on ‘groyne’ upstream of IFI fisheries building on LHS of Ridgepool. Temporary instream cofferdams of 50 m lengths on RHS of Ridgepool related to flood wall construction on River Moy within Ballina.	RHS: Ridgepool Road (260m) LHS: Ridgepool, parallel to Barret St (230 m),
Moy Estuary	**River Moy Instream works (downstream N59 Lower Bridge) (within SAC)** Potential for temporary cofferdams (if required) to dry out berm areas for flood wall construction on berms.	LHS: Bachelors Walk from the Lower Bridge to Rope Walk Lane (120 m) RHS: Clare Street (460 m)
Moy Estuary	**Works over or near water (not encroaching instream) adjacent to Cathedral Pool and downstream of N59 Lower Bridge (within / directly adjacent SAC):** (i) existing river wall upgrades with use of concrete / mortar, (ii) out of channel ground excavations, (iii) path / road level regrading.	LHS: Emmet St (170 m) and Bachelors Walk from Rope Walk Lane to Arbuckle Row (225 m)
Quignamanger	**Instream works** (i) Replacement of existing diversion culvert along Creggs Road with new 1.5 m diameter culvert, (ii) Replacement of culvert under Quay Road to River Moy, involving sections of dam/pump-over. (iii) Removal of existing flap valve at end of Cregg Road culvert.	New culvert (330 m)

Watercourse	Proposed Measures relevant to Aquatic Ecology Assessment	Linear length of channel directly affected (m)
Quignamanger	**Works over or near water:** flood wall construction along short, existing open section near Moy confluence. Removal of existing inner wall.	Flood walls on both banks (40 m)
Bunree	**Instream works** involving sections of dam/pump-over: (i) Replacement of existing culvert and open drain with one new culvert at 1.2m diameter, changing into a 1.5m diameter as it approaches the N59, (ii) Removal of culvert downstream of the N59 and restoration of open channel, Upgrading a field access culvert in the upper reach of the stream.	New culvert (c.1000 m); culvert removal (50 m)
Brusna (Glenree)	**Instream works (within SAC):** Shanaghy Heights Bridge upgrade works requiring installation of new bed and bank protection / reinforcement extending beneath and 6m upstream and downstream of existing structure. Water management required to create 'dry' working area.	Instream footprint 300 m^2
Brusna (Glenree)	**Works over or near water (within SAC):** (i) set back flood walls upstream of Shanaghy Height Bridge along R294 road, (ii) short sections of set-back flood embankment upstream / downstream of Shanaghy Heights Bridge, (iii) short sections of set-back flood walls RHS bank upstream / downstream of Shanaghy Heights Bridge, (iv) beam installation at Shanaghy Heights access bridge	RHS: Flood wall Shanaghy Heights (250m), Embankment (200m) LHS: Embankment (50 m), Flood wall on R294 (330m)
Tullyegan	**Instream works** and **works over or near water:** construction of short sections of new flood wall and embankment along the left and right bank between the N26 and the railway crossing.	Flood walls both banks (125 m) Embankment (c.25 m)

9.4.2 Sources of Construction Phase Effects

Impacts resulting from civil engineering works near watercourses are primarily related to three sources of potential water borne pollutant loss, i.e., suspended solids and sediment, concrete and hydrocarbons. Using the S-P-R model, the resultant effect on an aquatic ecological receptor depends on both the nature of the source (S), the pathway (P) to the receptor (R) and the sensitivity of the receptor.

Suspended Solids

The principal source of impact potential arises from the escape of suspended solids from construction areas. Sources of sediment escapement include (not exhaustively) earthworks, instream works, erosion of soil stockpiles, e.g., embankments, culvert installations, temporary access tracks and vehicular activity near drains and watercourses.

Depending on channel morphology, escaped solids can settle in watercourses, resulting in smothering of fish spawning areas and macroinvertebrate habitats, causing mortality or abandonment of the area, at least in the short-term. Elevated concentrations of suspended solids and resulting turbidity within the water column can potentially damage gills, physiology and behaviour of fish (e.g., respiration, migration) and/or benthic macroinvertebrates (e.g., respiration, drift responses). Like salmonids, lampreys depend on clean gravels for spawning which can be adversely impacted by sedimentation. Even though juvenile lamprey(ammocoetes) inhabit areas of deposited silt at river margins, the larvae can be negatively affected by excessive instream sedimentation owing to oxygen depletion and loss of organic biofilms within the silt margins.

Cement

Owing to its alkaline and corrosive nature, cement is potentially toxic to instream fauna and can cause fish and invertebrate kills downstream. As a Salmonid Water and SAC, the River Moy and the high status Brusna River are most at risk of any negative impacts if they were to occur. Any fish using the lower reaches of the Tullyegan and Quignamanger may also be at risk if cement was not controlled and escaped during construction. Less likely potential sources of high alkalinity run-off are from uncured or recently cured concrete, pump-out water from cofferdams, washing out of bulk liquid cement containers, wheel washing and washout of cement spills within site compounds (if the latter reach surface drainage channels).

Hydrocarbons

Hydrocarbon spills and leakages can result in oil slicks and tainting of fish, or (if large enough) fish and invertebrate kills. They can be detrimental to salmonid eggs and young fry in spawning areas. Hydrocarbons can reach drains and watercourses because of spills and leakage from poorly secured or non-bunded fuel storage areas; spills during re-fuelling; leaks from on-site vehicles, plant and equipment. As a Salmonid Water and SAC, the River Moy and the high status Brusna River are most at risk of any hydrocarbon spillages if they did occur. Any fish using the lower reaches of theTullyegan and Quignamanger may also be at risk if hydrocarbons were not correctly controlled and escaped to surface waters during construction.

Temporary Hydromorphological Effects

In the absence of suitable water and fisheries management techniques, temporary instream works can have serious effects on hydromorphology (river continuity, hydrology) that impact on instream habitats and biota through severance of fish passage and changes to downstream hydrological regime. Such effects can be managed by timing restrictions in relation to fish migration and by well-designed water management techniques (dam/pump-over, temporary diversion).

Temporary Habitat Disturbance

Temporary and short-term construction works with an instream footprint results in localised disturbance of macroinvertebrate habitats and may affect fisheries sensitivities depending on the watercourse in question. The significance of any effect is dependent on the quality and pre-existing fisheries sensitivity of the habitat; and the location, timing and duration of the works including any water management techniques, plus the quality of reinstatement once instream works are complete.

Invasive Alien Species

Construction works, especially those involving earthworks and importation of clay and earth (embankments), carry potential for introduction and/or transfer of invasive alien species and pathogens. Invasive alien plant species, if transferred either within the site or brought onsite with other materials, can have significant negative impacts on riparian corridors in terms of hydromorphology and aquatic ecosystem links. Plant, equipment and personal protective equipment (PPE) that comes into contact with water, e.g., pumps, excavators, footwear and clothing can carry waterborne pathogens. Crayfish plague (*Aphanomyces astaci*) is becoming more widespread in Ireland, and whilst no crayfish were detected in the immediate study area (and is considered absent from the Moy main channel), the species is present higher in the catchment tributaries. The risk of crayfish plague transfer is therefore low but cannot be ruled out.

9.4.3 Sources of Operational Phase Effects

Hydromorphology – Flood Walls / Embankments

In an unmodified system, overbank flow onto the floodplain during flood events dissipates the energy of flood waters, by way of in-channel velocity and stream power decrease. Conversely, flood walls and embankments contain river flow which can lead to increased channel velocities and potential changes to patterns of bed material transport (deposition / scouring) during an event.

Hydromorphology is also a quality element supporting the biological quality elements as per Annex V of the Water Framework Directive (WFD). WFD hydromorphology quality elements for River Water Bodies (RWBs) are:

- Hydrological regime (quantity and dynamics of water flow; connection to groundwater bodies)
- River continuity
- Morphological conditions (river depth and width variation; structure and substrate of the riverbed, structure of the riparian zone)

WFD hydromorphology quality elements for Transitional Waters are:

- Morphological conditions (depth variation; quantity, structure and substrate of the bed; structure of the intertidal zone)
- Tidal regime (freshwater flow; wave exposure)

Hydromorphological characteristics refer to the physical structure of surface water habitats which in turn affects the ecosystems that support biological quality elements that define water body status, i.e., macroinvertebrates (Q-value), fish, algae. Any physical impacts therefore must be assessed as to how they may alter instream habitats and affect fish and plant communities which, in turn can affect WFD objectives (CIS, 2017). In this respect, an examination of modelled changes to in-channel velocity, depth and froude number at selected cross-sections has been presented in **Appendix 9.8** and described in detail relating to each watercourse in **Section 9.4.5**. Froude number is a dimensionless descriptor of the flow environment of a river calculated as a function of depth and velocity. It is a useful signifier of hydraulic habitat in relation to salmonid spawning and nursery habitat, being more versatile than river velocity or depth alone (Moir et al, 2002). In particular, any post-scheme changes to froude number were examined for the Brusna (Glenree) as it is a salmonid spawning / nursery channel of the SAC. Depth and velocity were examined for reaches of the Moy as the channel is a migration route only within the scheme footprint.

9.4.4 Construction Phase Effects

9.4.4.1 River Moy

Description of Potential Effect	Characterization of Potential Effect prior to mitigation	Significance of Effect (without mitigation)
Ridgepool LHS (River Moy): Direct and/or Indirect Effects arising from instream works. Short term disturbance to sea lamprey habitats associated with temporary instream access route (Ballina Manor Hotel to Otter's Lodge Apartments)	There is no sea lamprey spawning or nursery habitat within the direct footprint of the proposed temporary instream access ramp on the LHS bank in front of and upstream of the IFI Building to the "groyne" area (see **Chapter 5: Project Description**, **Section 5.7.9.3**) The directly impacted area is ephemeral habitat for fish, becoming largely dewatered at low tide / low flow. The access ramp footprint is entirely unsuitable for sea lamprey spawning and there are no silt deposits for larval lamprey nursery (see details in **Appendix 9.6:** Ridgepool Instream Habitat Survey). **Potential Lamprey Spawning Habitat (Ridgepool LHS):** On a precautionary basis, the outer edge of the proposed instream access ramp on the LHS in front of the old warehouse building is considered to comprise substrates with some limited potential to support sea lamprey spawning (though sub-optimal), subject to the actual low flow wetted channel width during spawning season of any year. This precaution is based on the fact that dynamic, high-volume, tidal rivers like the Moy (with variable flow/tide characteristics) will always be subject to natural fluvial processes that can subtly alter spatial distribution of substrates over time. Sea lamprey themselves also act as "river engineers" in the way they move substrates during nest building using their oral suckers (Dhamelincourt et al., 2023). The area in question is adjacent to RP2A on the LHS (out from corner of warehouse) (see **Appendix 9.6**). A precautionary approach must be taken at point RP2A (see **Section 9.5.1**). . Once the access ramp is in place, construction activity during months of August to May inclusive is confined to the river margins with no intrusion into the pool. Sea lampreys that do not succeed in passing the Salmon Weir and end up spawning in the Ridgepool still have access to existing potential spawning habitat in the low-flow wetted part of the mid-channel c.30 m downstream of the weir where there are no direct instream construction works. **Lamprey Nursery Habitat (Ridgepool LHS):** Lamprey nursery habitat is present in one discrete area on the Ridgepool LHS 40 m upstream of the Upper Bridge (Site RP5, see **Appendix 9.6**). This area is located downstream of the proposed access ramp footprint and is not subject to direct instream works. It is potentially susceptible to indirect effects relating to uncontrolled washout of construction materials (sediment, pollutants) from the construction work zone and/or loss of materials (gravel, fines) from the installed access ramp itself. The main risk would be from excessive sediment washout from the access ramp surface itself which would likely cause juvenile lamprey to abandon the area and move downstream to below the N59 Lower Bridge where there is alternative habitat. Accidental spillage or leakage of potentially toxic pollutants (concrete, hydrocarbons) could cause direct mortality of small numbers of lamprey ammocoetes if concentrations are high enough, although the considerable dilution effect of the Moy in this location would likely quickly disperse spillages meaning effects, if any, would be very localized.	Potential **significant negative** short-term, reversible, though **unlikely** direct effects on *sea lamprey spawning habitat* locally in the Ridgepool in a discrete area adjacent RP2A on the outer margin of the temporary access ramp. This does not represent a significant effect at a catchment scale in terms of availability of lamprey spawning habitat but requires precautionary mitigation during the placement of the access ramp in the first August of the construction period. **Likely significant negative** short term localised indirect effects on *sea lamprey nursery habitat* locally in the Ridgepool in a discrete area downstream and adjacent to the temporary access ramp (Site RP5). This does not represent a significant effect at a catchment scale in terms of availability of lamprey nursery habitat but requires mitigation to prevent sediment /pollutant wash out.

Description of Potential Effect	Characterization of Potential Effect prior to mitigation	Significance of Effect (without mitigation)
Ridgepool LHS (River Moy): Direct and/or Indirect Effects arising from instream works. Short term disturbance to river margin habitats and fish (salmonids, eels) associated with temporary instream access route (Ballina Manor to Otter's Lodge Apartments)	The installation of the access ramp in front of the IFI Building and around the warehouse to the "groyne" area will cover benthic habitats along the LHS margin for 55 m, extending at most 8 m out into the channel (at the upstream corner of the warehouse) covering a total of 440m^2 of the instream river margin. Upstream of the access ramp a cofferdam area will be constructed to allow for dry working conditions in front of Otter's Lodge Apartments. This will cover the "groyne" area, increasing the marginal works footprint to a total of 2,300m^2. The habitats covered are described in **Appendix 9.6**, sites RP1, RP2 and RP3 to as far as RP4. Shallow marginal areas at RP1 and RP3/RP4 typically dewater at low tide, representing ephemeral habitat value to fish. The deeper glide adjacent to RP2 (c.40cm+ at 95 percentile of low tide/flow) forms a holding area for migrating salmonids with small amounts of instream rooted macrophtye and bryophyte on substrates of bedrock, boulder, cobble and coarse sand. It is at the tail end of the more reliable, deeper holding pool towards the upstream end of the 'groyne' which is not impacted by the access ramp. The size of the river means there are alternative holding habitats of good quality within the Ridgepool and Cathedral Pool available to migrating fish. **Instream Habitat Effects (Ridgepool LHS):** The access ramp will cover the LHS river margin for 20-22 months, impinging on instream habitats that are tidal and of ephemeral value to salmonids and benthic invertebrates. On removal of the access ramp, these marginal habitats will be returned to pre-existing bed-levels and will recover macrophyte cover fairly rapidly, with bryophytes re-establishing over time so long as channel margins are reinstated using natural bed substrate material (see **Section 9.5.1**). The pre-existing fluvial dynamics of the river margin area will return to near-original almost immediately following removal of the access ramp and cofferdams at which time there will be a ready supply of macroinvertebrate drift for recolonization at this point in the lower catchment. Microorganisms are likely to return to baseline density within 1-2 months, with periphyton returning to baseline biomass and productivity within 4-6 months (Niemi et al, 1990), certainly within a year (seasonally dependent)- noting that the works areas are proposed to be removed by end of May in Y2, meaning there is a whole summer season for recovery prior to winter onset. The river reach is characterized by aquatic plant species that are well adapted to disturbance, being subject to highly variable flow and tide combinations. Commonly occurring species in this reach, e.g., *Potamogeton perfoliatus, Myriophyllum spicatum, Sparganium emersum* have the ability to re-grow from fragments that establish roots within a few weeks of deposition in the aquatic margin (Henriksen 2023, Barrat-Segretain, 2000). It can be expected that these ephemeral habitats will be recolonized by commonly occurring macrophytes by the second year after disturbance (Henry et al., 1996), although aquatic mosses may take longer to fully re-establish. Given the width of the river, and the relatively small instream works footprint, aquatic biota has considerable habitat availability and migration pathways outside of the temporary work zone at all times. The direct instream works footprint, following initial temporary disturbance does not significantly impinge on highly sensitive fisheries habitat, nor does it significantly alter the ecology of the Ridgepool during the construction period.	**Not significant** but will result in short term moderate negative direct effects locally owing to placement of access ramp over ephemeral habitat of river margin for 22 months requiring mitigation measures to protect and reinstate benthic substrate upon completion of works.
Ridgepool LHS and RHS (River Moy): Fish entrapment in cofferdams	There is potential for localized mortality of any salmonids and eels that become trapped within a closed cofferdam work area on the groyne upstream of the IFI Building if they are not rescued and	**Likely significant negative** locally, owing to importance of

Description of Potential Effect	Characterization of Potential Effect prior to mitigation	Significance of Effect (without mitigation)
	relocated when the cofferdam is installed. Fish could also become trapped behind the cofferdam during unexpected flooding. The numbers of trapped fish would be expected to be low during initial cofferdam construction as they will tend to avoid disturbance related to sandbag cofferdam installation.	Ridgepool to salmonids and migration of critically endangered eel
River Moy and Moy Estuary LHS and RHS: Potential effects on fish migration	Ridgepool is the entry point to the freshwater River Moy for salmonids, juvenile eels and anadromous lampreys migrating from the Moy Estuary. Whilst there will be periods of temporary disturbance in relation to instream works these are confined to the extreme left and right banks, where habitat is ephemeral owing to tidal dewatering. The river is wide, comprising a diversity of fish holding and cover options for inward migrating fish. Fish migration pathways will at no point be obstructed during the construction works. In addition, the fact that no disturbance related to instream works will occur in the Ridgepool during June and July of any year (i.e., angling period restriction) means that the peak of the salmon migration, a considerable portion of eel and (to a lesser extent) lamprey migration periods will not be subject to disturbance related to localized instream works disturbances.	**Not significant and unlikely**
Ridgepool LHS (River Moy): Fisheries Enhancements Direct and/or Indirect Effects arising from instream works.	Reshaping of the upper corner of the existing "groyne" will require large instream boulders to be moved by machine prior to retreat from the cofferdam works area on the LHS. There are swift flows in the affected reach comprising boulder over bedrock with coarse interstitial sand as the dominant substrates. There are no fine sediment accumulations. Mobilisation of suspended solids will be minimal, limited to short distances downstream, resulting in primarily localized redistribution of coarse sand which is not unusual for this dynamic river reach. Some fish (salmon, juvenile eels) may be disturbed locally for a very short duration as the boulders are removed and replaced nearby, but without significant consequences on any sensitivities. There is a remote potential for hydrocarbons (oils, hydraulic fluid) to enter the river associated with long-reach plant necessary for the boulder removals, but only if machinery is not well maintained which is unlikely.	**Not significant.** Positive effects on fisheries holding areas in the Ridgepool
Ridgepool & Salmon Weir RHS (River Moy): Direct and/or Indirect Effects arising from instream works. Temporary to short term disturbance associated with instream works involving 4-5 No., 3-5m wide x 50m long sections of sandbag cofferdam for flood wall repair / maintenance and construction works along Ridgepool Road.	There is no sea lamprey spawning habitat within the direct footprint of the proposed temporary instream works area (5 m band from Ridgepool Road Quay wall). The impacted marginal areas comprise substrates and flows that are entirely unsuitable for sea lamprey spawning (see details in **Appendix 9.6**). **Potential Sea Lamprey Spawning Habitat (Ridgepool RHS):** On a precautionary basis, the outer edge of the proposed instream cofferdam area on the RHS from Site RP8 to RP8A (Ridgepool Road) (see **Appendix 9.6**) is considered to comprise substrates with limited potential to support sea lamprey spawning (though sub-optimal), subject to the actual low flow wetted channel width during any particular spawning season. While the cofferdam footprints cover primarily ephemeral river margin habitat, lampreys that fail to ascend the weir may attempt to build redds in this part of the Ridgepool adjacent to proposed cofferdams in the vicinity of RP8 – RP8A, noting that (1) sea lamprey will select areas of suitable habitat in terms of flow and substrate and will also engineer the selected area using their oral suckers to shift stones and (2) Ridgepool is a	Potential **significant negative,** though **unlikely** localized direct effects on *sea lamprey spawning habitat* in the Ridgepool in a discrete area on the outer margin of the cofferdam works zone (RP8-PP8A). This does not represent a significant effect at a catchment scale in terms of availability of lamprey spawning habitat but requires precautionary mitigation during the placement of the sandbag cofferdams in the

Description of Potential Effect	Characterization of Potential Effect prior to mitigation	Significance of Effect (without mitigation)
	sub-optimal "last resort" habitat for sea lampreys that fail to ascend the combined Salmon Weir and upstream rock outcrops earlier in the season. The following is noted - there will be no instream construction activity at the Ridgepool RHS before August 1st of Year 1 at earliest because of the IFI angling timing restriction. The timing restriction covers the peak sea lamprey spawning period (May-July) in Y1 and therefore avoids negative effects in Y1. Works will commence after August 1st of Y1 to create the new angling access point at the Weir Building using the first of the cofferdam containment areas (large sandbags filled with small sandbags covering a reach of up to 50m). In Y2 there shall be a timing restriction on instream works on the Ridgepool RHS in the reach between Sites RP8 and RP8A (see site locations in **Appendix 9.6** and timing restrictions in **Section 9.5.1**). Construction activity, once the 50 m sections of cofferdam are in place, will be confined to the RHS river margins with no lateral intrusion into the Ridgepool. Sea lampreys that fail to ascend Salmon Weir and end up spawning in Ridgepool will still have access to the existing spawning habitat outside the cofferdams in the low-flow wetted part of the mid-channel commencing c.30 m downstream of the weir where there will be no direct instream construction works. **Sea Lamprey Nursery (Ridgepool RHS):** There is one discrete patch of potential larval lamprey habitat on the RHS on Ridgepool Road upstream of the Upper Bridge (**Site RP11, Appendix 9.6**). This is potentially directly affected by the proposed 5 m instream works area. If possible, works on Quay walls at this point will be conducted from the road above, with no instream footprint. In the event this is not possible, any larval lampreys in the sediment beds would suffer mortality as a result of cofferdam placement and excavations if they were not removed and relocated during construction. **Instream Habitat Effects (Ridgepool RHS):** The ephemeral river margin habitats temporarily disturbed during construction within cofferdams along Ridgepool Road are described in **Appendix 9.6**, sites RP6, RP7 and RP8, RP8A, RP9, RP10, RP11. Marginal areas comprise mainly bedrock and embedded cobble, with bryophyte, filamentous green algae and occasional patches of common rooted macrophytes dominated by common pondweeds. Shallow marginal areas along the Moy RHS (Ridgepool Road) typically dewater under low flow/low tide conditions, representing ephemeral habitat value to fish and invertebrates. The temporary disturbance of successional 50 m reaches of marginal habitat over the construction phase will be followed by a period of relatively rapid recolonization by rooted macrophyte and filamentous algal species. Commonly occurring macrophyte species in the reach are well adapted to disturbance and will re-grow from fragments that establish roots within a few weeks of deposition in the aquatic margin (Henriksen 2023, Barrat-Segretain, 2000). It can be expected that these ephemeral habitats will be recolonized with commonly occurring macrophytes by the second year after disturbance (Henry et al., 1996), although aquatic mosses may take longer to fully re-establish. Given the width of the river, and the relatively small instream works footprint, aquatic biota has considerable habitat availability outside of the instream temporary work zones at all times and there is no obstruction to fish migration pathways.	first August of the construction period. **Likely significant negative** direct effects on *sea lamprey nursery habitat* locally in the Ridgepool RHS in a discrete area at RP11, upstream of the Upper Bridge. This does not represent a significant effect at a catchment scale in terms of availability of lamprey nursery habitat but requires precautionary mitigation during construction to avoid localised adverse impact on juvenile lamprey.

Description of Potential Effect	Characterization of Potential Effect prior to mitigation	Significance of Effect (without mitigation)
River Moy (Estuary): Downstream Lower Bridge – N59 Crossing LHS: Direct Effects arising from instream works. Temporary disturbance to sea lamprey larval habitat associated with 3-5m wide cofferdam installations and flood wall construction works adjacent to Bachelors Walk	The channel downstream of the Lower Bridge is sluggish with marginal silt deposits that support larval lamprey, including Annex II QI species sea lamprey (and possibly *Lampetra* spp.). Refurbishment of the river wall may require a short section of sandbag cofferdam (120m at most) and excavation work on the LHS adjacent to Bachelors Walk. This will result in disturbance of a strip of emergent and submerged instream vegetation on the LHS bank as well as the riparian tall herb swamp on the bank. Dewatering and excavation of a potential cofferdam area will cause mortality of benthic macroinvertebrates and (in the absence of mitigation) numbers of larval lamprey. Any fish that become trapped within the cofferdam and are not rescued will also likely suffer mortality. The numbers of trapped adult fish would be expected to be low as they will tend to avoid disturbance caused by cofferdam construction. Field results indicated the numbers of larval lamprey along the affected first 120m downstream of the Lower Bridge will be low because marginal habitat is already modified - being confined by a border of rock riprap that partially or fully dewaters at low tide / low flow. Further downstream (near the floating pontoon), river margin habitat is more stable and more amenable to larval lamprey, but this reach is not directly affected by possible instream works. It can be expected that, following temporary disturbance during construction, marginal instream habitats in the 120m downstream of the Lower Bridge LHS will be recolonized by commonly occurring rooted macrophytes by the second year after disturbance (Henry et al., 1996), and silt will accumulate and become available for larval lamprey. The success of recolonization of the riparian tall herb swamp vegetation will be dependent upon the quality of bankside reinstatement prior to cofferdam removal (refer to **Chapter 10: Terrestrial Biodiversity** for effects on riparian tall herb swamp adjacent to Bachelor's Walk).	**Likely significant negative** short term reversible localised effects on sea lamprey nursery habitat along the cofferdam reach on the RHS downstream of N59 Lower Bridge.
River Moy and Moy Estuary: General Indirect Effects arising from instream works. Degradation of water quality and aquatic habitats arising from pollutant wash-out from temporary works areas along the River Moy margins through Ballina	Unexpected flooding that inundates the temporary works areas, including overtopping of sandbag cofferdams in the Ridgepool and downstream of the N59 Lower Bridge during the construction period could lead to uncontrolled washout of mainly suspended solids, but also hydrocarbons and cement resulting in negative effects on aquatic receptors (see **Section 9.4.2**) locally and downstream on the River Moy. Potential exists for the temporary access ramp in the Ridgepool LHS to be eroded owing to swift and variable water levels on this part of the Moy, especially during winter. Loss of sediment and suspended solids from the access ramp surface would be transported into downstream habitats causing turbidity, and/or additional sedimentation in downstream habitats. The latter is not considered to be capable of causing likely significant effects downstream given that the downstream estuarine habitats are depositing by nature, but excess levels of sediment need to be avoided (see **Section 9.5.1**). Turbidity can affect behaviour of migrating fish (avoidance reactions), although fish can move away from a localized sediment plume in such a wide river.	**Likely Significant negative** in the absence of specific mitigations to control pollutant wash-out from temporary works areas
River Moy and Moy Estuary: General Indirect Effects arising from instream works. Degradation of water quality and aquatic habitats arising from pump out of ingress water from cofferdams	Indirect (downstream) effects related to untreated pump-out water from behind cofferdams are likely to occur if not well-managed. Pump-out water often contains highly concentrated suspended solids and may contain other pollutants (concrete, hydrocarbons). At worst, contaminated pump-out water may be toxic to fish (salmonids, lamprey, estuarine species) and aquatic macroinvertebrates causing localized mortality. The use of bulk liquid concrete to form the new fishing platform at the Weir building could lead to leakage or spillage of concrete contaminated water to the Ridgepool tainting fish locally or causing toxic effects in large quantities.	**Likely significant negative** short term reversible effects locally in relation to discharge of potentially toxic compounds and / or chronically elevated turbidity.

Description of Potential Effect	Characterization of Potential Effect prior to mitigation	Significance of Effect (without mitigation)
	High levels of continuous turbidity, if it occurred, may cause fish to abandon the area locally and can cause salmonids to temporarily delay passage upstream if turbidity was widespread for an extended period. On the latter, the volume of the Moy in Ballina means the zone of influence will be localized if such effects did occur. Noted also is that instream cofferdam works will occur August-May inclusive, which avoids the peak July migration period for salmonids on the Moy. Entrained sediment could settle in margins downstream with effects as described in **Section 9.4.2**, above, noting that the effects further downstream would be less significant because of the naturally depositing nature of the lower River Moy and Estuary.	
River Moy and Moy Estuary: General Indirect Effects arising from works over or near water. Degradation of water quality and aquatic habitats arising from out-of-channel flood wall repairs and construction, regrading of roads and footpaths, drainage features	Wash-out of pollutants (suspended solids, concrete, hydrocarbons) from bank-side construction areas to the River Moy, including bankside works on the Cathedral Pool (Emmet Street) reach, if not managed correctly are likely to degrade localized downstream habitats at least temporarily. At worst, such effects could include toxicity to or tainting of fish and macroinvertebrates related to concentrated concrete and/or hydrocarbon spills or wash-out. Ground excavations associated with river wall construction and localized road regrading can cause suspended solids washout and turbidity locally, which is likely to cause fish to avoid area temporarily. The extent of indirect effects is limited to zones immediately downstream of works areas and will dissipate reasonably quickly given the volume of the River Moy in Ballina where such works occur.	**Likely significant negative** short term reversible effects locally in relation to discharge of potentially toxic compounds and / or chronically elevated turbidity.
River Moy: Indirect Effects arising from Instream works on tributary culverts. Degradation of water quality and aquatic habitats of the River Moy and SACs	Uncontrolled wash-out of pollutants (suspended solids, concrete, hydrocarbons) associated with suspended solids and pollutant wash out during culvert replacements and flood defense wall / embankment construction works on tributary streams (see **Section 9.4.4.2** to **Section 9.4.4.5** below) can flow to the River Moy (within the River Moy SAC and Killala Bay / Moy Estuary SAC) with effects on aquatic receptors as set out in **Section 9.3.3.3**. The main risk is high concentrations of suspended solids which if discharged untreated to the tributary streams may cause localised water quality and fisheries habitat degradation at the confluence with the Moy where there is extensive sea lamprey larval habitat at river margins downstream of the N59 Lower Bridge and migratory water for anadromous fishes (salmonids, lampreys, eel).	**Likely significant negative** short term reversible effects locally in relation to discharge of suspended solids and/or toxic compounds from within the tributaries.

9.4.4.2 Quignamanger

Description of Potential Effect	Characterization of Potential Effect prior to mitigation	Significance of Effect (without mitigation)
Quignamanger: Direct and Indirect Effects arising from instream works. Physical impact and pollutant wash-out arising from culvert removals / installations.	The stream is of minor aquatic ecological value in the reach that will be subject to culvert replacement, limited to passage of eels through the existing culvert. Eel migration could be disrupted by instream works which can be managed by adherence to instream works timing restrictions. The diversion culvert can be replaced technically without “instream works” so long as it is isolated from flow entering upstream. Flows will remain in the main channel when work is complete.	**Likely significant negative** temporary-to-short term reversible in the lower Quignamanger, potentially impacting on Annex I priority habitat *7220 tufa deposits.

Description of Potential Effect	Characterization of Potential Effect prior to mitigation	Significance of Effect (without mitigation)
	The open reaches of the stream: (1) at the Creggs/Quay Road junction, and (2) from a point 20 m upstream of the existing culvert system are of County Importance owing to presence of QI priority habitat *7220 with tufa deposits which support indicator algal species. These areas may be negatively affected directly (physical removal) or indirectly (through sedimentation / pollutant washout). Physical removal of tufa deposits along is likely to occur along the lower few metres of open channel when it is regraded for installation of the new box culvert under Quay Road. The main area of tufa deposition is at the small cascades 15 m upstream of the existing culvert, which could be made an exclusion zone, but there is no avoiding the (less prominent) patches of tufa deposition closer to Quay Road. What is evident is that tufa deposition is constant in the stream as it forms over ephemeral algal masses (*Vaucheria*) which are seasonal in growth. Tufa habitat in this reach has been subject to disturbance in the past but has reformed in the modified and drained channel. There is no doubt, considering the stream water chemistry (**Appendix 9.7**), that tufa deposits will reform following disturbance, but the quality of the tufa habitat will likely depend on the morphological reinstatement of the regraded channel (see **Section 9.4.5**). Given the extent and magnitude of culvert replacement works, both direct and indirect effects are likely (in the absence of mitigation), comprising periods of elevated turbidity and potential for increased sedimentation in the open reach near the Moy confluence. The Moy Estuary is sluggish and depositing in the confluence reach, and sedimentation if it did arise would potentially cause temporary slight negative reversible effects on benthic macroinvertebrates, slightly altering local diversity and abundance but with no significant consequences. At worst, cement and/or hydrocarbon spills from works areas could be transported into the Moy which can have toxic effects on benthic macroinvertebrates and fish, including benthic fauna of the Qualifying Habitat “Estuaries”, however this is unlikely to occur from a well-managed construction site.	

9.4.4.3 Bunree

Description of Potential Effect	Characterization of Potential Effect prior to mitigation	Significance of Effect (without mitigation)
Bunree: Indirect Effects arising from instream works. Pollutant wash-out arising from culvert removal / installation.	The stream is of minor aquatic ecological value and low (if any) fisheries value. Direct significant negative effects on aquatic receptors within the Bunree itself are not at all likely. Given the extent and magnitude of culvert replacement works, indirect effects are likely (in the absence of mitigation) in the lower Bunree and also at the Moy confluence, comprising periods of elevated turbidity and perhaps causing localised sedimentation near the outfall to the Moy. The Moy is sluggish and depositing in the confluence reach, and sedimentation if it did arise would cause temporary slightly negative effects on benthic macroinvertebrates, slightly altering	**Not Significant,** although there is likely to be temporary to short-term slight negative reversible effects related to sediment and pollutant wash-out confined to the lower open

Description of Potential Effect	Characterization of Potential Effect prior to mitigation	Significance of Effect (without mitigation)
	local diversity and abundance but with no significant consequences. At worst, cement and/or hydrocarbon spills from works areas could be transported into the Moy which can have toxic effects on benthic macroinvertebrates and any locally foraging fish, including lamprey ammocoetes that utilize the marginal silt deposits of the Moy. It is noted that these indirect effects are unlikely to occur from a well-managed construction site.	reach just above the Moy confluence.

9.4.4.4 Brusna (Glenree) River

Description of Potential Effect	Characterization of Potential Effect prior to mitigation	Significance of Effect (without mitigation)
Brusna (Glenree) River: Direct and Indirect Effects arising from instream works. Replacement of instream bed and bank protection at Shanaghy Heights Bridge using sandbag cofferdams (left and right alternately)	Instream works will use alternate left and right cofferdams to flume water past the 'dry' works area on each bank alternately. Potential for direct mortality of salmon and trout within temporary cofferdams if not rescued and relocated prior to dewatering. Crayfish are very unlikely to be present, but if they did emerge during dewatering, they would suffer mortality if not rescued and relocated. Salmonid migration (salmon, sea trout) can be severed or disrupted by instream works which can be managed by adherence to instream works timing restrictions (works allowed July 1st to September 30th). Short term loss of localised salmonid habitat (300m^2 plus some additional area for temporary construction works) is confined to nursery water as spawning is not possible on the existing concrete/stone bed protection. Removal of existing bed and bank protection will generate concrete spoil, fines, and dust, which is alkaline and can taint fish and smother habitats locally. This can be managed by careful removal of all removed material including fines and disposal in a licensed waste facility. Cofferdam containment areas will be subject to constant water ingress. These areas will become constant sources of contaminated water (sediment and concrete washings) which will need to be pumped-out to maintain dry working conditions. Such pump-out water is likely to be turbid as well as highly alkaline (old and new concrete washings) and potentially contaminated with hydrocarbons (polycyclic aromatic hydrocarbons (PAHs), oils). If discharged directly back to the river or general environment in the absence of specialized treatment, there is potential for adverse effects on salmonids locally in the form tainting and toxicity to fish, and at worst instream plant and fish mortality. Sedimentation of downstream salmon and trout habitats could occur in the absence of treatment. If unexpected flooding with out-of-bank flow occurred during construction with materials, plant, machinery and associated fuels, oils, and lubricants within the river cofferdams there is a risk of pollutant loss (concrete, sediment, hydrocarbons) to the Brusna, with consequences as set out in **Section 9.4.2**.	**Likely significant negative** temporary-to-short term effects locally

Description of Potential Effect	Characterization of Potential Effect prior to mitigation	Significance of Effect (without mitigation)
Brusna (Glenree) River: Indirect Effects arising from works in and near water. Degradation of water quality and aquatic habitats arising from out-of-channel flood wall and embankment construction	Wash-out of pollutants (mainly suspended solids, and to a lesser extent concrete and hydrocarbons) from bank-side construction areas to the nearby Brusna River, if not managed correctly, is likely to degrade localized downstream habitats, at least temporarily causing juvenile salmonids to avoid the area and potential localised sedimentation of spawning / nursery areas. Such effects could include toxicity to or tainting of fish and macroinvertebrates, i.e., highly concentrated concrete and/or hydrocarbon wash-out. Ground excavations associated with river wall and embankment construction are likely to cause temporary elevation in suspended solids instream, locally, until such time as exposed ground is revegetated. Locally elevated turbidity can adversely affect juvenile trout and salmon respiration and feeding behaviour, although fish will likely avoid the areas temporarily. In a worst-case scenario, newly formed embankments could wash out completely resulting in sedimentation of spawning and nursery beds locally and for a short distance downstream which may decrease recruitment locally for at least one season. It is worth noted however that most of the spawning and nursery occurs further upstream in the Brusna catchment and tributaries. The extent of localized indirect effect is primarily limited to zones in the first few hundred metres downstream of work areas and will dissipate reasonably quickly given the turbulent flow of the lower Brusna.	**Likely significant negative** temporary-to-short term effects locally.

9.4.4.5 Tullyegan

Description of Potential Effect	Characterization of Potential Effect prior to mitigation	Significance of Effect (without mitigation)
Tullyegan: Direct Effects arising from Instream Works associated with flood defense wall construction	Instream works will use a dam and pump-over water management technique to create a 'dry' working area in-channel. Potential for direct mortality of trout, eel, and brook lamprey within temporary cofferdams, if not rescued and relocated prior to dewatering. Crayfish are very unlikely to be present, but if they did emerge during dewatering, they would suffer mortality if not rescued and relocated. Trout migration can be severed or disrupted by instream works which can be managed by adherence to instream works timing restrictions (works allowed May 1st to September 30th). Short term loss of localised trout and eel habitat (c.320 m^2 wetted width) is mainly confined to sub-optimal nursery water within the existing drained and modified stream, although patches of trout spawning cannot be ruled out. Removal of any existing bed and bank protection will generate concrete spoil, fines, and dust, which is alkaline and can taint fish and smother habitats locally. This can be managed by careful removal of all removed material including fines and disposal in a licensed waste facility. The 'dry' dam-pump over containment area will be subject to constant water ingress which will become constant sources of contaminated water (sediment and concrete washings) and will	**Not significant** though temporary moderate negative reversible effects are likely, localised to a short distance downstream of the works.

Description of Potential Effect	Characterization of Potential Effect prior to mitigation	Significance of Effect (without mitigation)
	need to be pumped-out to maintain dry working conditions. Such pump-out water will be turbid and potentially alkaline (old and new concrete washings) and potentially contaminated with hydrocarbons (including polycyclic aromatic hydrocarbons (PAHs)). If discharged directly to the stream or the general environment in the absence of specialised treatment, there is potential for negative effects locally in the form tainting and toxicity to fish, and at worst fish mortality and sedimentation of downstream trout habitats. Unexpected flooding with out-of-bank flow during construction could entrain construction materials, and pollutants (concrete, sediment, hydrocarbons) to the Tullyegan, with consequences as set out in **Section 9.4.2**.	
Tullyegan: Indirect Effects arising from works near water. Degradation of water quality and aquatic habitats arising from out-of-channel flood wall construction	Wash-out of pollutants (mainly suspended solids, and to a lesser extent concrete and hydrocarbons) from bank-side construction areas to the nearby Tullyegan Stream, if not managed correctly, is likely to degrade localized downstream habitats, at least temporarily. At worst, such effects could include toxicity to (mortality) or tainting of fish and macroinvertebrates, i.e., concentrated concrete and/or hydrocarbon wash-out. Ground excavations associated with river wall and embankment construction are likely to cause temporary elevation in suspended solids instream, locally until such time as ground is revegetated. Locally elevated turbidity can affect juvenile trout respiration and feeding and will likely cause fish to avoid the areas temporarily. The extent of localised indirect effect is limited initially by water management that will dry the area out and mobilization of pollutants will be mainly into the containment working area and can be treated when pumped out. By the time flow is reinstated, there will be less risk of elevated levels of pollutant wash-out which in this low-quality instream habitat would not have significant consequences, perhaps causing some temporary disturbance to small numbers of trout and eel.	**Not significant** though temporary moderate negative reversible effects are likely, localised to a short distance downstream of the works.

9.4.5 Operational Phase Effects

9.4.5.1 River Moy

Description of Potential Effect	Characterisation of Potential Effect prior to mitigation	Significance of Effect (without mitigation)
River Moy: Hydromorphology. Potential hydraulic effects on instream habitats and biota	The River Moy within Ballina is tidally influenced and modified by historical deepening and constriction within existing flood defence walls. A wide variation of in-channel velocities influenced by tide and river discharge is the normal baseline for the Ballina reach. The refurbishment of existing walls and installation of relatively short sections of new flood wall will increase the overbank flow height by an average of 0.8 m (0.45 – 1.2 m) within Ballina. Hydraulic cross section modelling within the Ridgepool (Appendix 9.8) shows that compared to the baseline hydraulic scenario, the Proposed Scheme would result in a very slight reduction of average cross section velocity during more common, smaller flood events (50% AEP). During more rare flood	**Not Significant.** Long-term imperceptible to neutral effects in terms of instream habitats for fish, macroinvertebrates and plants.

Description of Potential Effect	Characterisation of Potential Effect prior to mitigation	Significance of Effect (without mitigation)
	events (1% AEP), the Proposed Scheme will result in a very slight increase in average cross section velocity at one location about halfway along the Ridgepool, but a very slight decreases at cross sections at either end of the Ridgepool (see **Figure A9.8.4**, **Appendix 9.8**). The velocities are peak average values (i.e., at low tide), and as such would naturally decrease at higher tide and be variable across the channel cross section (i.e., slacker water at shallow margins). These changes signify the worst-case scenario, i.e., low tide peak velocities, meaning that any changes to high tide velocities will be even less perceptible. Such small changes to hydraulic conditions within a channel of enormously variable flow/tide combination means that mobilisation, transport and deposition patterns of bed substrates will not significantly alter over baseline conditions. The hydraulic model also shows imperceptible changes to mean cross section velocity and depth in the estuarine river reach downstream of the N59 Lower Bridge (**Appendix 9.8**, **Figure A9.8.10**). Consequently, instream habitats will be subject to imperceptible, if any, long-term or permanent physical modification in terms of: (1) sea lamprey spawning substrates in a discrete area of the Ridgepool (see **Appendix 9.6**) and (2) two discrete patches of lamprey nursery habitat in the Ridgepool (see **Appendix 9.6**) and, (3) river margin habitat downstream of the N59 Lower Bridge. Channel velocities will remain largely unchanged in terms of upstream migration of salmon, sea trout and lamprey under pre-scheme and design scenarios, especially considering that upstream fish movement through the estuary to river-entry often occurs during spates on the high tide, i.e., facilitated by favorable tidal conditions. Reshaping of the existing “groyne” as part of fisheries enhancement will improve salmonid holding and migration habitat on the riverine (mid-channel) side adjacent to the groyne and slightly downstream on the LHS by improving flow and depth characteristics. This will have a net neutral to positive effect on instream habitats for fish locally. There are no significant changes to hydromorphology quality elements (morphological conditions, hydrological conditions, river continuity) that underpin WFD status for the freshwater River Moy as a consequence of the proposed scheme. The proposed scheme does not result on hydromorphological effects that could cause deterioration in WFD river water body status (Moy_120 IE_WE_34M021100) nor prevent attainment of good status (i.e., improvement from current moderate status). There are no significant changes to hydromorphology quality elements (morphological conditions, tidal regime) that underpin WFD status for the (estuarine) transitional River Moy as a consequence of the proposed scheme. The proposed scheme does not result in hydromorphological effects that could cause deterioration in WFD transitional water body status (Moy Estuary IE_WE_420_0300) nor prevent attainment of good status (i.e., improvement from current ‘moderate’ status). (see WFD Assessment, Appendix 12-1).	
River Moy: Water Quality. Changes to water quality associated with flood defenses and new storm water drainage outfalls to the Moy	Flood walls will help prevent contamination arising from uncontrolled over-bank flows during extreme events, providing a positive effect on water quality in the long-term for the Moy and the downstream estuary. Upgraded storm water outfalls as described in **Chapter 5: Project Description**, **Section 5.5.4** will be fitted with hydrocarbon interceptors. This is likely to reduce the level of waterborne	**Not significant.** Positive to neutral long-term effects on the River Moy in and downstream of Ballina

Description of Potential Effect	Characterisation of Potential Effect prior to mitigation	Significance of Effect (without mitigation)
	contaminants reaching aquatic receptors in the River Moy but require regular maintenance to retain this function. The worst-case scenario (i.e., no maintenance) is assessed here.	
River Moy: Water Quality. Changes to water quality associated with new surface water pumping stations to the Moy	Four new pumping stations will be installed as part of the Proposed Scheme to manage excess surface water during floods (refer to **Chapter 5: Project Description** for details). The pumping stations will collect urban runoff and outfall directly to the River Moy. In the absence of treatment, discharged surface water could contain contaminants, primarily hydrocarbons and sediment with potential for effects on aquatic receptors as set out in **Section 9.4.2**.	**Likely significant negative** intermittent, temporary effects on the River Moy in and downstream of Ballina

9.4.5.2 Quignamanger

Description of Potential Effect	Characterization of Potential Effect prior to mitigation	Significance of Effect (without mitigation)
Quignamanger: Hydromorphology. Changes to fisheries habitat and or fish passage related to hydraulic conditions	The post-scheme modelled hydraulic scenarios show moderately increased velocities at the downstream cross section at 50% AEP and 1% AEP, just upstream of the Quay Road culvert (see **Appendix 9.8**). This is owing to the removal of flow constriction at the existing Quay Road culvert, which will be replaced by a correctly sized culvert that flows into an open channel downstream of Quay Road to meet the River Moy. The resulting velocities at the Quay Road culvert are still low (circa 1m/s) during either the 50 %AEP or 1% AEP design events and are therefore not barriers to fish passage. Slight increases in velocity (<0.5 m/s) under rare flood events (1% AEP) are also predicted at the upstream end (culvert exit on Creggs Road) because of improvement in conveyance in the new diversion culvert. Overall, the effect will be positive for any potential fish passage in the long term. The above hydraulic conditions do not give rise to significant changes to hydromorphology quality elements (morphological conditions, hydrological conditions, river continuity) that underpin WFD status for the Quignamanger stream. The proposed scheme does not result on hydromorphological effects that could cause deterioration in WFD river water body status (Dooyeaghhny_or _Cloonloughan_010 IE_WE_34D310990) nor prevent attainment of good status (i.e., no change from current 'good' status) (see WFD Assessment, **Appendix 12-1)**).	**Not Significant.** Long-term imperceptible to neutral effects in terms of instream habitats for fish, macroinvertebrates and plants.
Quignamanger: Hydromorphology. Changes to fisheries habitat and or fish passage related to physical modifications	The possibility for eel passage through the replaced culvert will be improved by removal of flap-valve on existing culvert. Improved fish passage and potentially increased foraging value for salmonids in the lower, open channel reaches of the stream will result from removal of the current constricted pipe and replacement by box culvert and open channel connecting to the Moy downstream of Quay Road. The open channel at Creggs/Quay Road is currently deepened and constrained by existing walls. The RHS wall along Creggs Road will be increased in height, but the channel is still open to over-bank flow on the LHS downstream, flowing out into a 'biodiversity area' enclosed by walls set	**Not Significant.** Positive to neutral effects.

Description of Potential Effect	Characterization of Potential Effect prior to mitigation	Significance of Effect (without mitigation)
	back from the channel. This means that baseline level of "floodplain connectivity" is essentially not altered by the Proposed Scheme. The culvert replacements represent an improvement over baseline with regard to hydromorphological quality sub-element: 'continuity' (i.e., fish passage).	
Quignamanger: Hydromorphology. Changes to Priority 7220* Tufa Habitat related to physical modification	Regrading of the lower few metres of the existing confined, open channel into the proposed new box culvert at Quay Road has potential to alter morphological conditions affecting a short reach (5-7m) that currently supports ephemeral tufa deposits (over seasonal algal growth of *Vaucheria*). This short reach is associated with the more defined tufa Priority *7220 habitat located 15m upstream of the Quay Road culvert. There is no doubt, considering the stream water chemistry (**Appendix 9.7**), that tufa deposits will reform in the operational phase following short-term construction phase disturbance. Tufa deposits may even be improved in the long term because of slightly higher water velocities during elevated flows, i.e., increased calcium carbonate precipitation owing to turbulence (Chen, et al., 2004). It is noted that the channel has been subject to a high level of historical disturbance and, because of the stream water chemistry has reformed tufa deposit habitat. However, if the reinstated stream bed (following regrading) was overly uniform, i.e., laminar flows over a smooth surface, there is potential for losses of tufa deposits along 5-7m of regraded channel. Conversely, if channel reinstatement included bed-roughness elements, it is very likely to give rise to increased tufa deposition owing to slightly increased water velocity and turbulence. The worst-case scenario, i.e., poor reinstatement of channel bed is assessed. In the absence of sensitive channel reinstatement there could be deterioration in the hydromorphological quality sub-element: 'morphology', which could negatively impact on tufa deposit habitat.	**Likely significant negative** long-term effect locally if channel regrading reinstatement does not ensure bed-roughness elements that facilitate tufa deposition.
Quignamanger: Hydromorphology Habitat fragmentation	The new Quay Road culvert, if not correctly designed and installed, has potential to introduce a fish passage barrier, preventing eel and salmonids entering the lower reaches of the Quignamanger and resulting in long term habitat fragmentation	**Likely significant negative**

9.4.5.3 Bunree

Description of Potential Effect	Characterisation of Potential Effect prior to mitigation	Significance of Effect (without mitigation)
Bunree: Hydromorphology. General	There are losses of short sections of low-quality instream habitat open channel and reopening of previously culverted Bunree channel under the proposed scheme. A slightly positive long-term effect is likely in the Moyvale Park reach where existing culverting will be removed and the stream opened. This will restore a short section of aquatic habitat, which will support macroinvertebrates and may potentially be used by eels in the operational phase as they have a better chance of ascending existing culverts to the newly open channel reach compared to the baseline scenario. The connectivity of the open channel with the surrounding bank/floodplain in Moyvale Park represents a positive impact on hydromorphology.	**Not Significant** positive to neutral long-term effect.

Description of Potential Effect	Characterisation of Potential Effect prior to mitigation	Significance of Effect (without mitigation)
	Replacement of old culverts and installation of new culvert along the existing Bunree watercourse removes current flow constrictions along the channel, which improves conveyance and results in significantly increased cross-sectional velocities under the proposed scheme, compared to baseline. The cross sections were examined within Moyvale Park where flow is currently constricted in undersized culverts. This reach will be reinstated as open channel (culvert removal), which will restore the types of flow that ought to be present in this stream in the absence of historical culverting, therefore an improvement to hydromorphology.	

9.4.5.4 Brusna (Glenree)

Description of Potential Effect	Characterization of Potential Effect prior to mitigation	Significance of Effect (without mitigation)
Brusna (Glenree): Hydromorphology. Severance of fish passage in relation to replacement of bed and bank protection at Shanaghy Heights Bridge	The existing riverbed-protection below the bridge has eroded in the mid-channel forming a 'natural' low flow channel that has been colonised by aquatic mosses and has deposition of natural cobble, gravel, and coarse sand. The morphology is such that fish migration is facilitated during even the lowest flows. Flows are also turbulent owing to the existing concrete conglomerate structure of the bed protection which provides channel 'roughness' creating turbulent flows that provide cover to salmonids migrating through the reach. Replacement of this bed protection has potential to remove the low-flow channel and remove the turbulent flow / morphology which can disrupt or prevent fish passage (salmon, trout, eel) especially during low flows. This can be prevented by good design and engineering of the bed protection such that the low flow channel and bed 'roughness' elements are included in the design (see **Section 9.5.2**). In the absence of mitigation salmonid migration may be disrupted long-term which would undermine the 'continuity' sub-element of the hydromorphological quality elements that support WFD status for the river water body (RWB) and connecting RWBs upstream.	**Likely significant negative** long-term effects in terms of fish passage
Brusna (Glenree): Hydromorphology. Potential effects of hydraulic changes on instream habitats and fish as a result of new flood walls / embankment	To assist in assessment of potential impacts on the hydraulic environment of the Brusna River, baseline and post-scheme values for two hydraulic parameters were examined in detail, i.e., channel velocity (m/s) and Froude number (see **Appendix 9.8, Figures A9.8.7** and **Figure A9.8.9**). Modelled hydraulic changes were examined for nine (9 no.) river cross-sections spanning 545m upstream to 260 m downstream of Shanaghy Heights Bridge. The examination of hydraulic changes pre- and post-works showed virtually no change in either mean cross section channel velocity or Froude number between baseline and post-scheme 50% AEP and 1% AEP scenarios on the Brusna (Glenree) in relation to physical modifications in the reaches near Shanaghy Heights Bridge. This is a channel that already undergoes periods of elevated velocity and Froude number owing to existing channel morphology.	**Not Significant** imperceptible to neutral long-term effects in terms of salmonid habitats.

Description of Potential Effect	Characterization of Potential Effect prior to mitigation	Significance of Effect (without mitigation)
	Based on the post-scheme modelled hydraulic parameters, changes to sediment (bed-substrate) transport, deposition and settlement are predicted to not significantly alter over baseline conditions meaning any localized spawning and nursery habitats for salmon and trout will not be adversely affected. In terms of salmon and sea trout upstream migration, channel velocities through the bridge structure and along the reach affected by set-back walls/embankment are not significantly altered in the 50% AEP and 1% AEP design scenarios. Water velocities in flood events are quite high (generally 1.8 to >2m/s) both at baseline and in the design scenario. Salmonids will likely temporarily delay downstream of the bridge (at baseline and post-scheme) during higher discharges. Presence of the scour pool downstream of the bridge (which will not alter under the design) provides holding habitat for lay-overs. This means that temporary delays on the upward migration will not be any more frequent post scheme than under the baseline scenario. Fish will rapidly pass the structure once elevated flood event velocities begin to recede. There are no significant changes to the hydromorphology quality elements (morphological conditions, hydrological conditions, river continuity) that underpin WFD status for the freshwater Brusna/Glenree River as a consequence of predicted long-term hydraulic changes under the proposed scheme. Changes to hydraulic conditions do not give rise to hydromorphological effects that could cause deterioration in WFD river water body status (Glenree_030 IE_WE_34G010200) nor prevent attainment of at least good status (i.e., no change from current 'good' status).	
Brusna (Glenree): Hydromorphology. Potential habitat degradation arising from loss of riparian tree cover	The affected c.500 m reach comprises good salmonid habitats (spawning, nursery and holding), enhanced by dappled shade from southern bankside trees, providing beneficial ecosystem functions, i.e., fish cover, instream thermal regulation, suppression of ephemeral algal blooms that can lead to habitat changes and biological oxygen demand (BOD) pulses. Tree loss mapping is addressed and referenced in **Chapter 10: Terrestrial Biodiversity**. Small numbers of trees will be removed on the LHS bank upstream of Shanaghy Heights Bridge, removing a proportion of this beneficial function. There will also be losses of bankside trees on the RHS river corridor owing to set-back flood wall construction. Whilst there will still be considerable cover from both LHS and RHS banks, the loss of function provided by the existing tee cover may lead to increased ephemeral (filamentous green) algal growth and loss of localized cover for fish habitats.	**Likely significant negative** medium-term, reversible effect locally on salmonid habitats within the SAC, affecting QI species: salmon.

9.4.5.5 Tullyegan

Description of Potential Effect	Characterization of Potential Effect prior to mitigation	Significance of Effect (without mitigation)
Tullyegan: Hydromorphology. Changes to hydraulic conditions as a result of flood walls and embankments	The proposed slight increase in flood wall height does not significantly alter hydromorphology in this deeply drained section of the stream which is already constrained by vertical banks and walls along the proposed works reach. The examination of hydraulic changes pre- and post-	**Not Significant** but slight, reversible negative long-term

Description of Potential Effect	Characterization of Potential Effect prior to mitigation	Significance of Effect (without mitigation)
	works are set out in **Appendix 9.8**. There are predicted slight increases in 50% AEP and 1% AEP post-scheme velocities, primarily downstream of the proposed works area, owing to new walls/embankment. The post-scheme average cross section velocities at the downstream end are no greater than 1.2 m/s, which would not be considered to cause a significant barrier to fish migration (trout in the case of the Tullyegan). On this, it is noted, that approximately half of flows will be less (than those modelled at 50% AEP) meaning lower velocities are also common. There will also be variability in velocity across the channel during higher flows, i.e., areas of higher and lower velocity. In historically deepened, modified channels such as the Tullyegan, slight increases in channel velocity locally can also help flush fine sediments and give rise to new, faster-water habitats (riffle/run) for trout nursery and spawning leading to improved recruitment locally. Overall, the post-scheme hydraulic effects on fisheries potential of this currently highly modified channel is predicted to be imperceptible in the long-term, with perhaps slight improvements and slight degradation locally but not significantly altering the current value or migration characteristics of the channel to trout and eel. The baseline brook lamprey habitat is poor in this reach potentially owing to historical drainage / modification. If channel substrate variability was not reinstated correctly following construction, e.g., gravels, rocks, and larger cobbles, this could lead to a localized loss of hydraulic refugia and micro-habitats for fish during higher flow conditions.	effect locally in the absence of channel reinstatement.

9.4.6 Summary of Likely Significant Effects

Table 9-15 and **Table 9-16** summarise construction and operation phase effects described in **Section 9.4.4** and **Section 9.4.5**. The aim of this summary is to clearly identify likely and significant effects and establish where specific mitigation measures are required for avoidance, prevention and reduction of potentially negative effects. Only those areas requiring specific mitigation measures are carried through to **Section 9.5**.

Table 9-15 Construction Phase – Summary of Effects

Watercourse	Brief Description of Construction Phase Effects	Significance of Effect (without mitigation)	Requires mitigation?
River Moy (Ridgepool)	**Ridgepool LHS: Direct and/or Indirect Effects arising from instream works**. Temporary to short term disturbance to sea lamprey habitats associated with temporary instream access route	Potential **significant negative** short-term, reversible, though **unlikely** direct effects on *sea lamprey spawning habitat* locally in a discrete area at RP2A (see **Appendix 9.6**) on LHS **Likely significant negative** short term localised indirect effects on *sea lamprey nursery habitat* locally on LHS at RP5 (see **Appendix 9.6**)	Yes
River Moy (Ridgepool)	**Ridgepool LHS: Direct and/or Indirect Effects arising from instream works**. Short term disturbance to river margin habitats and salmonids associated with temporary instream access route	**Not Significant.** Temporary-to-short term moderate negative direct effects locally	Yes
River Moy (Ridgepool)	**Ridgepool LHS and RHS:** Fish entrapment in cofferdams	**Likely significant negative** locally	Yes
River Moy (Ridgepool)	**Ridgepool LHS: Fisheries Enhancements** Direct and/or Indirect Effects arising from instream works.	**Not Significant**, Positive effects on fisheries holding areas in the Ridgepool LHS	No
River Moy (Ridgepool)	**Ridgepool & Salmon Weir RHS: Direct and/or Indirect Effects arising from instream works**. Temporary to short term disturbance to river margin and sea lamprey habitats associated with instream works involving 4-5 No., 3-5m wide x 50m long sections of sandbag cofferdam for flood wall repair / maintenance and construction works along Ridgepool Road.	Potential **Significant negative,** though **unlikely** localized direct effects on *sea lamprey spawning habitat* in the Ridgepool RHS at RP8 – RP8A (see **Appendix 9.6**) **Likely significant negative** direct effects on *sea lamprey nursery habitat* locally in the Ridgepool RHS in a discrete area at RP11 (see **Appendix 9.6**)	Yes
River Moy (Downstream N59 Lower Bridge)	**Downstream N59 Lower Bridge LHS: Direct Effects arising from instream works**. Temporary disturbance to sea lamprey habitats associated with 3-5m wide cofferdam installation (120m linear length) and flood wall construction works adjacent to Bachelors Walk	**Likely significant negative** short term reversible localised effects on sea lamprey nursery habitat	Yes

Watercourse	Brief Description of Construction Phase Effects	Significance of Effect (without mitigation)	Requires mitigation?
River Moy	**General Indirect Effects arising from instream works**. Degradation of water quality and aquatic habitats arising from pollutant wash-out from temporary works areas along the River Moy margins through Ballina	**Likely significant negative** in the absence of specific mitigations to control pollutant wash-out from temporary works areas	Yes
River Moy	**General Indirect Effects arising from instream works**. Degradation of water quality and aquatic habitats arising from pump out of ingress water from cofferdams	**Likely** short term **significant negative** reversible effects locally in relation to discharge of potentially toxic compounds and / or chronically elevated turbidity.	Yes
River Moy	**General Indirect Effects arising from works over or near water**. Degradation of water quality and aquatic habitats arising from out-of-channel flood wall repairs and construction, regrading of roads and footpaths, drainage features	**Likely significant negative** short term reversible effects locally in relation to discharge of potentially toxic compounds and / or chronically elevated turbidity.	Yes
River Moy	**Indirect Effects arising from Instream works on tributary culverts.** Degradation of water quality and aquatic habitats of the River Moy and SACs	**Likely significant negative** short term reversible effects locally in relation to discharge of suspended solids and/or toxic compounds from within the tributaries.	Yes
Quignamanger	**Direct and Indirect Effects arising from instream works.** Physical impact and pollutant wash-out arising from culvert removals / installations.	**Likely significant negative** temporary-to-short term reversible in the lower Quignamanger, potentially impacting on Annex I priority habitat *7220 tufa deposits.	Yes
Bunree	**Indirect Effects arising from instream works.** Pollutant wash-out arising from culvert removal / installation.	**Not Significant**	No
Brusna (Glenree)	**Direct and Indirect Effects arising from instream works**. Replacement of instream bed and bank protection at Shanaghy Heights Bridge using sandbag cofferdams (left and right alternately)	**Likely significant negative** temporary-to-short term direct and indirect effects locally	Yes
Brusna (Glenree)	**Indirect Effects arising from works in and near water**. Degradation of water quality and aquatic habitats arising from out-of-channel flood wall and embankment construction	**Likely significant negative** temporary-to-short term indirect effects locally	Yes
Tullyegan	**Direct Effects arising from Instream Works** associated with flood defense wall construction	**Likely significant negative** locally	Yes
Tullyegan	**Indirect Effects arising from works near water**. Degradation of quality and aquatic habitats arising from out-of-channel flood wall construction	**Not significant** though temporary moderate negative reversible effects are likely	Yes

9.4.6.1 Operational Phase

Table 9-16 Operation Phase – Summary of Effects

Watercourse	Brief Description of Operational Phase Effects	Significance of Effect (without mitigation)	Requires specific mitigation
River Moy	**Hydromorphology**. Potential hydraulic effects on instream habitats and biota	**Not Significant.** Long-term imperceptible to neutral	No
River Moy	**Water Quality.** Changes to water quality associated with flood defenses and new storm water drainage outfalls to the Moy	**Not significant.** Positive to neutral long-term effects on the River Moy in and downstream of Ballina	No
River Moy	**Water Quality.** Changes to water quality associated with new surface water pumping stations to the Moy	**Not significant.** Neutral long-term effects on the River Moy in and downstream of Ballina	No
Quignamanger	**Hydromorphology**. Changes to fisheries habitat and or fish passage related to hydraulic conditions	**Not Significant.** Long-term imperceptible to neutral effects	No
Quignamanger	**Hydromorphology**. Changes to fisheries habitat and or fish passage related to physical modifications	**Not Significant.** Positive to neutral effects.	No
Quignamanger	**Hydromorphology**. Changes to Priority 7220* Tufa Habitat related to physical modification	**Likely significant negative** long-term effect locally	Yes
Bunree	**Hydromorphology.** Very little net change over baseline.	**Not Significant** positive to neutral long-term effect.	No
Brusna (Glenree)	**Hydromorphology**. Fish passage in relation to Shanaghy Heights bed and bank protection	**Likely significant negative** long-term effects	Yes
Brusna (Glenree)	**Hydromorphology**. Potential effects of hydraulic changes on instream habitats and fish as a result of new flood walls / embankment	**Not Significant** Imperceptible to neutral long-term effects	Yes
Brusna (Glenree	**Hydromorphology**. Potential habitat	**Likely significant negative** medium-term, reversible effect locally	Yes

Watercourse	Brief Description of Operational Phase Effects	Significance of Effect (without mitigation)	Requires specific mitigation
	degradation arising from loss of riparian tree cover		
Tullyegan	**Hydromorphology.** Changes to hydraulic conditions as a result of flood walls and embankments	**Not Significant.** Slight, reversible negative long-term effect locally.	No

9.5 Mitigation Measures

9.5.1 Construction Phase

The CEMP accompanying this application sets out best practise methods and environmental controls relating to the proposed development. Contractors will be obliged to adopt the CEMP and all measures set out in **Section 9.5.1.1** to **Section 9.5.1.8**. The contractor will be obliged to update the CEMP to include any requirements conditioned in a planning permission. It is normal practise that IFI be given an opportunity to review the detailed Construction Method Statement (CMS) for areas of instream construction, well in advance of works commencing. A detailed Construction Method Statement (CMS) for each area of instream works as part of the scheme shall be prepared by the contractor and submitted to IFI for approval in the early stages of construction planning.

Relevant staff in IFI Ballina must be consulted by the contractor prior to commencement of any instream works in each of the channels, providing an opportunity to refine the CMS in compliance with the Schedule of Environmental Commitments, updated subject to any planning conditions. Any further requirements deemed necessary (e.g., as a result of planning conditions) shall be agreed with the IFI no less than 6 weeks in advance of works commencing. Importantly, the contractor must hold pre-commencement consultation meetings with staff of IFI Ballina in advance of works starting on the main channel of the Moy, particularly concerning the Ridgepool and Cathedral Pool stretches where there are:

1. Timing restrictions in recognition of their fisheries status.
2. Fisheries enhancement measures to be incorporated in the Ridgepool while the access ramp is in place on the LHS between Ballina Manor Hotel and Otter's Lodge Apartments.

The pre-commencement consultation meeting with IFI must be held in the early stages of finalising the project work schedule so that angling and instream works timing restrictions can be adhered to, and so that IFI have full awareness of finalised work schedule relating to individual elements of the proposed scheme.

The Contractor, overseen by an appointed Ecological Clerk of Works (ECoW), will be responsible for implementation of mitigation measures specific to aquatic ecology, as set out in the tables below. The CEMP sets out the overall roles and responsibilities of the ECoW in terms of overseeing and implementation of environmental controls throughout the project.

The following sub-sections cover general mitigation measures, followed by site-specific mitigation measures relevant to each watercourse to avoid prevent and reduce likely significant effects. General mitigation measures (**Section 9.5.1.1**) apply to all watercourses, while site-specific measures are bespoke to particular works required on that watercourse.

Table 9-17: Timing Restriction Summary

Watercourse	Watercourse Reach and Type of Works	Timing restriction (work allowed)
Freshwater River Moy	Instream works (Ridgepool and Salmon Weir)	**Angling restriction**: No instream works allowed in Ridgepool before August 1st in Year 1, but as agreed with IFI, Ridgepool instream works can continue through Year 2 (subject to sea lamprey spawning habitat protection timing restrictions set out in this table). **Sea lamprey spawning habitat protection restriction**: see details of bespoke timing restrictions set out in Row 3 of table in **Section 9.5.1.3** below regarding instream works in the vicinity of Ridgepool Points RP2A and RP8 to RP8A (see **Appendix 9.6** for locations).
Freshwater River Moy	Bankside works (no instream intrusion)	No timing restriction
Estuarine River Moy	Instream works downstream of N59 Lower Bridge, both banks.	No timing restriction: work occurs in Transitional Water and does not affect spawning / nursery waters
Estuarine River Moy	Works over or near water (not encroaching instream) adjacent to Cathedral Pool and downstream of N59 Lower Bridge	No timing restriction
Quignamanger	All instream works (culvert replacements).	May 1st to September 30th
Quignamanger	All works over or near water (flood wall construction along existing open section)	No timing restriction for works above water.
Bunree	All instream works for culvert replacement and installation	May 1st to September 30th
Brusna (Glenree)	All instream works (Shanaghy Heights Bridge upgrade)	July 1st to September 30th
Brusna (Glenree)	Works over or near water (set back flood wall and embankment construction)	May 1st to September 30th
Tullyegan	All instream works (flood wall construction)	May 1st to September 30th

9.5.1.1 Water Quality Protection Measures

General Water Quality Protection

Refer to **Chapter 11: Land, Soils, Geology and Hydrogeology, Section 11.5** and **Chapter 12: Water, Section 12.5.1** for all measures relating to surface water quality protection as relates to controls that mitigate against potential sediment, cement and hydrocarbon wash-out effects on aquatic ecological receptors during the construction phase.

9.5.1.2 Invasive Species Measures

Adherence to IFI biosecurity protocol (Caffrey, 2010) for avoidance of spread of pathogens will be followed by contractors and surveyors. Careful disinfection and biosecurity measures is essential to prevent transfer of damaging pathogens, e.g., crayfish plague disease and zebra mussel, between sites and river sub-catchments within and outside of the watercourses. This will apply to all personnel working in or near water, plus machinery that meets surface water and/or drainage to surface waters.

Transfer of invasive plant species between sites within the catchment and to other catchments will be prevented. An invasive species management plan is set out in the CEMP which includes that specific locations of invasive plants (e.g. Japanese knotweed) along open watercourses and works areas will be identified, with details of how the area will be treated to prevent spread and transfer of invasive species along river corridors.

- Personnel working instream will be aware of potential for presence of aquatic invasive species (including but not restricted to zebra mussel, crayfish plague) and strict biosecurity measures applied to any equipment used in the water.
- Check/Clean/Dry policy shall be applied. All equipment used for instream works shall be checked before leaving site and any plant or animal material/debris removed. Equipment shall then be cleaned.
- Biosecurity facilities shall be installed on-site prior to site works commencing within the site compound. Any personal protective equipment (PPE) machinery and equipment used during instream works for the construction shall be washed down and disinfected in this facility. It shall include facilities for wheel brushing, brushing down of vehicles, cleaning of footwear and other equipment prior to arrival on site and on leaving site. It shall also include an area where bushing can be directed into a dedicated and contained area. Washdown water shall not be allowed to enter surface water bodies. Vehicles leaving the site shall be inspected for any plant/animal material and cleaned down in the biosecurity containment area following the biosecurity procedures within the guidance documents below. Water shall not be abstracted from the River Moy for cleaning. A sign-off sheet shall be maintained by the Contractor to confirm cleaning.
- The disinfection protocol is set out in IFI Biosecurity Protocol for Field Survey Work (Caffrey, 2010)

9.5.1.3 River Moy (Ridgepool)

Potentially Significant Impact Category Identified	Mitigation
1. Timing Restrictions	• **Angling restriction:** No instream works allowed in Ridgepool before August 1st in Year 1, but as agreed with IFI, Ridgepool instream works can continue through Year 2 (subject to sea lamprey spawning habitat protection timing restrictions set out in this table). • **Sea lamprey spawning habitat protection restriction:** see details of bespoke timing restrictions set out in **Row 3** of this table regarding instream works in the vicinity of Ridgepool Points RP2A and RP8 to RP8A (see **Appendix 9.6** for locations).
2. Access ramp construction LHS in front of IFI Building	• The entire temporary access ramp must be comprised of materials that do not cause a constant leaching of suspended solids to the River Moy arising from scour and sediment wash-out owing to variable and at times elevated and swift, erosive flows. To achieve this the base of the access ramp will be constructed using a product such as Ridgeway (Kyowa) Rockbags: Rockbags in Europe and UK - Rockbags or a similar product (e.g., rock filled reno-mattresses) which delivers the same function and effectiveness. Rockbags are a type of flexible rock gabion that can be placed on top of each other to form a base, which could then have a surface of, for example, temporary steel access ramps placed atop to form the access ramp, precluding any requirement for hardcore material with fines that would otherwise be subject to sediment wash-out. Because the access ramp needs to be in place for 20-22 months, a robust, non-erodible solution such as this is required as the construction is within the SAC and adjacent to an iconic angling pool. • Use of rockbags (or product of similar function and effectiveness in terms of being non-erodible) will also protect the composition of underlying benthic substrates, such that when the access ramp is removed the overlying bags can be lifted, leaving substates largely unaltered in terms of sediment size class to recolonise with algae and aquatic mosses similar to baseline conditions.
3. Potential Sea lamprey spawning habitat protection at Sites RP2A and RP8-RP8A (see **Appendix 9.6**)	• Although there are no potential lamprey spawning habitats directly affected by the temporary works areas in the Ridgepool (see **Appendix 9.6**), on a precautionary basis there are two discrete areas (Sites RP2A and RP8-RP8A, see locations in **Appendix 9.6**) in proximity to the outer margins of the proposed temporary instream works areas on both banks that are subject to precautionary restrictions / mitigations set out here. This is because sea lampreys are mobile and opportunistic and will construct redds in

Potentially Significant Impact Category Identified	Mitigation
	suitable substrates, subject to the actual low flow wetted channel characteristics during spawning season of any year. • It is crucial to take advantage of low flows in the Ridgepool during the construction programme to carry out instream works for wall repairs on the RHS (Ridgepool Road) quay walls which are badly eroded and collapsing at the base. Doing these works during low flows will greatly decrease the risk of pollutant washout from works areas and avoid delays to the overall work programme. • **In Year 1 (Y1):** cofferdams will not be placed between points RP8 and RP8A (RHS) and the access ramp will not be laid adjacent to point RP2A (LHS) before end of Week 2 of August Y1 – this only applies to these specific reaches as an extreme precaution to allow for any late spawned sea lamprey eggs to hatch. Other instream works downstream of these points can commence in Ridgepool on August 1st in Y1. • **In Year 2 (Y2):** The access ramp (LHS) remains in-situ through Y2 with no additional lateral incursion into the Ridgepool. Works will continue on the LHS using the access ramp and the cofferdam containment area. On Ridgepool Road (RHS), instream works downstream of Point RP8A can continue or commence at any time in Y2. However, as a precaution, if works were not completed between RP8 and RP8A between mid-August of Year 1 and the 1st of May in Year 2, then there are two options for placement of cofferdams along the reach that covers RP8 and RP8A on Ridgepool Road (RHS): • **OPTION A (RHS, Y2):** Cofferdams that include the reach RP8 to RP8A must be placed during mid-April, as this is before water temperature reaches 15oC in the Ridgepool and no sea lamprey spawning will have been initiated (see **Appendix 9.6**). Water temperature must be taken by the ECoW to ensure it is below 15^{o}C. Once the cofferdam id laid in April, any lamprey that then select to nest adjacent to the cofferdam will do so in May / June /July once temperatures reach 15^{o}C, and they will not be subject to direct disturbance during spawning. Prior to removal of cofferdams – if this occurs before mid-August - a qualified, experienced aquatic ecologist or fisheries scientist will be employed to SCUBA or snorkel survey the outer edge of the 5m temporary works cofferdam footprint. This will occur during mid-to-high tide when snorkelling over the area is possible because depth will be more suitable without undue disturbance to any lamprey that are present. If there are no redds or lamprey nest building activity observed by the surveyor, then the temporary cofferdam can be removed immediately and without delay. If there is lamprey nesting building activity or redds observed then cofferdam removal along the reach will be delayed until the end of Week 2 of August Y2, to avoid disturbing nests prior to egg hatching and larval emergence. • **OPTION B (RHS, Y2):** If cofferdams cannot be placed in April of Y2, then there can be no laying of cofferdams later than the last week of April (subject to water temperature being below 15oC) unless a qualified, experienced aquatic ecologist or fisheries scientist is employed to SCUBA or snorkel survey the outer edge of the 5m temporary works footprint in the days before proposed cofferdam placement, i.e., in May June or July. Instream survey will occur during mid-to-high tide when snorkelling over the area is possible because depth will be suitable without undue disturbance to any lamprey that do happen to be present. If sea lamprey nest building / spawning activity is recorded on the outer edge of the proposed 5m temporary work area, then the cofferdam placement will be delayed in that defined reach (encompassing RP8-RP8A) for one month to allow for hatching and emergence of larval lampreys. After that month has passed, another SCUBA survey must be carried out and once again: (1) in the absence of lamprey redd(s) and/or nest building activity the cofferdam can immediately be installed, or (2) if lamprey redd(s) and/or nest building activity is occurring, works must be delayed in that defined reach for a further month. If works have not been achieved because of these restrictions, then the final SCUBA / snorkel survey shall occur in the third week of July in Year 2, at which time, if sea lamprey spawning activity is absent then the cofferdam can be installed immediately with no further timing restriction. If sea lamprey nesting activity was still recorded in the third week of July, the cofferdam installation must be delayed until the end of the 2nd week of August of Y2 between RP8 and RP8A to allow for any late emergence of larval lampreys. • Whilst the above timing restrictions appear laborious, they protect sea lamprey, whilst allowing for the possibility of completing critical instream repairs to the Quay Walls on the Ridgepool Road (RHS) during the low flow period in the River Moy. This will greatly reduce the potential for adverse effects that could arise from unexpected inundation of

Potentially Significant Impact Category Identified	Mitigation
	cofferdams by floods, since flooding has a lower probability of occurring May-July inclusive. • Records of the exact location and number of sea lamprey and/or redds observed in the above surveys shall be kept and submitted to NPWS and IFI.
4. Wildlife rescue and relocation on groyne area - Ridgepool LHS	• 1-tonne sandbag cofferdams (if required) must be placed in the channel on low tide. • Once in place the cofferdam shall be sealed on a low tide as this will reduce water volume and decreases probability of fish entrapment. • Once sealed, electrofishing will be conducted within the cofferdam under approval and supervision of IFI staff (subject to licence and agreement with IFI Ballina). Any rescued fish shall be temporarily held in containers of clean, well-oxygenated river water or immediately transferred to the outside of the cofferdam.
5. Protection of lamprey nursery habitat - Ridgepool LHS at Site RP5	• The stand of emergent reeds (*Sparganium erectum*) in front of Ballina Manor Hotel at Site RP5 (see **Appendix 9.6**) will be cordoned off marking the area as an exclusion zone. • A double line of silt fencing will be installed on the landward side of the emergent reed stand, extending all the way along the existing grassed bankside verge to prevent sediment loss from the access ramp and bankside works zone. • The ECoW will conduct a toolbox talk explaining the presence of larval lampreys and the importance of protecting the RP5 area from disturbance.
6. Wildlife rescue and relocation – larval lampreys Ridgepool RHS at Site RP11	• If possible, repairs to the river walls will be carried out without the use of instream cofferdams (i.e., using scaffold or platform from the footpath above) in which case the marginal sediment deposit on Ridgepool RHS between RP11 and the Upper Bridge: (see **Appendix 9.6**) will be treated as an exclusion zone (no disturbance). • If instream works are required in the vicinity of Site RP11, the sandbag cofferdam will be installed and sealed at low tide to help prevent fish entrapment. • Electrofishing will then be conducted by either IFI Ballina staff or by a qualified aquatic ecologist (Level 9 or higher) with electrofishing experience, licenced and under supervision by IFI staff. The aquatic ecologist will remain onsite during the initial pump-out and water draw down inside the cofferdam to observe any sign of lamprey ammocoetes that may emerge from silt accumulations in the RP11 to Upper Bridge reach. • Larval lamprey shall be captured by hand or pond net and temporarily be kept in a bucket of clean river water then transferred immediately outside of the cofferdam where they will move downstream and settle in suitable silt deposits which are widely available downstream of the Lower Bridge. • The ECoW will be present for the dewatering and records of type / number of trapped and released fish shall be kept by the ECoW. • The first pass of any earthmoving activity within the Ridgepool RHS RP11 to Upper Bridge cofferdam shall involve the digger removing the top layer of marginal silt to a depth of about 30-50 cm and spreading it out on a patch of the dewatered work zone so that lamprey ammocoetes can be collected and released. Juvenile lamprey will quickly re-burrow into suitable substrates once relocated (King, et al., 2008)
7. River margin reinstatement prior to cofferdam removal – Ridgepool RHS (Ridgepool Road) and LHS on “groyne” area adjacent to Otters Lodge Apartments	• If there are excavations to be carried out within the cofferdams, the top 30 cm of naturally occurring substrates will be scraped off and stockpiled for reinstatement before cofferdam removal. These substrates shall also be used to gauge the size of replacement substrate material for reinstatement works prior to cofferdam removal. Thus, reinstated substrates will be of the same size classes as the pre-existing condition and will facilitate sediment deposition patterns equal to baseline for regrowth of aquatic plants at the river margin. • Prior to removal of cofferdams on the RHS of the Ridgepool the river margin areas must be reinstated inside the cofferdam using a combination of the retained substrates (as above) and locally sourced, clean, calcareous substrates of cobble that is approved by IFI and that broadly mimic the naturally occurring substrates. IFI carry out other river improvement works in the catchment using locally sourced cobble / gravel materials and as such they are the appropriate body to be contacted by the ECoW to establish current (at the time) approved supplier(s) of such materials prior to the reinstatement period.

Potentially Significant Impact Category Identified	Mitigation
	• Prior to removal of cofferdams on the LHS of the Ridgepool, the 'groyne' area must also be reinstated inside the cofferdam (and within the proposed realigned 'groyne' outline) using approved, locally sourced, clean, calcareous cobble and pebble that is approved by IFI and that broadly mimics the naturally occurring substrates. IFI is the appropriate body to be contacted by the ECoW to establish current (at the time) approved supplier(s) of such materials prior to the reinstatement period. • Reinstatement within the cofferdam shall match the profile of the bed level on the outside of the cofferdam, and at the upstream and downstream ends, such that there is no significant step-change in lateral or longitudinal riverbed profile. • Cofferdams shall be removed beginning downstream and working in an upstream direction beginning at low tide and working through to the high tide to slowly submerge the newly reinstated river margin areas. This is to avoid wash-out of newly reinstated substrates owing to strong river flows from the upstream end at low tide. The ECoW will be responsible for ensuring implementation of the above reinstatement measures for the River Moy channel margins within the Ridgepool in conjunction with IFI Ballina. •
8. Management of ingress water (Cofferdams on the River Moy)	• Cofferdams will be carefully managed On-site pumps must be present to dewater, as required, at cofferdam containment areas to maintain a dry working area. These areas will inevitably be subject to water ingress. • Pumped-out ingress water must not be directly discharged to either the River Moy or any adjoined drainage channels, unless treated before discharge. • In the absence of appropriate treatment, pump-out water must also not be directly discharged to the general environment at any other location. • On-site storage facilities for pump-out water (e.g., proprietary sedimentation tanks) must be of sufficient volume to hold the volumes of pump-out water encountered, and tank volume should be overcompensated by 10% so as to ensure adequate containment capacity, thus avoiding spills and overflows to the river. • Pump-out water can be treated on-site (e.g., sediment settlement and pH monitored) or can be removed off-site for discharge at a licenced treatment facility. • "Appropriate treatment" means attenuation and treatment that ensures discharge water does not exceed 25 mg/l suspended solids and must be within the pH bracket of ≥ 6 ≤ 9 (related to concrete usage).
Effects of bulk liquid concrete usage on aquatic receptors (if leakage or spillage occurs)	• At the new fishing access area on Ridgepool Road at Weir Building, where possible, pre-cast units will be used, e.g., steps, and pre-cast slabs. Any cast in-situ concrete usage will be carefully managed using Best Practice. Concrete materials cast in place will remain inside sealed formed structures until set. • It will be ensured that no concrete, cement, mortars, and other Portland cement, concrete debris and dust, wash or contact water enters any surface water. • Concrete delivery trucks will be washed-down at designated containment areas in the site compound and never to the river. Concrete wash-down water will be removed for disposal at a licenced facility.

9.5.1.4 River Moy (Downstream of Lower Bridge - N59 crossing)

Potentially Significant Impact Category Identified	Mitigation
Timing Restrictions	• No timing restrictions on instream works as habitats are within the transitional water.
Wildlife rescue and relocation – larval lampreys LHS River Moy downstream of Lower Bridge (N59 crossing)	• If possible, repairs to the river walls will be carried out without the use of instream cofferdams, i.e., using the space available on the berms inside the existing river walls. • In the 120m LHS reach downstream of the Lower Bridge adjacent Bachelors Walk cofferdams are likely to be required as the berm is narrow and the Knockanelo culvert meets the Moy.

Potentially Significant Impact Category Identified	Mitigation
	• 1-tonne sandbag cofferdams (where required) must be placed in the channel on low tide. • Once in place the cofferdam shall be sealed on a low tide as this will reduce water volume and decreases probability of fish entrapment. • Electrofishing will then be conducted by either IFI Ballina staff or by a qualified aquatic ecologist (Level 9 or higher) with electrofishing experience, licenced and under supervision by IFI staff. • The aquatic ecologist will remain onsite during the initial pump-out and water draw down inside the cofferdam to observe any sign of lamprey ammocoetes that may emerge from silt during the dewatering. Any rescued fish shall be temporarily held in containers of clean, well-oxygenated river water and immediately transferred to the outside of the cofferdam. Species are likely to be encountered include, at a minimum, eel and lamprey ammocoetes, but could include estuarine species such as grey mullet, flounder and possibly coarse species such as roach. • The ECoW will be present for the dewatering and records of type / number of trapped and released fish shall be kept by the ECoW. • The first pass of the earthmoving activity within the cofferdam shall involve the digger removing the top layer of marginal silt to a depth of about 30-50 cm and spreading it out on the nearby bank so that lamprey ammocoetes can be gathered by the ecologist into buckets of clean water and transferred to alternative habitat downstream. Juvenile lamprey will quickly re-burrow into suitable substrates once translocated (King, et al., 2008). • Larval lamprey shall be captured by hand or pond net and temporarily be kept in a bucket of clean river water then transferred immediately outside of the cofferdam where they will move downstream and settle in suitable silt deposits which are widely available downstream of the Lower Bridge. • The existing boulder riprap shall be removed and stockpiled on the bank for use in reinstatement following the works.
Water quality degradation affecting instream biota during flood wall construction on vegetated berms (Downstream Lower Bridge LHS and RHS)	• Where cofferdams and instream works are not required (owing to sufficient berm space), a double line of silt fencing will be installed along the riverbank between the wall construction zone and the river. The ECoW will be responsible for regular checks and will request the contractor to carry out maintenance to silt fencing if and when required to ensure its efficacy.
River margin reinstatement prior to cofferdam removal – Bachelors Walk LHS	• The existing boulder riprap material shall be reused in the bank/berm reinstatement following the temporary instream works. • Prior to cofferdam removal, the line of boulder riprap will be installed, and the river margin will be backfilled with clean earth and tamped down so as to recreate the riverside berm of the same width as the pre-existing condition. The berm shall be reinstated as described in **Chapter 10: Terrestrial Biodiversity**, to ensure that FS2 tall reed swamp habitat is replaced. • Stockpiled boulders shall be used and if additional rocks are required, these shall be locally sourced, clean, calcareous boulder and large cobble that are approved by IFI and that broadly mimics the pre-existing substrates. As set out above, the IFI is the appropriate body to be contacted by the ECoW to establish current (at the time) approved supplier(s) of such materials prior to the reinstatement period. • The ECoW will be responsible for implementing the above reinstatement measures for the River Moy channel margins along Bachelors Walk in conjunction with IFI Ballina and NPWS. • Replacement of boulder riprap along to river margin will encourage deposition of finer material and eventual sedimentation and regrowth of marginal plant species. This will in time also allow for re-establishment of juvenile lamprey populations at low levels as is the baseline condition. • All reinstatement within the cofferdam shall be carried out to match the profile of the bed level on the outside of the cofferdam, and at the upstream and downstream ends, such that there is no significant step-change in lateral or longitudinal riverbed profile.

Potentially Significant Impact Category Identified	Mitigation
	• The cofferdam shall be removed beginning downstream and working in an upstream direction to slowly submerge the newly reinstated river margin areas. This is to avoid wash-out of substrates owing to river flows from the upstream end.

9.5.1.5 Quignamanger

Potentially Significant Impact Category Identified	Mitigation
Timing Restrictions	• Instream works period stipulated by IFI is May 1st to September 30th of any year.
Water quality protection during culvert removal / installation (Creggs Road)	• The contractor will be required to notify IFI in advance of instream works and provide an updated detailed construction work plan for approval including any planning conditions and consequent environmental commitments before works commence. • Each section of culvert replacement must be installed in a 'dry' works area using an appropriate method of water management, e.g., dam and pump-over, temporary piping. • Works shall proceed in an upstream direction. • A schedule of works will be drawn up by the contractor to break the culvert replacement works into manageable sections (e.g., 30-50 m at a time) such that water management can be adequately controlled, thus preventing entrainment of sediment and other potentially polluting substances. • Where possible, the new culvert should be installed off-line with flow diverted from the old culvert following completion.
Water quality protection during culvert removal / installation (Quay Road)	• The Quay Road culvert must be installed in a 'dry' works area using an appropriate method of water management, e.g., dam and pump-over, temporary piping. • The contractor and ECoW will be required to notify IFI in advance of instream works and provide an updated detailed construction work plan for approval including any planning conditions and consequent environmental commitments before works commence. • There can be no discharge of any polluting substances (sediment, concrete, hydrocarbons) directly to the watercourse during the construction.
Management of ingress water ('dry' instream working areas of Quignamanger during culvert replacements)	• On-site pumps must be present to dewater and maintain 'dry' working containment areas to complete instream works. • Dewatering pumps to be placed in sumps surrounded by drainage stone. • There will be no dewatering discharge directly back to the Quignamanger or any adjoining drainage channel. • Ingress waters will be pumped out and discharged via a silt bag 30m away from the watercourse. The discharge point will be a vegetated area of land and will be surrounded by a triple line of staked silt fencing surrounding a circle of staked down strawbales wrapped in terram. Any outflow from the protected discharge point will be visually monitored to ensure there is no escapement of highly turbid water. If highly turbid water is observed works will be stopped by the ECoW and additional silt control measures will be implemented, e.g., use of settlement tank in series with silt bag. These mitigations will be overseen by the ECoW.
Protection of Tufa deposit *7220 Habitat	• Prior to instream works commencing for the Quay Road culvert (above) the stream must be surveyed by a qualified, experienced ecologist (Level 9 or higher) identifying the tufa cascades (these were located approximately 15 m upstream of the Quay Road culvert in 2023). This area must be cordoned off using hazard tape, upstream and downstream to delineate it as an exclusion zone. The ECoW will be responsible for ensuring that there is no tracking or walking through the stream, nor any other direct physical impact upon the tufa habitat within the exclusion zone. • The works area upstream of the existing Quay Road culvert shall be carefully planned by the contractor to only impact on a short section of the open channel leading into the proposed new culvert. This will be no more than 5 -7 m of channel upstream of the existing Quay Road culvert. The ECoW is responsible for ensuring this spatial restriction is adhered to.

Potentially Significant Impact Category Identified	Mitigation
Design Measures to be incorporated during construction	• Refer to **Section 9.5.2.2**, below, for design measures to be implemented in the construction phase relating to the regrading of the Quignamanger upstream of Quay Road culvert, i.e., baffles or step-pool design to facilitate fish passage and tufa deposition in the operational phase.

9.5.1.6 Bunree

Potentially Significant Impact Category Identified	Mitigation
Timing Restrictions	• Instream works period stipulated by IFI is May 1st to September 30th of any year.
Water quality protection during culvert removal / installation	• Each section of culvert replacement must be installed in a 'dry' works area using an appropriate method of water management, e.g., dam and pump-over, temporary piping. • Works shall proceed in an upstream direction. • A schedule of works must be drawn up to break the culvert replacement works into manageable sections (e.g., 30-50 m at a time) such that water management can be adequately controlled, thus preventing entrainment of sediment and other potentially polluting substances. • Where possible, the new culvert should be installed off-line with flow diverted from the old culvert following completion.
Management of ingress water ('Dry' instream working areas of Bunree during culvert replacements)	• On-site pumps must be present to dewater and maintain 'dry' working containment areas to complete instream works. • Dewatering pumps to be placed in sumps surrounded by drainage stone. • There will be no dewatering discharge directly back to the Bunree or any adjoining drainage channel. • Ingress waters will be pumped out and discharged via a silt bag 30m away from the watercourse. The discharge point will be a vegetated area of land and will be surrounded by a triple line of staked silt fencing surrounding a circle of staked down strawbales wrapped in terram. Any outflow from the protected discharge point will be visually monitored to ensure there is no escapement of highly turbid water. If highly turbid water is observed works will be stopped by the ECoW and additional silt control measures will be implemented, e.g., use of settlement tank in series with silt bag. These mitigations will be overseen by the ECoW.

9.5.1.7 Brusna (Glenree)

Potentially Significant Impact Category Identified	Mitigation
Timing Restrictions	• Instream works period is stipulated by IFI as July 1st to 30th September 30th of any year. • Works near or over water within the SAC is stipulated May 1st to September 30th of any year.
Sediment loss controls during embankment construction - Brusna (Glenree)	• There must be a line of well-secured silt fencing between the proposed embankment construction and the river channel during all earthmoving works adjacent to the channel. This must be put in place in advance of any work commencing on-site. • The temporary access track and all works on formation of the embankment will be carried out on the outside of the proposed embankment, ensuring as little disturbance as possible to vegetated ground between the proposed embankment and the river. • Embankments will be formed, then firmly tamped down and reseeded immediately upon completion. The use of hydroseeding on the newly formed earth embankment is recommended to rapidly establish vegetative cover.

Potentially Significant Impact Category Identified	Mitigation
	• All drains and preferential flow pathways that connect to the River Brusna/Glenree from temporary works areas, site compounds and construction material storage areas must be subject, as appropriate to silt control measures in the form of e.g., bunds, geotextile sheeting, silt fencing to avoid entrainment and prevent sediment run-off into drains and the river. • Material storage areas and stock-piled spoil / earth shall be located outside the SAC boundary and not within 20 m of the River Brusna or any drain to same. In addition to silt fencing around loose material stockpiles (e.g., earth, gravel with high fine content) these shall be covered with geotextile during extended storage periods to avoid mobilisation of suspended solids.
Works near and over water – flood walls, bridge parapet	• There must be no discharge of deleterious substances, e.g., sediment, concrete rubble / dust or new liquid concrete, from the works areas to the river. All concrete waste will be immediately removed and disposed of at a licenced waste facility. The bridge parapet will be prefabricated and not involve use of bulk liquid concrete in proximity to the river.
Instream works Rathkip/Shanaghy Bridge	• A 'dry' working area must be formed at the Rathkip/Shanaghy Bridge, encompassing the reach subject to instream bed and bank protection replacement works. A suitable method to create the dry working area will be set out in the contractors detailed construction method statement and agreed with IFI prior to instream works commencing (noting that IFI have agreed in principle to the works subject to timing restrictions, plus methods to protect water quality and fish passage). • It is proposed that partial cofferdams covering alternate halves of the river shall be used to create the instream dry working area. At any one time the river will be flowing on the opposite half of the normal wetted width. This is to protect fish passage and hydrological conditions. An alternative method such as a large pipe or flume capable of passing a 10% AEP flood event that achieves the same goals would be acceptable, i.e., it must create a dry working area. • Cofferdams can be constructed of small or large geotextile bags filled with clean sand, but there can be no use of soil or clay to bund the structure because the risk to water and habitat quality is too high in this SAC channel with high value salmonid habitat. Sandbags can be wrapped in impermeable geotextile if necessary to prevent excessive water ingress. • The height of the coffer dams must be higher than the 10% AEP flood flow plus freeboard (minimum top height of 14.32mOD + freeboard) to prevent consequences of, e.g., concrete, and other pollutant escapement, if unexpected flooding was to occur, noting that the instream works timing restriction means that works will occur in summer when flooding is least likely. • Access routes for material delivery to and from the cofferdam areas must be from each bank alternately, i.e., no passing of construction materials over water. • **Pre-construction Bathymetry Survey:** The river reach through Rathkip/Shanaghy Bridge will require pre-construction channel bathymetry survey in the reach covering a minimum of 50 m upstream and downstream of the bridge faces. Bathymetry survey will take place during the months of May to September inclusive to record the baseline condition, using both cross section and long section measurements. This will occur in the season before or early in the season of construction works commencing. This will record the existing bed levels so that they can be replaced like-for-like making sure that there is a suitable low flow channel and that the upstream and downstream ends of the new bed protection are drowned out at all times during the operation phase. The existing scour pool at the downstream side of the Rathkip/Shanaghy bridge will be retained with the same morphology and dimensions (depth, width, length) as pre-existing. The pool is an important feature in terms of fish lay-over during flood events given the elevated water velocities that occur (under baseline and post-scheme scenarios) in this reach of the river.
Management of ingress water ('Dry' instream working areas at Shanaghy Bridge)	• On-site pumps must be present to dewater and maintain 'dry' working containment areas to complete instream works. • Dewatering pumps to be placed in sumps surrounded by drainage stone. • There will be no dewatering discharge directly back to the Brusna (Glenree) or any adjoining drainage channel. • Ingress waters will be pumped out and discharged via a silt bag 30m away from the watercourse. The discharge point will be a vegetated area of land and will be

Potentially Significant Impact Category Identified	Mitigation
	surrounded by a triple line of staked silt fencing surrounding a circle of staked down strawbales wrapped in terram. Alternatively, a plan may be put in place to clean the water using a series of settlement tanks or system with similar effect (water filtration system). This allows treatment of water in an instance where vegetated land, if saturated, may not have capacity to adsorb water being removed even with strawbales and silt fencing. Any outflow from the protected discharge point will be visually monitored to ensure there is no escapement of highly turbid water. If highly turbid water is observed works will be stopped by the ECoW and additional silt control measures will be implemented, e.g., use of settlement tank in series with silt bag. A sample of the final discharge effluent will be taken by the ECoW to ensure suspended solids (SS) concentration does not exceed 25mg/l. These mitigations will be overseen by the ECoW.
Design Measures to be incorporated during construction	• Refer to **Section 9.5.2.1**, below, for design measures to be implemented during the construction phase relating to the Rathkip/Shanaghy bridge scour protection (bed-protection), i.e., incorporation of low flow channel / depression and roughness elements (concrete conglomerate or inset rock/cobble) to prevent shallow laminar flows in the operational phase.
Direct impact on white-clawed crayfish during instream works	• Although crayfish are very unlikely to be present, for the avoidance of doubt, during initial water drawdown within the areas of water management (dam and pump-over on the Tullyegan) a qualified experienced ecologist will be present and shall have the appropriate licence from National Parks and Wildlife Service to capture any emerging crayfish, keep them in a bucket of clean river water and return them to the channel upstream of the works area. This is a once off operation (a few hours at most in each location). Once the working area is dried out, there will be no further requirement for the crayfish licence holder to be present.
Channel reinstatement	• The Brusna channel will be reinstated prior to rewatering using clean washed gravels and cobbles of local origin (calcareous) and of an appropriate size, in agreement with IFI. This will allow recolonisation by macroinvertebrates and fish during operation.

9.5.1.8 Tullyegan

Potentially Significant Impact Category Identified	Mitigation
Timing Restrictions	• Instream works period stipulated by IFI is May 1st to September 30th of any year.
Water quality protection during out-of-channel flood wall / embankment construction	• All drains and preferential flow pathways that connect to the Tullyegan Stream from the temporary work area must be subject, as appropriate, to silt control measures in the form of e.g., bunds, geotextile sheeting, silt fencing to avoid entrainment and prevent sediment run-off into drains and the river. • There must be no discharge of deleterious substances, e.g., sediment, concrete rubble / dust or new liquid concrete, from the works areas to the stream. All concrete waste will be immediately removed and disposed of at a licenced waste facility.
Water quality protection during instream flood wall / embankment construction	• A 'dry' instream works area must be created using an appropriate method of water management, e.g., dam and pump-over, temporary piping. • Prior to dewatering the dammed area, the stream will be de-stocked of fish. Fish removal shall be carried out by authorised personnel under electro-fishing licence and in agreement with, or under supervision of IFI Ballina. Fish must be kept in clean oxygenated water and returned to the channel upstream of the works area. • Before any excavation within the channel, the top 30 cm of bed material must be scraped off and stockpiled for use in reinstatement.
'Dry' working area ingress water – during instream works	• On-site pumps must be present to dewater and maintain 'dry' working containment areas to complete instream works. • Dewatering pumps to be placed in sumps surrounded by drainage stone. • There will be no dewatering discharge directly back to the Tullyegan or any adjoining drainage channel.

Potentially Significant Impact Category Identified	Mitigation
	• Ingress waters will be pumped out and discharged via a silt bag 30m away from the watercourse. The discharge point will be a vegetated area of land and will be surrounded by a triple line of staked silt fencing surrounding a circle of staked down strawbales wrapped in terram. Alternatively, a plan may be put in place to clean the water using a series of settlement tanks or system with similar effect (water filtration system). This allows treatment of water in an instance where vegetated land, if saturated, may not have capacity to adsorb water being removed even with strawbales and silt fencing. Any outflow from the protected discharge point will be visually monitored to ensure there is no escapement of highly turbid water. If highly turbid water is observed works will be stopped by the ECoW and additional silt control measures will be implemented, e.g., use of settlement tank in series with silt bag. These mitigations will be overseen by the ECoW.
Direct impact on white-clawed crayfish during instream works	• Although crayfish are very unlikely to be present, for the avoidance of doubt, during initial water drawdown within the areas of water management (dam and pump-over on the Tullyegan) a qualified experienced ecologist will be present and shall have the appropriate licence from National Parks and Wildlife Service to capture any emerging crayfish, keep them in a bucket of clean river water and return them to the channel upstream of the works area. This is a once off operation (a few hours at most in each location). Once the working area is dried out, there will be no further requirement for the crayfish licence holder to be present.
Channel reinstatement	• The Tullyegan channel will be reinstated prior to rewatering using clean washed gravels and cobbles of local origin (calcareous) and of an appropriate size, in agreement with IFI. This will allow recolonisation by macroinvertebrates and fish during operation.

9.5.2 Operational Phase

The following operational phase mitigations address only the areas where likely significant effects were identified in **Section 9.4**.

9.5.2.1 Brusna (Glenree)

Potentially Significant Impact Category Identified	Mitigation
Riparian tree loss LHS between river and R294 road	• Retain as much tree and shrub cover as possible on the LHS floodplain between the river and the proposed flood wall along the R294 road. • Retain all marginal and bankside growth along the river in the reach where bankside tree loss is unavoidable. This includes any fringing emergent reeds and tall bankside herbs and grasses which offer cover to fish and thermal regulation to the river. • Any replanting shall be in using appropriate native tree / shrub species in scattered aggregations in areas where tree loss is unavoidable. • Strip planting shall be avoided as this causes tunnelling and loss of instream productivity when it is too dense. • Retain as much tree cover on the RHS bank as possible to ameliorate losses of tree cover on the LHS bank.
Fish passage – design and construction of scour protection at Shanaghy Bridge	• Bed scour protection will be designed with a low flow channel or mid-channel depression so that water depth will always be sufficient for fish passage. • The entire bed scour protection will include ‘roughness’ elements (mortared riprap, embedded stones, blocks) to break up laminar flow and create turbulence that mimics natural conditions, providing cover for migrating and resident fish. Under no circumstances will the bed protection comprise laminar flow over a smooth, flat concrete bed. • The replacement bank scour protection shall be similar to existing with boulder riprap used upstream and downstream of the bridge abutments, as these provide a degree of flow diversity and bankside habitat for plants and macroinvertebrates.

9.5.2.2 Quignamanger

Potentially Significant Impact Category Identified	Mitigation
Hydromorphology: Tufa habitat disturbance / recovery upstream of Quay Road culvert	• When the lower reach of the Quignamanger channel upstream of the existing Quay Road culvert is graded down into the new enlarged Quay Road culvert, rather than leaving a uniformly sloping channel, the design shall include a series of fixed rock or concrete baffles or step-pools (ensuring a low- flow notch) using natural rock and cobble to create turbulent flow as shown in **Chapter 5: Project Description**, **Figure 5-9**. This will encourage tufa deposition and is likely to assist in extending the area of *7220 habitat because turbulence encourages precipitation of calcite, similar to the tufa cascades and *7220 habitat located upstream. • The regraded channel with the baffles or low rock step-pool design shall be agreed with IFI in advance of construction such that fish passage will be maintained. The baffled design is required as the residual slope of the regraded channel is 5.8%.
Hydromorphology: Prevention of habitat fragmentation arising from new box culvert (Quay Road)	• The new box culvert must be set at least 500 mm below the existing bed level, and at the same gradient or near the same gradient as the existing bed and not >3% slope. • Additional works to minimise erosion must be undertaken, e.g., rock armour, downstream pools, baffles to maintain channel structure. All such works must ensure fish passage is not obstructed. • Original bed material should be stockpiled and reinstated or where imported will consist of local rock type, rounded washed gravels which will be either seeded upstream of the culvert or placed in the culvert before it becomes live. • There shall be no screening of the culvert to prevent rubbish build up as this can cause obstruction to fish passage. The culvert faces at Quay Road are amenable to maintenance and debris clearance from the road.

9.6 Residual Effects

9.6.1.1 Freshwater River Moy

Residual impacts on aquatic qualifying interests of European sites are assessed against Site-Specific Conservation Objectives (CO) (NPWS, 2016).

Table 9-18 Residual Impacts on Atlantic Salmon (River Moy SAC Conservation Objectives)

Attribute	Target	Residual Impact of Proposed Scheme
Distribution: extent of anadromy	100% of river channels down to second order accessible from estuary	**Not Significant,** neutral. No change over baseline. The scheme does not introduce any new barriers to salmon migration through Ballina
Adult spawning fish	CL for each system consistently exceeded	**Not Significant,** neutral**.** No change over baseline. The scheme does not impact on adult salmon returning numbers nor salmon spawning habitat which is primarily upstream of the Ridgepool on the Moy. There is no reason under the proposed scheme that CL will not continue to be exceeded.
Salmon fry abundance	Maintain or exceed 0+ fry mean catchment-wide abundance at 17 salmon fry /5 minutes sampling	**Not Significant,** neutral**.** No change over baseline. The scheme does not impact on adult salmon returning numbers nor salmon spawning habitat. There is no reason under the proposed scheme that salmon fry catchment-wide abundance would not be maintained.
Out-migrating smolt abundance	No decline	**Not Significant,** neutral**.** No change over baseline. The scheme does not impact on downstream migrating smolts meaning there will be no decline in abundance of smolts reaching the sea.
Number and distribution of redds	No decline in number and distribution of spawning redds due to anthropogenic causes	**Not Significant,** neutral**.** No change over baseline. The scheme does not impact on abundance of salmon reaching the spawning grounds nor on the spawning grounds themselves

Attribute	Target	Residual Impact of Proposed Scheme
		which are upstream of the Ridgepool, meaning the number and distribution of redds will not be affected.
Water quality	At least Q4 at all sites sampled by EPA	**Not Significant,** neutral. Q-value just upstream of Ballina (and upstream of the proposed scheme) is Q3-4 (2022 EPA data), which fails to meet the target. The reach affected by the scheme does not impinge on the Q-rating, but if it did, scheme measures would (if anything) be likely to result in at least a **slightly positive, long-term** impact on water quality through and downstream of Ballina because of reduction in risk and frequency of flood waters overtopping walls and being contaminated within the urban drainage area. The proposed scheme does not result in changes to hydromorphology or water quality that would cause deterioration of the biological quality element (Macroinvertebrate Q-value). There is no cause for deterioration in water body status and the scheme does not jeopardise attainment of good status, hence compliant with WFD objectives.

Table 9-19 Residual Impacts on Sea Lamprey (River Moy SAC Conservation Objectives)

Attribute	Target	Residual Impact of Proposed Scheme
Distribution: extent of anadromy	Greater than 75% of main stem length of rivers accessible from estuary	**Not Significant,** neutral. No change over baseline. The proposed scheme does not introduce any new barriers to sea lamprey migration through Ballina.
Population structure of juveniles	At least three age/size groups present	**Not Significant,** neutral**.** There will be temporary slight negative reversible effects locally but no net change to population structure at catchment scale and no negative effect on CO target. Direct instream impacts during the construction phase impinge short term on one discrete location: Ridgepool RHS immediately upstream of Upper Bridge (see Site RP11, **Appendix 9.6**). Any disturbed individuals will be relocated according to prescribed mitigation with no effect on the CO target.
Juvenile density in fine sediment	Mean catchment juvenile density at least 1/m²	**Not Significant,** neutral**.** There will be temporary slight negative reversible effects locally but no significant net effect at catchment scale and no negative effect on CO target. Direct instream impacts during the construction phase impinge temporarily on one discrete location: Ridgepool RHS immediately upstream of Upper Bridge (see Site RP11, **Appendix 9.6**). Any disturbed individuals will be relocated according to prescribed mitigation meaning a redistribution but no loss in density. There are no significant hydraulic or hydromorphological changes that would preclude recovery of marginal depositing silt habitat in the area between RP11 and the Upper Bridge meaning no significant effect on the CO target.
Extent and distribution of spawning habitat	No decline in extent and distribution of spawning beds	**Not Significant,** neutral**.** With mitigations in place there will be no effects on what is, in fact, sub-optimal lamprey spawning habitat of the Ridgepool and no negative effect on the CO target.
Availability of juvenile habitat	More than 50% of sample sites positive	**Not Significant,** neutral. Catchment wide surveys (O'Connor, 2004) showed 24% of 75 Moy catchment sample sites were positive for sea lamprey, which falls short of the target. The construction phase impinges temporarily at one discrete area of mainly sub-optimal sea lamprey nursery habitat: Ridgepool RHS between RP11 and the Upper Bridge (see **Appendix 9.6**). With mitigations in place that include capture and release of juveniles, plus the fact that hydraulic and fluvial dynamics do not alter significantly in the operation phase, silt depositing habitats will recover post-works and the overall catchment juvenile habitat positivity rate will not be affected compared to baseline.

Table 9-20 Residual Impacts on Brook Lamprey (River Moy SAC Conservation Objectives)

Attribute	Target	Residual Impact of Proposed Scheme
Distribution	Access to all watercourses down to first order streams	**Not Significant,** neutral. No change over baseline. The proposed scheme does not introduce any new barriers to brook lamprey access.
Population structure of juveniles	At least three age/size groups present	**Not Significant,** neutral**.** Juvenile brook lamprey were not recorded on the lower Moy (in Ballina) (O'Connor, 2004). The Ridgepool is not considered brook lamprey spawning habitat, being tidally influenced and lacking in suitable substrates. There will be no change in population structure of juvenile brook lamprey with respect to works in the Ridgepool and no negative effect on the overall CO target
Juvenile density in fine sediment	Mean catchment juvenile density at least 2/m²	**Not Significant,** neutral**.** The Ridgepool is not significant brook lamprey spawning habitat, being tidally influenced and lacking in suitable substrates. There will be no decline in brook lamprey juvenile density locally and no negative effect on the CO target.
Extent and distribution of spawning habitat	No decline in extent and distribution of spawning beds	**Not Significant,** neutral**.** The Ridgepool is not significant brook lamprey spawning habitat, being tidally influenced and lacking in suitable substrates. There will be no decline in brook lamprey spawning habitat with respect to works in the Ridgepool and no negative effect on the CO target.
Availability of juvenile habitat	More than 50% of sample sites positive	**Not Significant,** neutral. Catchment wide surveys (O'Connor, 2004) showed 60.3% of 75 Moy catchment sample sites were positive for Lampetra spp. (includes brook lamprey, which exceeds this target. Lampetra spp. were absent from the lower reaches of the Moy in Ballina, so the Proposed Scheme does not give rise to any change over baseline in terms of sample site positivity for brook lamprey.

9.6.1.2 Estuarine River Moy

Residual impacts on aquatic qualifying interests of European sites are assessed against Site-Specific Conservation Objectives (CO) (NPWS, 2016).

Table 9-21 Residual Impacts on Sea Lamprey (Killala Bay/Moy Estuary SAC Conservation Objectives)

Attribute	Target	Residual Impact of Proposed Scheme
Distribution: extent of anadromy	No barriers for migratory life stages of lamprey moving from freshwater to marine habitats and vice versa	**Not Significant,** neutral. No change over baseline. The scheme does not introduce any new barriers to sea lamprey migration through the estuary.
Population structure of juveniles	At least three age/size groups present	**Not Significant,** neutral**.** There will be temporary slight negative reversible effects locally but no significant effect at catchment scale and no negative effect on CO target. Direct instream impacts during the construction phase impinge temporarily on 120m of river margin adjacent to Bachelors Walk downstream of the N59 Lower Bridge. Any disturbed individuals will be relocated according to prescribed mitigation and the habitat will recover in the operational phase with no effect on the CO target.
Juvenile density in fine sediment	Mean catchment juvenile density at least 1/m²	**Not Significant,** neutral**.** Direct instream impacts during the construction phase impinge temporarily on 120m of river margin adjacent to Bachelors Walk downstream of the N59 Lower Bridge. Any disturbed individuals will be relocated according to prescribed mitigation. Sub-optimal silty depositing habitats will forming equivalent habitat to baseline following the works. There are no significant hydraulic or hydromorphological changes that would preclude recovery of marginal depositing

Attribute	Target	Residual Impact of Proposed Scheme
		silt habitat in the area immediately upstream of the Upper Bridge meaning no effect on the CO target.

9.6.1.3 Quignamanger

Phase	Residual Impact of Proposed Scheme
Construction	**Not Significant.** With all mitigations in place in the areas of water quality protection and construction phase water management relating to culvert upgrades during the construction phase, residual construction phase effects are limited to temporary, slight reversible negative locally.
Operation	**Not Significant.** With all mitigations in place in the areas of design and implementation of the channel regrade (baffles or low step-pool type cascades) down into the new Quay Road culvert there will be a neutral to positive effect on fish passage and tufa deposition in conjunction with priority habitat *7220 tufa springs (further upstream). There will be a neutral to long-term positive residual effect owing to improved fish passage through removal of flap valve on Creggs Road diversion culvert, potentially improving access for migrating eels.

9.6.1.4 Bunree

Phase	Residual Impact of Proposed Scheme
Construction	**Not Significant.** With all mitigations in place in the area of water quality protection and construction phase water management relating to culvert upgrade, residual construction phase effects are limited to temporary, slight reversible negative locally in relation to instream disturbance to the short, lower open reach just upstream of the Moy confluence.
Operation	**Not Significant,** neutral. At best slight positive owing to introduction of open channel area at Moyvale Park which may become accessible and be utilised by eels in the long term.

9.6.1.5 Brusna (Glenree) River

Residual impacts on aquatic qualifying interests of the Brusna (Glenree) European site are assessed against Site-Specific Conservation Objectives (CO) (NPWS, 2016).

Table 9-22 Residual Impacts on Salmon – Brusna (Glenree) (River Moy SAC Conservation Objectives)

Attribute	Target	Residual Impact of Proposed Scheme
Distribution: extent of anadromy	100% of river channels down to second order accessible from estuary	**Not Significant,** neutral. No change over baseline. The scheme, with mitigation in place concerning the replacement of bed protection at Shanaghy Heights Bridge does not introduce any new barriers to salmon migration in the Brusna.
Adult spawning fish	CL for each system consistently exceeded	**Not Significant,** neutral**.** No change over baseline. The scheme does not impact on adult salmon returning numbers. There is no reason under the proposed scheme that CL will not continue to be exceeded.
Salmon fry abundance	Maintain or exceed 0+ fry mean catchment-wide abundance at 17 salmon fry /5 minutes sampling	**Not Significant,** neutral**.** No change over baseline. The scheme does not impact on adult salmon returning numbers nor salmon spawning habitat. There is no reason under the proposed scheme that salmon fry abundance in the Brusna will not be maintained at baseline values and therefore no net change to catchment wide abundance.
Out-migrating smolt abundance	No decline	**Not Significant,** neutral**.** No change over baseline. The scheme does not impact on downstream migrating meaning

Attribute	Target	Residual Impact of Proposed Scheme
		there will be no decline in abundance of smolts reaching the sea from the Brusna system.
Number and distribution of redds	No decline in number and distribution of spawning redds due to anthropogenic causes	**Not Significant,** neutral**.** No change over baseline. The scheme does not impact on abundance of salmon reaching the spawning grounds. There are no significant hydraulic or hydromorphological changes under the proposed scheme that would cause decline in number and distribution of spawning redds in the reach subject to flood relief measures.
Water quality	At least Q4 at all sites sampled by EPA	**Neutral**. Q-value within affected reach is Q4-5 (high status) which exceeds this target. RWB status is 'good' for the EPA 2016-2021 reporting cycle. The proposed scheme does not result in changes to hydromorphology or water quality that would cause deterioration of the biological quality element (Macroinvertebrate Q-value).

Table 9-23 Residual Impacts on Sea Lamprey - Brusna (Glenree) (River Moy SAC Conservation Objectives)

Attribute	Target	Residual Impact of Proposed Scheme
Distribution: extent of anadromy	Greater than 75% of main stem length of rivers accessible from estuary	**Neutral**. No change over baseline. The scheme does not introduce any new barriers to sea lamprey migration in the Brusna (Glenree).
Population structure of juveniles	At least three age/size groups present	**Neutral.** The Brusna (Glenree) is naturally inaccessible to migrating sea lamprey and does not contribute to the conservation objectives for the species in this SAC.
Juvenile density in fine sediment	Mean catchment juvenile density at least 1/m²	**Neutral.** The Brusna (Glenree) is naturally inaccessible to migrating sea lamprey and does not contribute to the conservation objectives for the species in this SAC.
Extent and distribution of spawning habitat	No decline in extent and distribution of spawning beds	**Neutral.** The Brusna (Glenree) is naturally inaccessible to migrating sea lamprey and does not contribute to the conservation objectives for the species in this SAC.
Availability of juvenile habitat	More than 50% of sample sites positive	**Neutral.** The Brusna (Glenree) is naturally inaccessible to migrating sea lamprey and does not contribute to the conservation objectives for the species in this SAC.

Table 9-24 Residual Impacts on Brook Lamprey – Brusna (Glenree) (River Moy SAC Conservation Objectives)

Attribute	Target	Residual Impact of Proposed Scheme
Distribution	Access to all watercourses down to first order streams	**Not Significant,** neutral. No change over baseline. The proposed scheme does not introduce any new barriers to brook lamprey access.
Population structure of juveniles	At least three age/size groups present	**Not Significant,** neutral**.** Juvenile brook lamprey were not recorded upstream of the fish passage barriers on the Brusna (Glenree) (O'Connor, 2004), i.e., absent from the Shanaghy Heights reaches affected by the Proposed Scheme. Even if the species were present, the Proposed Scheme does not introduce any significant hydraulic or hydromorphological changes that would preclude maintenance of brook lamprey juvenile population structure, hence no effect on CO target.
Juvenile density in fine sediment	Mean catchment juvenile density at least 2/m²	**Not Significant,** neutral**.** The Brusna (Glenree) has very little brook lamprey nursery habitat, being swift and lacking in suitable silt deposits in the Shanaghy Heights reaches affected by the Proposed Scheme. Larval *Lampetra* spp. have not been recorded in this part of the Brusna (Glenree). There will be no decline in mean catchment brook lamprey juvenile density and no negative effect on the CO target.

Attribute	Target	Residual Impact of Proposed Scheme
Extent and distribution of spawning habitat	No decline in extent and distribution of spawning beds	**Not Significant,** neutral**.** The Brusna (Glenree) is not significant brook lamprey spawning habitat, being swift and lacking in supporting substrates for recruitment. Even if the species were present, the Proposed Scheme does not introduce any significant hydraulic or hydromorphological changes that would alter the extent or distribution of brook lamprey spawning habitat.
Availability of juvenile habitat	More than 50% of sample sites positive	**Not Significant,** neutral. Catchment wide surveys (O'Connor, 2004) showed 60.3% of 75 Moy catchment sample sites were positive for *Lampetra* spp. (includes brook lamprey). Brook lamprey were absent upstream of the fish passage barriers on the Brusna (Glenree), i.e., absent from the Shanaghy Heights reaches affected by the Proposed Scheme and therefore the works on the Brusna (Glenree) do not give rise to any change over baseline in terms of sample site positivity for brook lamprey. No negative effect on CO target.

9.6.1.6 Tullyegan

Phase	Residual Impact of Proposed Scheme
Construction	**Not significant.** With all mitigations in place in the area of water quality, construction phase water management and fisheries habitat protection the residual effect will be temporary, imperceptible locally.
Operation	**Not significant,** neutral. The proposed works on the Tullyegan do not result in any significant changes to hydromorphology or water quality that would cause deterioration of the biological quality element (Macroinvertebrate Q-value) nor would there be any loss of trout or brook lamprey habitat or recruitment capability in the long term.

9.7 Monitoring

9.7.1 Construction Phase

9.7.1.1 Responsibilities

As part of this EIAR, as transposed to the Construction and Environmental Management Plan (CEMP) for the Proposed Scheme, surface water quality monitoring procedures have been proposed during construction works. Details of surface water monitoring locations, sampling frequency and sample parameters are set out in **Chapter 12: Water**.

The developer will be required to employ a suitably qualified and experienced technical professional(s) as Environmental Clerk of Works (ECoW) for the duration of the construction phase. The ECoW shall be based on site and shall oversee the implementation of pollution mitigation measures, compliance with environmental planning conditions, monitoring and reporting on environmental aspects of the development, and liaison with third parties and the Planning Authority. The ECoW appointment and role must cover all phases of the construction including any advance works and accommodation works.

- The proposed construction works and associates in situ control measures will be supervised full-time by the ECoW.
- The ECoW is responsible for all monitoring duties and shall not delegate duties to other staff. The only exception is for unforeseen absence and annual leave cover, in which case the Site Manager shall appoint a suitably qualified back-up ECoW to temporarily fulfil the role. Training for each member of staff on their specific area of responsibility to implement environmental controls shall be carried out before the commencement of that operation. A record of all training carried out shall be maintained in the CEMP.

- Toolbox talks on the CEMP will be presented by the ECoW to all site staff immediately before works commence. The subject shall be the measures that have been put in place to protect the environment and the procedures, monitoring and recording that is to be undertaken in accordance with the Construction Methodology, environmental commitments and the CEMP. Site personnel will also be made aware of the ecological sensitivity of the site and its surrounds.
- The ECoW will report any instances of failure of mitigations, spillage, non-conformances, maintenance and repair by way of specific Incident Reporting sheets that include how the issue was remedied.
- The ECoW will attend all relevant stakeholder meetings throughout the construction (IFI, NPWS etc.).

9.7.1.2 Daily Site Monitoring Procedure

The following daily environmental monitoring procedure will be carried out to ensure that environmental protection and management requirements are being implemented and are meeting their objectives:

General Procedures

- All water quality protection mitigation/ control measures shall be inspected daily by the ECoW during specific construction area working days with any maintenance and repairs carried out immediately.
- All environmental monitoring and checklists shall be recorded and added to the CEMP on a daily basis, as appropriate to the active works zones.

Weather Forecasts

- Future seven-day forecasts will be checked daily by the ECoW, with construction works programmed accordingly if heavy rainfall is forecast. Prior to any forecast heavy rainfall, the ECoW will ensure that all sediment loss prevention measures and environmental controls are functioning correctly. During and immediately after heavy periods of rain, earthmoving activities must be reviewed with temporary restrictions where necessary.

Visual Checks

- Underpinning the monitoring approach will be daily visual checks conducted by the ECoW to ensure all mitigation measures are implemented as set out in the CEMP. These visual checks will include checks on integrity of all on-site mitigation infrastructure, e.g. silt fencing, attenuation / treatment tanks, on-site drainage flow paths etc. Any required maintenance will be carried out immediately.
- Daily visual checks for evidence of silt plumes and oil slicks will also be carried out at watercourses and drainage ditches surrounding works areas.
- Daily visual check of turbidity levels and measurements using a calibrated hand-held probe at upstream and downstream of each discrete, active works area.
- Daily visual check of pH using a calibrated hand-held probe upstream and downstream at each discrete, active works area.
- During daily checks, the ECoW will have powers to stop works if there are obvious sediment plumes observed in watercourses or obvious erodible sediment sources along any pathways from construction areas to drains and/or watercourses. In the instance that works must stop, the source(s) and/or reasons for observed sediment loss will be identified and controls will be bolstered through additional silt fencing and check-dams or pump-out and removal to a licenced waste treatment facility.

9.7.1.3 Weekly and Monthly Site Monitoring Procedures

In addition to the daily visual checks set out above, water sampling focused on suspended solids will occur weekly and monthly.

Water Sampling Schedule

- The ECoW will collect samples once weekly (e.g., Tuesday) to be tested for suspended solids at locations upstream and downstream of each discrete construction work area. The downstream sampling point must be in the main channel below the mixing zone for the potential works area run-off so as to

reflect assimilated concentrations. The sampling day cannot be altered based on weather conditions, as this will ensure capture of a random sample of rainfall and flow conditions.

- In addition, the ECoW will target a minimum of two high flow events per month and sample suspended solids upstream and downstream of each active works zone. This is to provide an efficacy record for sediment loss control measures during times of active rainfall.

9.7.1.4 Water Quality Sampling – Action Trigger Points

It is very difficult to set monitoring criteria for suspended solids for numerous reasons including:

- There are daily and seasonal variations in natural background levels, especially in tidally influence waters such as the lower River Moy.
- Impact of suspended solids on aquatic organisms depends upon both the concentration and the duration of exposure.
- The type of sediment (e.g., grain size) and the morphology of the river channel (e.g., eroding versus depositing systems) determines effects on habitats and biota.
- The wide variation in reported concentrations for onset of acute (sub-lethal and lethal) effects on aquatic biota.

Based broadly on the literature (Kerr 1995, Newcombe and Jensen 1996), and given the extended construction period for the project, the following applies:

- The ECoW must tabulate the once weekly upstream and downstream suspended solids results for the freshwater River Moy and the Brusna (Glenree) River as these are the more sensitive receptors. The rolling average of downstream (mixed) suspended solids concentration must not exceed 10 mg/l if the upstream concentration is ≤100mg/l. Suspended solids concentration downstream must not exceed 5% of the upstream level if the upstream concentration is >100mg/l.
- If the emerging rolling average is exceeding these thresholds, then The ECoW will have powers to stop works and instruct additional efforts to be made to reduce suspended sediment sources and control pathways by strengthening the sediment control measures as set out in the CEMP and **Section 9.5** above.
- Alternatively, the contractor may employ alarmed turbidity sondes (installed and maintained by a company that specialises in this type of monitoring) to measure real-time turbidity upstream and downstream of the works areas during construction on the Brusna (Glenree). A site-specific, laboratory based correlation between suspended solids levels (mg/l) and turbidity (NTU) must be made for each location. Following that, the sonde notification alarm will be set to indicate when the downstream NTU level (in-channel) exceeds 25 mg/l. If this is higher than the corresponding real-time upstream NTU, all works will cease until the source of the increased turbidity is identified and rectified (if caused by the construction works). If the increase in turbidity is determined to not be attributable to the construction works, the works will continue. The use of alarmed turbidity sondes for the freshwater River Moy (Ridgepool) would not be useful because of its tidal nature (causing water to back up from downstream and confound readings).

The trigger levels for pH are determined by the allowable concentrations under the Salmonid regulations, i.e. 6.0≤ pH ≤9.0. The mean pH measured in the River Moy at EPA River Station 34M021100 (Ardnaree Bridge) between 2007-2023 is 8.03 (n=270 samples). If a pH >9.0 is measured in the watercourse using a calibrated hand-held probe, all upstream concreting works must cease until the pH has returned to an acceptable level and control measures have been reviewed.

9.7.1.5 Cofferdam Pump-out Water Management

Pump-out water is highly likely to be contaminated with suspended solids and potentially concrete/mortar and hydrocarbons. Pump-out water will not be discharged directly to the River Moy or the Brusna (Glenree) without treatment. For the purposes of this project, “appropriate treatment” means:

- For discharges back to the freshwater River Moy (i.e., dewatering at Ridgepool) or the Brusna (Glenree) suspended solids in the final effluent may not exceed 25mg/l and pH must be in the range 6.0-9.0.

These thresholds are as stipulated in Guidelines on protection of fisheries during construction works in and adjacent to waters (IFI, 2016).

$$T95 = \frac{F95 \times Cr + Fe \times Ce}{F95 + Fe} \quad (1)$$

where:

F95	Q95% flow in the river (l/s)
Fe	effluent discharge volume (l/s)
Cr	SS concentration in river upstream of discharge (mg/l)
Ce	SS concentration of the effluent (mg/l)

Ingress waters to containment areas on smaller tributaries where there are culvert works (Bunree, Quignamanger) and flood wall works (Tullyegan) and also at the Brusna (Glenree) River in relation to bridge work cofferdams can be pumped out and discharged via a silt bag 30m away from the watercourse. The discharge point will be a vegetated area of land and will be surrounded by a triple line of staked silt fencing surrounding a circle of staked down strawbales wrapped in terram. Any outflow from the protected discharge point will be visually monitored to ensure there is no escapement of highly turbid water.

In the event that instream works are required downstream of the Lower Bridge (i.e., LHS adjacent to Bachelors Walk), pump-out waters resulting from cofferdam ingress can be returned to the River Moy at a concentration of up to 250mg/l suspended solids. The rationale for this is: (1) such a concentration ought to be attainable relatively rapidly from bank-side settlement treatment train (discharge via tank and silt bag, and (2) within the estuarine river reach there are unlikely to be significant effects on aquatic biota unless downstream (mixed) concentrations exceed 1000mg/l suspended solids for >1 day (Wilber and Clarke, 2001; Boelhert and Morgan 1985 cited Kerr 1995). The discharge TSS limit applied is 25% of this value and there is huge dilution in this part of the tidal River Moy. Visual monitoring for any obvious plumes will be conducted in this reach along with the weekly and monthly upstream/downstream sampling as set out in **Section 9.7.1.3** above. In the event of highly turbid water escapement from the construction site, the ECoW will have the power to stop works until such time as sediment loss mitigation measures are strengthened.

9.7.1.6 Biological Water Quality Monitoring

The EPA rated the River Brusna (RWB Glenree_030 EPA Code: IE_WE_34G010200) at good ecological status for the 2016-2021 2nd cycle River Basin Management Planning (RBMP): macroinvertebrates = good status, hydromorphology = high status, supporting physicochemical quality = good status. Sampling for this EIAR in 2023, as well as the EPA macroinvertebrate rating (2022) was Q4-5 (high status). To remain compliant with WFD objectives, status cannot deteriorate from high. Pre- and post-construction Q-values will be undertaken upstream and downstream of the works area on the River Brusna at locations shown in **Figure 9-5**.

Figure 9-5 Proposed Q-Value Monitoring Sites Brusna (Glenree)

Pre construction Q-value surveys will occur prior to the initial construction phase intervention within the seasonal window of May to September (inclusive).

Post-construction surveys will occur between May and September (inclusive) at least 3 months after works are completed (Y1), and again one year later (Y2). If works are completed at the end of September (as per timing restrictions, then the (Y1) survey shall occur in the following May, with the (Y2) survey occurring in May of the following year.

There is no possibility of upstream/downstream Q-value sampling on the Moy (i.e., tidal) nor on the highly modified small tributaries (Quignamanger, Bunree or Tullyegan) because instream habitats are not conducive for comparative kick-sampling. Hence Q-value monitoring on these watercourses is not applicable.

9.7.2 Operational Phase

Refer to **Chapter 12: Water**, **Section 12.7.2** for details of operational phase water quality monitoring requirements. Any applicable water quality monitoring measures will serve for aquatic habitat protection purposes.

9.8 Interactions and Cumulative Effects

9.8.1 Interactions

Interactions between Traffic and Transport and environmental factors such as population, human health, water, biodiversity, air quality and climate, material assets, noise and vibration, landscape and visual have been addressed in **Chapter 20: Interactions and Cumulative Effects**.

9.8.2 Cumulative Effects

Potential Cumulative Effects between the Proposed Scheme and other projects with Traffic and Transport has been addressed in **Chapter 20: Interactions and Cumulative Effects**.

9.9 Schedule of Environmental Commitments

Please see **Chapter 22 Schedule of Environmental Commitments** which sets out all the mitigation and monitoring commitments to minimise the potential impacts for **Chapter 9: Aquatic Biodiversity** during the construction and operational phase of the Proposed Scheme.

9.10 Chapter References

Barrat-Segretain, M. & Gudrun, B., 2000. *Regeneration and colonization abilities of aquatic plant fragments: effect of disturbance seasonality,* s.l.: Hydrobiologia.

Caffrey, J., 2010. *IFI Biosecurity Protocol for Field Survey Work ,* s.l.: s.n.

Chen, Z. J., Wang, D. S., Xiao, T. & Huang, R., 2004. Factors Controlling Tufa Deposition in Natural Waters at Waterfall Sites. Volume 166.

CIEEM, 2018. *Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine Version 1.2 - Updated April 2022,* s.l.: Chartered Institute of Ecology and Enviromental Management.

CIS, 2017. WFD Common Implementation Strategy Guidance Document No. 36 - Exemptions to the Environmental Objectives according to Artile 4(7).

DCHG, 2017. *The 3rd National Biodiversity Action Plan 2017-2021,* s.l.: Department of Culture, Heritage and the Gaeltacht.

DCHG, 2022. *The 4th National Biodiversity Action Plan 2023-2027 (Draft),* s.l.: Department of Housing, Local Government and Heritage.

Denyer, 2021. *Petrifying Spring Survey and Assessment Moy Estuary, Co. Moyo,* s.l.: River Moy Search and Rescue Ballina.

DHLGH, 2018. *Second Cycle of River Basin Management Plan for Ireland 2018-2021,* s.l.: Department of Housing, Plannng and Local Government.

DHLGH, 2022. *Draft Third Cycle of River Basin Management Plan for Ireland 2022-2027,* s.l.: Department of Housing, Local Government and Heritage.

EPA, 2021. *3rd Cycle Draft Moy & Kilalla Bay Catchment Report (HA 34),* s.l.: Catchment Science & Management Unit Environmental Protection Agency.

EPA, 2022. *Guidelines on Information to be Contained in Environmental Impact Assessment Reports ,* s.l.: s.n.

Fossit, J., 2000. *A Guide to Habitats in Ireland,* s.l.: Heritage Council.

Hatton-Ellis, T., 2003. Ecology of Watercourses Characterised by Ranunculion fluitantis and Callitricho-Batrachion Vegetation.

Holmes, T., Gargan, P., Millane , M. & Roche, W., 2022. *Report on Salmon Monitoring Programmes 2021 Rivers Funded under the Salmon Conservation Fund,* s.l.: Inland Fisheries Ireland.

IFI, 2016. *Guidelines on protection of fisheries during construction works in and adjacent to waters.* s.l.:Inland Fisheries Ireland .

IFI, 2021. *IFI Consolidated Fish Counter Summary Report 2020,* s.l.: Inland Fisheries Ireland.

IFI, 2022. *IFI Consolidated Fish Counter Summary Report 2021,* s.l.: Inland Fisheries Ireland .

IFI, 2023. *IFI Consolidated Fish Counter Summary Report 2022,* s.l.: Inland Fisheries Ireland.

Kelly et al., 2009. *Sampling Fish for the Water Framework Directive Summary Report 2009,* s.l.: Inland Fisheries Ireland.

Kelly et al., 2010. *Sampling Fish for the Water Framework Directive: A summary of Inland Fisheries Ireland's Water Framework Directive Monitoring Programme for Fish in Lakes, Rivers and Transitional Waters 2007-2009,* s.l.: Inland Fisheries Ireland.

Kelly et al., 2013. *Sampling Fish for the Water Framework Directive Summary Report 2012,* s.l.: Inland Fisheries Ireland.

Kelly et al., 2017. *Sampling Fish in Rivers 2016 (National Research Survey Programme),* s.l.: Inland Fisheries Ireland.

King, J., Hanna, G. & Wightman, G. D., 2008. Ecological Impact Assessment (EcIA) of the Effects of Statutory Arterial Drainage Maintenance Activities on Three Lamprey Species (Lampetra planeri Bloch, Lametra fluviatilis L., and Petromyzon marnus L.). Volume Series of Ecological Assessments on Arterial Drainage Maintenance No 9 Environment Section.

MCC, 2022. *Mayo County Development Plan 2022-2028,* s.l.: Mayo County Council.

McGarrigle & Lucey, 2009. Intercalibration of Ecological Status of Rivers in Ireland for the Purpose of the Water Framework Directive. 109B(No. 3).

Mickle, M. F. & Higgs , D. M., 2018. Integrating Techniques: A Review of the Effects of Anthropogenic Noise on Freshwater Fish. Volume 75.

Millane et al. , 2023. *Report of the Technical Expert Group on Salmon (TEGOS) to the North-South Standing Scientific Committee for Inland Fisheries: The Status of Irish Salmon Stocks in 2022 with Catch Advice for 2023,* s.l.: s.n.

Millane, M. et al., 2023. The Status of Irish Salmon Stocks in 2022 with Catch Advice for 2023.

NIEA, 2014. *River Hydromorphology Assessment Technique (RHAT),* s.l.: Northern Ireland Environment Agency.

NPWS, 2012. *Conservation Objectives Supporting Document - Coastal Habitats. Conservation Objectives: Killala Bay/Moy Estuary SAC 000458,* s.l.: National Parks and Wildlife Service.

NPWS, 2012. *Conservation Objectives Supporting Document - Marine Habitats and Species. Conservation Objectives: Killala Bay/Moy Estuary SAC 000458,* s.l.: National Parks and Wildlife Service.

NPWS, 2012. *Conservation Objectives: Killala Bay/Moy Estuary SAC 000458. Version 1.0,* s.l.: National Parks and Wildlife Service.

NPWS, 2016. *Conservation Objectives: River Moy SAC 002298. Version 1,* s.l.: National Parks and Wildlife Service.

NRA, 2003. *Guidelines for Assessment of Ecological Impacts of National Road Schemes, Revision 1,* s.l.: National Roads Authority .

NRA, 2009. *Guidelines for Assessment of Ecological Impacts of National Schemes, Revision 2,* s.l.: National Roads Authority.

O'Connor, W., 2004. A Survey of Juvenile Lamprey Populations in the Moy Catchment. Volume Irish Wildlife Manuals No. 15.

Peay, S., 2003. Monitoring the White-clawed Crayfish Austropotamobius pallipes. Volume Conserving Natura 2000 Rivers Monitoring Series No. 1..

Popper, A. et al., 2014. *Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report Prepared by ANSI- Accredited Standards Committee S3/SC1 and registered with ANSI,* s.l.: ANSI-Accredited Standards Committee.

Toner et al, 2005. *Water Quality in Ireland 2001-2003,* s.l.: Environmental Protection Agency.

Toner, P., Bowman, J., Clabby, K. & Lucy, J., 2005. *Water Quality in Ireland 2001-2003,* s.l.: s.n.

Villacorta-Rath, C., Hoskin, C., Strugnell, J. & Burrows, D., 2021. *Long distance (>20 km) downstream detection of endangered stream frogs suggests an important role for eDNA in surveying for remnant amphibian populations,* s.l.: PeerJ.